AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
	09/25/2015		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS 20 North 8th Street - 9th Floor Phila, Pa 19107	3PQCV	GSA PBS 20 North 8th Street - 9th Floor Phila, Pa 19107	3PQCV

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICITATION NO.
	☐	RJP-NASA_MSL-0001-8-11-2015 9B. DATED *(SEE ITEM 11)*
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO. 10B. DATED *(SEE ITEM 13)*
CODE / FACILITY CODE		

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☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

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Amendment 0001
NASA MSL Project
Solicitation number RJP-NASA_MSL-0001-8-11-2015

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15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0001

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 25 September 2015 to incorporate the following:

Pre proposal conference sign in sheet

Pre proposal conference PowerPoint presentation

Standard Form 30 – Amendment 0001.

In response to questions submitted by potential offerors, the following is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is identifiable in the solicitation package.

Should past performance evaluations/CCASS be provided with the proposal in Factor 1 following the 2 page project description?

Response: If the CCASS evaluation is completed, this may be provided with the Factor 1 information on Past Performance.

Should a completed 1442 be submitted with the proposal?

Response: The 1442 does not have to be submitted with the Phase I proposal. The 1442 will be required as part of the Phase II submittal.

What are the small business subcontracting goals for this solicitation? None have been stated.

Response: GSA's Subcontracting Goals (2015)

GOALING CATEGORY GOAL
Small Business 32%
Small Disadvantaged Business (SDB) 5%
Woman-Owned Small Business 5%
HUBZone Small Business 3%
Service-Disabled Veteran-Owned Small Business 3%

The Factor 4 requirement includes completing the Subcontracting Methodology Form. It is premature to assume dollar values for work subcontracted when we have not even seen the plans for the project. Please consider moving this requirement to Phase 2.

Response: The Offeror shall submit the following: (1) proposed small business subcontracting goals for this procurement, (2) narrative describing your firm's outreach program for small businesses, and (3) narrative describing how your firm will maximize competition and select subcontractors that provide best value. The Subcontracting Methodology Form shall be submitted as part of the Phase II submission.

The relevant project information requested on page 8 & 9 of the solicitation states a two page maximum, except for photos. Can the maximum be increased to three pages, due to the amount of information requested?

Response: A maximum of three pages is allowed. Photos count as separate pages.

The safety information requested on pages 12 & 13 of the solicitation states a one page limit. Can the limit be increased to four pages, since each of the three OSHA 300A forms requested will take one page each, plus the letter from the insurance company regarding the EMR will take one page?

Response: This is acceptable.

The safety information requested also asks for OSHA 300A forms and EMR's from significant subcontractors. Can this requirement be eliminated from the Phase I response as subcontractor pricing & selection will be performed in Phase II? Whiting-Turner's safety information will be provided as required.

Response: This is acceptable.

The required Subcontracting Methodology Form asks for projected dollar values to be provided for the various types of business subcontracts. We are okay with submitting projected percentages for those subcontracts, but feel it is too early to submit the requested dollar values, since we do not know the full value of the project. Please confirm the projected dollar values for the various businesses can be submitted with the Phase II response?

Response: The Offeror shall submit the following: (1) proposed small business subcontracting goals for this procurement, (2) narrative describing your firm's outreach program for small businesses, and (3) narrative describing how your firm will maximize competition and select subcontractors that provide best value. The Subcontracting Methodology Form shall be submitted as part of the Phase II submission.

Construction Project for Measurement Systems Laboratory (MSL)

NASA Langley Research Center

Hampton, Virginia

Project Pre Proposal Conference 16 September 2015

	Name	Company	Phone	E-mail Add
1	Tony Dell'Arciprete	GSA	215.446.4503	Tony.DellArcip
2	Ray Porter	GSA	215 756 3439	raymond.porter
3	Brett Molash	GSA	215.446.5787	Brett.Molash@gsa.g
4	Anthony Teti	GSA	215 - 756 - 5252	anthony.teti@gsa.
5	[redacted] (b) (6)	WT	[redacted] (b) (6)	
6	ROBERT "CHRIS" HUDGINS	NASA	757 864 4373	robert.c.hudgins
7	Chris Reilly	Hill	[redacted] (b) (6)	
8	Will Abrams	NASA	757 864 5598	william.i.cabrams
9	Ed Weaver	AECOM	[redacted] (b) (6)	

Construction Project for Measurement Systems Laboratory (MSL)

NASA Langley Research Center

Hampton, Virginia

Project Pre Proposal Conference 16 September 2015

	Name	Company	Phone	E-mail Ad
10	[redacted] (b) (6)	W m Jordan	[redacted] (b) (6)	
11		K W.M. Jordan		
12		Turner Construction		
13				
14				
15				
16				
17				
18				

Construction Project for Measurement Systems Laboratory (MSL)

NASA Langley Research Center

Hampton, Virginia

Project Pre Proposal Conference 16 September 2015

	Name	Company	Phone	E-mail Adc
19	[redacted] (b) (6)	C&W-TESCO	[redacted] (b) (6)	[redacted]
20		Whiting-Turner		
21		Whiting-Turner		
22		Whiting-Turner		
23		Tactical		
24		TURNER		
25				
26				
27				

Construction Project for Measurement Systems Laboratory (MSL)

NASA Langley Research Center

Hampton, Virginia

Project Pre Proposal Conference 16 September 2015

	Name	Company	Phone	E-mail Add
28	[redacted] (b) (6)	GET Solutions, Inc	[redacted] (b) (6)	
29		GET Solutions, Inc		
30		GET Solutions Inc.		
31				
32				
33				
34				
35				
36				

Construction Project for Measurement Systems Laboratory (MSL)

NASA Langley Research Center

Hampton, Virginia

Project Pre Proposal Conference 16 September 2015

	Name	Company	Phone	E-mail Ad
37	[redacted] (b) (6)	Atlantic TESTING IN	[redacted] (b) (6)	
38				
39				
40				
41				
42				
43				
44				
45				

National Aeronautics
and Space Administration

U.S. General Services Administration

NASA Revitalization Project

Measurement Systems Laboratory (MSL)

Langley Research Center

Hampton, Virginia

Design-Bid-Build

Pre-Proposal Conference

September 16, 2015

Agenda 10:00 AM – 12:00 PM

Speaker: Anthony (Tony) Dell'Arciprete, GSA

- Introductions of Government & Project Contractors
- Purpose of Pre-Proposal Conference
- NASA Revitalization Plan
- Design Overview for Measurement Systems Laboratory (MSL)
- Pre-Proposal Overview Phase 1
- Timeline
- Questions & Answers

GC: TBD

Introduction: Gov't Representatives

U.S. General Services Administration

- **Anthony Dell'Arciprete** Program Manager
- **Ray Porter** Contracting Officer
- **Anthony Teti** Contracting Officer
- **Brett Molash** Project Engineer

U.S. National Aeronautics & Space Administration

- **William Abrams** Project Manager
- **Floyd Quintana** Program Manager

GC: TBD

Introduction: Project Contractors

A/E Firm: AECOM

- **Ed Weaver** Program Manager

Construction Management Firm: Hill International

- **Jim Beckett** Project Executive
- **Christopher Reilly** Senior Project Manager

GC: TBD

Purpose: Pre-Proposal Conference

Speaker: Anthony Dell'Arciprete, GSA

- Design-Bid-Build Services in Request for Proposal (RFP)
- Measurement Systems Laboratory (MSL)

GC: TBD

NASA Revitalization Plan Overview

Speaker: Floyd Quintana, NASA

- NASA Revitalization Plan

GC: TBD

NASA Revitalization Plan Overview

GC: TBD

Creating Langley's Future…It's VITAL

Langley creates innovative solutions to the grand challenges of earth science, space exploration and flight in all atmospheres, for the benefit of all humankind.

Heritage

- "Mother Center"
- NACA
- National Aeronautics Lab
- Unitary Plan
- Birth of Space Program

Present

- New Town
- Revitalize Langley
- Lab Consolidation
- Diversified Portfolio
- Repair by Replacement
- Recapitalization

Future

- Enables full spectrum of R&D
- Promotes collaboration and productivity
- Flexible and adaptive to changing mission needs
- Environmentally sustainable
- Embraces future work environments

NASA GSA AECOM Hill International GC: TBD

Aging Infrastructure Poses Risk to Mission

- **Agency-wide, more than 80 percent of NASA's infrastructure and facilities by value are beyond their design life – thus more likely to be unsuitable for current and future missions.**
  - **Aging, Apollo-era legacy infrastructure is inefficient and costly to maintain and operate.**
  - **Assets over 40 years old (typical design life is 30 years) pose a risk to NASA's unique research and development mission.**
- **Risk severity rises as assets age beyond 40.**
  - **To control risk, control the share and average age of assets >40**
- **Maintenance backlog continues to grow.**

Whitlow—"NASA Facility Strategy Presentation" at the 2011 Facilities Engineering Conference

LaRC's oldest building is 80 years old and the Center average is around 44 years old—We are proactively revitalizing the Center's core infrastructure to meet future missions.

NASA GSA AECOM HILL Hill International GC: TBD

Figures of Merit

- **Relevance to the NASA Mission**
  - Supports Multiple NASA Mission Directorates (current and future)
  - Ability to Sustain/Develop Core Competency
- **Utilization**
  - Usage rates
  - Enables our competitiveness/Reimbursable opportunities
- **Cost of Ownership**
  - Maintenance and Utility Costs
  - Deferred Maintenance / Facility Condition Assessment (FCA)
- **Linkage to Master Plan**
  - Central to Core Campus
  - Sustainability / Energy Efficiency

GC: TBD

Overarching Revitalization Decisions

- Sustain / enhance essential in-house experimental capability
- Enable multi-disciplinary integrated systems capability
- Incorporate Computational Simulation as a cross-cutting capability in everything we do
- Continually assess the needs of NASA's missions and divest of facilities (even large ones) when it no longer makes sense for the mission and the national good

Summary of Investments & Savings

- **Provides new state-of-the-art, sustainable, energy efficient R&D facilities**
  - **Sustains, enhances and creates our essential experimental capability to meet future agency missions by providing more efficient and effective facilities and labs**
- **By 2030 the Center Revitalization Plan:**
  - **Saves nearly $100M Maintenance and Utilities**
  - **Eliminates $141M Deferred Maintenance**
  - **Reduces our footprint by 1.21M sq. ft.**
  - **Achieves approximately 600K sq. ft. of new building space**
  - **Reduces the current replacement value (CRV) by approximately $1B**
- **Plan requires investments which will be funded through Agency Construction of Facilities (CoF) and Recapitalization funds, Program dollars and LaRC's CMO**

GC: TBD

Headquarters Building (AOB1)

- **Langley Headquarters**
  - Office of the Director
- **Houses multiple organizations**
  - Office of Human Capital
  - Chief Financial Officer
  - Office of Procurement
  - Office of Chief Counsel

GC: TBD

Integrated Engineering Services Building (IESB)

- **Engineering Design Studio**
  - Brings different technical groups together during the design process
- **Flight Mission Support Facility**
  - Provide a facility to monitor and inform team while mission in flight
- **Training and Learning Classrooms**
- **Conference Facilities**
- **Cafeteria**

GC: TBD

Computational Research Facility (CRF)

FY Start	Description	Justification *(Demo's No Earlier Than)*	Cost Savings ($M)
2014	**Computational/Office: Data Center and High Density Office Space**	Relevant to all MDs; Core campus; consolidation of IT capability; energy efficient; Demo B1209 and repurpose B1268	M+U: $0.6 DM: $1.3 CRV: $10.9

- **Current Status:**
  - Initiated Pre-Design Study – March 2013 Completion
  - B1194 deemed not appropriate
  - New site and design completed
- **Future Work:**
  - **FY15 – Begin Construction**

GC: TBD

ViTAL – Vibrant Transformation to Advance Langley

Goal: Re-ViTALize LaRC

Transform the Center to enable LaRC to make vital contributions to NASA missions – both current and future – by establishing a stimulating work environment, modernizing infrastructure and investing in new capabilities to meet the accelerating pace of science and technology trends.

Revitalization success through strategic workforce partnerships with GSA and USACE enables LaRC to focus our critical hires toward the Agency Mission.

NASA GSA AECOM Hill International GC: TBD

ViTAL – Vibrant Transformation to Advance Langley

Current Investment Timeline

2004 – **New Town** focus on modernizing aging facilities

2010 – **Master Plan** approach for future campus development

2011 – **ViTAL** integrated facility strategy to meet NASA mission

2013 – **Revitalization Office** established to execute ViTAL plan

2015 – **Master Plan Update** incorporates ViTAL plan

2016 – Continued Progress and Planning

2018+

AOB1 **IESB** **CRF** **MSL**

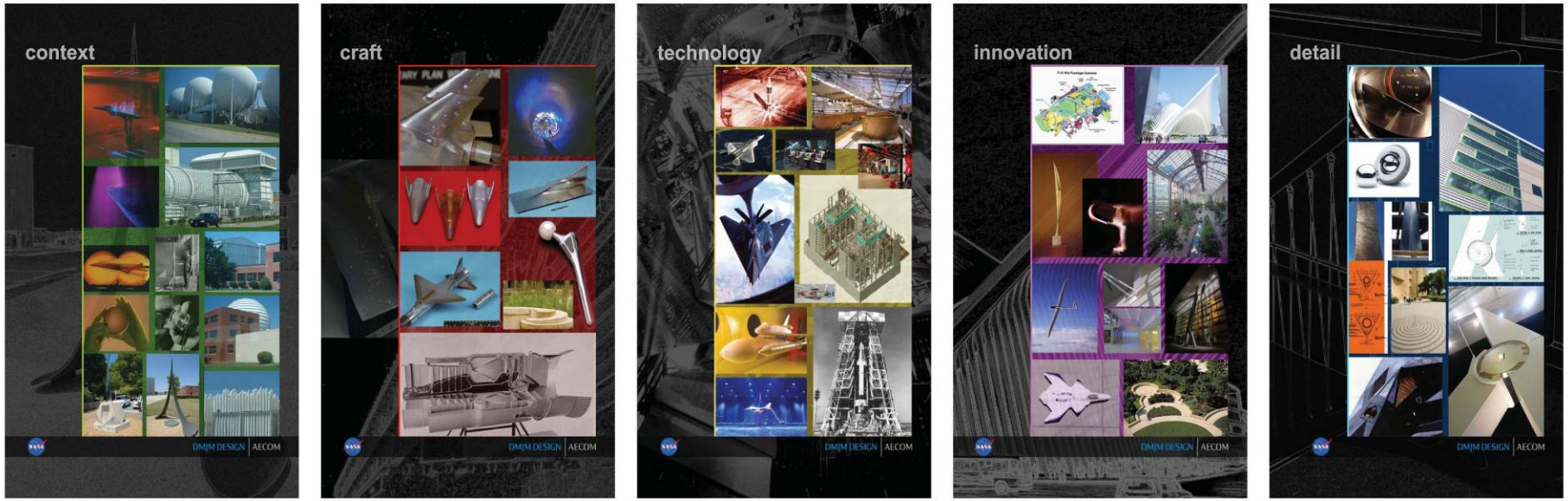
NASA GSA AECOM Hill International GC: TBD

Concept Design Overview

Speaker: Ed Weaver, AECOM

GC: TBD

Guiding Themes / Key Drivers



INSPIRATIONS - GUIDING THEMES

- Sustainability
- Interior Environment
- Campus Setting / Context
- Presence

GC: TBD

Campus Context - Buildings

GC: TBD

Roles and Responsibilities

Speaker: Chris Reilly, Hill International

- Construction Management Overview

GC: TBD

Roles and Responsibilities

- Open, Timely Communications
- Commitment to Issue Resolution
- Proactive Quality Program
- Viable Schedule Used as a Tool
- Risk Management
- Partnering
- SAFETY!

GC: TBD

Roles and Responsibilities

ePM Systems

- Proliance
  - RFIs
  - Submittals
  - Correspondence

GC: TBD

Proposal Overview

Speakers: Anthony Dell'Arciprete, GSA
Ray Porter, GSA
Anthony Teti, GSA

- 2 Phase Source Selection Process

GC: TBD

Proposal Overview: Phase 1

Phase 1:

- **Past Performance on Similar Project**
- **Project Team Qualifications**
- **Safety**
- **Subcontracting Methodology**

GC:TBD

Proposal Overview: Phase 1

- **Past Performance**
  - Past Performance on Similar Projects
    - Construction Firms

GC: TBD

Proposal Overview: Phase 1 --continued

- **Project Team Qualifications:**
  - Offeror's Principal-In-Charge/Project Executive
  - Construction Project Manager
  - Construction Superintendent
  - Construction MEP Coordinator
  - Quality Control Manager
  - Safety Coordinator
  - BIM Coordinator & Document Manager
  - LEED Accredited Professional (AP)

GC: TBD

Proposal Overview: Phase 1 --continued

- Safety
- Subcontracting Methodology

- Notification of Technical Rating to All Firms
- Develop the Advisory Shortlist
- Offerors on the Advisory Short List will be invited to participate in Phase 2

GC: TBD

Proposal Overview: Phase 2

Phase 2:

- Project Management and Delivery Plan
- Interactive Discussions
- Project Labor Agreement
- Price

GC: TBD

Timeline

Speaker: Ray Porter, GSA

- **10/1/2015: Proposals are Due 2:00PM to Ray Porter GSA**
  10 Hard Copies Required, No Fax/PDFs
- **11/23/2015:** GSA Will Notify Offerors
- **12/1/15:** Phase 2 Criteria Will be Sent
- **3/2016:** Anticipated Award
- **4/2016:** Notice to Proceed (NTP)
- ***24 Months*** *for Construction NTP to S.C.*

GC: TBD

Questions & Answers

Thank You For
Joining Us Today

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CODE | FACILITY CODE

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Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

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		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

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[redacted] (b) (3) (A)

CODE | FACILITY CODE

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NASA Langley Research Center
Hampton, Virginia

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(Signature of person authorized to sign)		(Signature of Contracting Officer)	

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CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0002	04/28/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

W.M. Jordan Company
11010 Jefferson Avenue
Post Office Box 1337
Newport News, Virginia 23601
Attn: [redacted] (b) (6)
Business Development Manager
[redacted] (b) (6)

CODE | FACILITY CODE

(X) 9A. AMENDMENT OF SOLICITATION NO.

☐ 9B. DATED (SEE ITEM 11)

☐ 10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0002

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 28 April 2016 to incorporate the following:

The GSA project contracting officer:

Raymond J Porter
Contracting Officer
U.S. General Services Administration
Acquisition Management Division (3PQ)
The Dow Building
100 S. Independence Mall West
Philadelphia, PA 19106
215-756 - 3439
Raymondj.porter@gsa.gov

1. Standard Form SF30

2. The proposal due date for Phase II technical and pricing proposals is 20 June 2016 by 2 PM. Please provide five (5) copies of the technical proposal and one (1) copy of the pricing proposal in an electronic format.

3. In accordance with the "Liquidated Damages" clause in Section III (Terms and Conditions), liquidated damages shall be revised to be calculated at a rate of $13,227.70 per calendar day.

4. Please be advised that the HIRF to WISE3R shall be redesigned per the attached project diagram and text which are incorporated.

5. The NASA MSL Project Bid Form is incorporated.

6. FAR Part 6 project Justification & Approvals are incorporated.

7. The Technical Evaluation Factors for Phase II are revised as follows:

From:

PHASE II

FACTOR I. PROJECT MANAGEMENT/DELIVERY PLAN

The Offeror is to provide a Project Management/Delivery Plan (PMDP) describing its management philosophy for the construction and post-construction activities for this project. The PMDP shall not exceed five (5) pages, not inclusive of a project schedule. The schedule and staging plan can be above the 5 pages of the PMDP. At a minimum, provide the following:

Phasing Plan

1. Describe in your plan how you will deliver a quality project on time and within budget.

2. Describe your understanding of the design and how you will successfully control quality on the project from award, through construction, substantial completion and contract closeout. Describe your approach to working on this secured campus, with other buildings in the vicinity, foot and vehicular traffic.

Subcontracting

1. Describe your procurement approach for selecting and contracting the mechanical, electrical, plumbing and curtain wall subcontractors. Given the building type, it is anticipated that these trades will have experience in building types described in Phase I, Factor I.

2. Describe your approach to procuring and installing of the HIRF laboratory.

Staging and Jobsite Management

Show the details of the staging area, including where material lay down will be located for each phase of the project, placement of job trailers, cranes, how work will be staged, and paths of travel for workers and tenants, etc. Note that this staging plan is not included in the 5 page limit for the PMDP.

Security/AV/IT Systems

The infrastructure (conduit, back boxes, cable trays, etc.) for the security, AV and IT systems will be funded and installed as part of the base building. The wiring and devices will be installed via Options by the Offeror. Describe your approach to managing this and show on your schedule when the Government will have to provide acceptance of the Options for this work to proceed within the project schedule to achieve substantial completion

Third Party Contractors

1. The GSA will purchase and install furniture for this building. Describe how and when GSA furniture procurements will addressed in your phasing plan to enable a turn-key project for NASA.

Permits and Safety

NASA is the Authority Having Jurisdiction (AHJ) for fire and life safety; security and environmental issues. The AHJ will provide approvals for all work in these areas. Describe how your project team will satisfy this requirement.

Submittals

The Government and its representatives reserves two (2) weeks of review time for submittals. Describe how you will manage the government's involvement with submittal reviews in relation to schedule, budget and quality. Identify any mock-up activities and their relation to the construction schedule. Identify when the government and it representatives will be brought in for inspections and walk-throughs.

Project Risk Analysis

List risks that you see to this project and how you will work with the Government and its representatives to mitigate these risks.

Communication Plan

Describe how you plan on communicating with GSA, its clients and government representatives, the LaRC Community, and other stakeholders throughout the life of the contract. GSA has procured the services of Hill International (Hill) as it's Construction Manager as Agent. GSA has also procured the services of AECOM as the Design Excellence Firm. Hill and AECOM will be involved from project award through post-construction as GSA and NASA representatives. Describe your involvement with Hill and AECOM and how you will engage them to assist in managing this project.

Cost and Change Management

Describe how you will manage the initial budget upon award, utilizing Earned Value Management, or other Cost Management Techniques. Describe how you will manage your subcontractors, with respect to cost and change management, and what you will do to keep the process moving expeditiously. Describe your approach with change management with regard to government changes.

Commissioning

This is a significant laboratory building with a sophisticated Mechanical, Electrical and Plumbing Systems. The Government and its representatives will have an independent, 3rd Party Commissioning Agent. Describe your understanding of the commissioning specifications and approach and application of commissioning for this project from award to completion with the involvement and oversight of a 3rd Party Commissioning Agent.

Building Information Modeling (BIM)

The Offeror is required to provide a complete as-built BIM model at the end of the project, using the design BIM model as a starting point. The design BIM model is a Revit model. The preference is to have the final BIM model a Revit, or equal, model. Describe your BIM Management Plan and how you will incorporate as-built changes into the model and how the BIM data can be used for Facility Management, MAXIMO, after substantial completion.

ePM - Proliance

Explain your understanding and use of GSA's ePM system to manage the project.

LEED Registration and Submittal Management

Describe your approach and experience with the LEED certification process, and how you would apply that experience to this project.

Schedule

The total project duration from Notice to Proceed to Substantial Completion is twenty four (24) months. Provide a bar chart schedule, defining all critical project elements, that demonstrates how the Offeror will achieve on-time completion. This includes but is not limited to procurement, government review time of submittals and fabrication activities for all critical project components.

Minimum Standard
The standard is met when the Offeror submits a PMDP addressing each of the items listed above which ensures that the requirements of this project will be successfully delivered. The plans shall be discussed in detail and organized such that the proposed management of this project is so structured that the Offeror demonstrates an understanding of the government's requirement.

FACTOR II. ORAL PRESENTATIONS

Key Project Members are required to attend a maximum 2 hour oral presentation. Offerors will be required to provide a brief presentation on their proposal. Additionally, the SSEB will have questions and topics for discussion based on the Offeror's submitted proposal from Phase 1 and Phase 2. It is recommended that the team be familiar with the project components and approach. The SSEB will develop uniform questions for the Offerors prior to the Oral Presentations as well as questions specific to the Offeror's proposal.

FACTOR III. PROJECT LABOR AGREEMENTS

In accordance with GSA Procurement Information Bulletin 10-04, this factor will be included to evaluate the offeror's intent with respect to employing a project labor agreement (PLA). A proposal submitted subject to the PLA requirements will be given full credit under this evaluation factor. A proposal not subject to the PLA requirements will receive no credit under this factor.

<u>To:</u>

PHASE II

FACTOR I. PROJECT MANAGEMENT/DELIVERY PLAN

The Offeror is to provide a Project Management/Delivery Plan (PMDP) describing its management philosophy for the construction and post-construction activities for this

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3. Describe your procurement approach for selecting and contracting the mechanical, electrical, plumbing and curtain wall subcontractors. Given the building type, it is anticipated that these trades will have experience in building types described in Phase I, Factor I.

4. Describe your approach to procuring and installing of the HIRF laboratory.

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Show the details of the staging area, including where material lay down will be located for each phase of the project, placement of job trailers, cranes, how work will be staged, and paths of travel for workers and tenants, etc. Note that this staging plan is not included in the 5 page limit for the PMDP.

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The standard is met when the Offeror submits a PMDP addressing each of the items listed above which ensures that the requirements of this project will be successfully delivered. The plans shall be discussed in detail and organized such that the proposed

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FACTOR II. PROJECT LABOR AGREEMENTS

In accordance with GSA Procurement Information Bulletin 10-04, this factor will be included to evaluate the offeror's intent with respect to employing a project labor agreement (PLA). A proposal submitted subject to the PLA requirements will be given full credit under this evaluation factor. A proposal not subject to the PLA requirements will receive no credit under this factor.

8. FAR Clause 52.248-3 Value Engineering—Construction is incorporated.

9. Department of Labor General Decision Number: VA160101 04/15/2016 VA101is incorporated in this amendment.

10. GSA Form 1442 is incorporated in this amendment.

All other terms and conditions remain the same.

SOLICITATION, OFFER, AND AWARD *(Construction, Alteration, or Repair)*	1. SOLICITATION NUMBER	2. TYPE OF SOLICITATION ☐ SEALED BID *(IFB)* ☒ NEGOTIATED *(RFP)*	3. DATE ISSUED 04/28/2016	PAGE OF PAGES

IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NUMBER	5. REQUISITION/PURCHASE REQUEST NUMBER	6. PROJECT NUMBER

7. ISSUED BY CODE 3PQC	8. ADDRESS OFFER TO
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106

9. FOR INFORMATION CALL:	a. NAME	b. TELEPHONE NUMBER *(Include area code) (NO COLLECT CALLS)*
	Raymond J Porter	215 756 3439

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying number, date)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

11. The contractor shall begin performance within 1 calendar days and complete it within 730 calendar days after receiving ☐ award, ☐ notice to proceed. This performance period is ☒ mandatory ☐ negotiable. *(See* To Substantial Completion *).*

12a. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? *(If "YES", indicate within how many calendar days after award in Item 12b.)*	12b. CALENDAR DAYS
☒ YES ☐ NO	10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

a. Sealed offers in original and 5 copies to perform the work required are due at the place specified in Item 8 by 2:00 PM ET *(hour)* local time 06/20/2016 (date). If this is a sealed bid solicitation, offers will be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

b. An offer guarantee ☒ is, ☐ is not required.

c. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

d. Offers providing less than 120 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

OFFER *(Must be fully completed by offeror)*

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NUMBER *(Include area code)*
	16. REMITTANCE ADDRESS *(Include only if different than Item 14.)*
CODE FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in Item 13d. Failure to insert any number means the offeror accepts the minimum in Item 13d.)*

AMOUNTS ▶

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS

(The offeror acknowledges receipt of amendments to the solicitation – give number and date of each)

AMENDMENT NUMBER										
DATE.										

20a. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20b. SIGNATURE	20c. OFFER DATE

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 copies unless otherwise specified)* ▶	ITEM	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 3304(a) ( )
26. ADMINISTERED BY		27. PAYMENT WILL BE MADE BY

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return _____ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work requirements identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.

☐ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30a. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31a. NAME OF CONTRACTING OFFICER *(Type or print)*	
30b. SIGNATURE	30c. DATE	31b. UNITED STATES OF AMERICA BY	31c. DATE

The First Floor area indicated in Diagram 'A' below is being modified to reflect new programmatic requirements for NASA Langley Research Center. Specifically, the HIRF Facility is being replaced with a smaller Shielded Chamber Facility, an extended Utility Corridor, and four additional electronics laboratory modules, as shown graphically in Diagram 'B' below. The modified drawings reflecting the revised area and building infrastructure impacts will be released for incorporation into the bidding process as soon as they are available. GSA will issue an amendment with the updated documents at least two weeks prior to the bid due date for contractor pricing.

(b) (5)

[redacted]

General Decision Number: VA160101 04/15/2016 VA101

Superseded General Decision Number: VA20150101

State: Virginia

Construction Type: Building

County: Hampton* County in Virginia.

*INDEPENDENT CITY

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the solicitation was issued on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.15 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016
1	01/15/2016
2	01/22/2016
3	04/15/2016

BOIL0045-004 01/01/2016

	Rates	Fringes
BOILERMAKER	$ 31.92	25.21

BRVA0001-004 07/01/2013

	Rates	Fringes
BRICKLAYER	$ 19.00	8.13

CARP0613-008 05/01/2015

	Rates	Fringes
CARPENTER	$ 22.05	2%+9.56

ELEC1340-010 12/01/2015

	Rates	Fringes
ELECTRICIAN	$ 26.00	12.15

ENGI0147-024 11/01/2013

	Rates	Fringes
Power equipment operators:		
Cranes 90 tons & over capacity; Tower & Climbing Cranes with Controls 100 ft. above ground	$ 28.30	8.69%+8.15
Cranes under 90 tons	$ 27.38	8.69%+8.15
Forklift	$ 23.58	8.69%+6.55

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* IRON0079-010 01/01/2016

	Rates	Fringes
IRONWORKER, STRUCTURAL	$ 25.00	14.47

LABO0351-003 06/01/2010

	Rates	Fringes
LABORER (Mason Tender Brick)	$ 13.85	5.55

PLUM0540-007 05/01/2015

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe & System Installation)	$ 26.45	15.08
PLUMBER	$ 26.45	15.08

SHEE0100-038 07/01/2015

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation)	$ 21.93	15.37

SUVA2010-106 09/20/2010

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 23.29	10.09
CEMENT MASON/CONCRETE FINISHER	$ 17.75	3.08
IRONWORKER, ORNAMENTAL	$ 24.00	10.16
LABORER: Common or General	$ 10.07	1.69
LABORER: Landscape	$ 10.64	0.00
LABORER: Mason Tender - Cement/Concrete	$ 12.96	3.12
LABORER: Pipelayer	$ 14.44	2.35
METAL BUILDING ERECTOR	$ 15.75	2.07

OPERATOR: Backhoe	$ 17.67	3.15
OPERATOR: Bobcat/Skid Steer/Skid Loader	$ 15.62	2.40
OPERATOR: Bulldozer	$ 21.50	4.80
OPERATOR: Excavator	$ 16.43	4.82
OPERATOR: Loader	$ 20.63	4.80
OPERATOR: Mechanic	$ 18.23	1.59
OPERATOR: Roller	$ 21.50	4.80
PAINTER: Brush and Roller	$ 17.34	5.59
PAINTER: Spray	$ 21.01	6.91
ROOFER	$ 21.55	7.01
TILE FINISHER	$ 17.32	6.72
TILE SETTER	$ 21.12	7.68
TRUCK DRIVER: Dump Truck	$ 13.25	1.80

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

==========

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of

the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination

* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION

BASE BID

MSL

GC Price Proposal Form

CONSTRUCTION		
Spec Division	**Spec Description**	**Price Proposal**
01	General Requirements/General Conditions	
02	Existing Conditions	
03	Concrete	
04	Masonry	
05	Metals	
06	Wood, Plastics, & Composites	
07	Thermal & Moisture Protection	
08	Openings	
09	Finishes	
10	Specialties	
11	Equipment	
12	Furnishings	
13a	Special Construction	
13b	Drawings RQ & Spec 132754 (Allowance)	
14	Conveying Equipment	
21	Fire Suppression	
22	Plumbing	
23a	Heating, Ventilating, & Air Conditioning	
23b	Building Controls (Only)	
23c	Bldg Control Integration into Campus BAS (Only)	
26	Electrical	
27	Communications	
28	Electronic Safety & Security	
31	Earthwork	
32	Exterior Improvements	
33	Utilities	
43	Process Gas	
	TOTAL BASE BID	$ -
	TOTAL OPTIONS (NET):	$ -
	TOTAL EVALUATED PRICE:	$ -

<-- WISE3R Allowance. Will provided as part of the amendment for the WISE3R.

Note that this work will be sole sourced and the allowance will cover the for the sole source.

NAME SIGNATURE DATE

OPTIONS

MSL

OPTIONS as per Spec Section 012360

Option #	Option Title	Days Option Open from Award Date	Overall DEDUCT Costs	Overall ADD Costs
Deduct Options				
1	Delete Cove Light Fixtures	90		
2	Delete Terrazzo & Stair Tread	90		
3	Delete Glass Marker Boards	90		
4	Delete Vibration Points	90		
5	Delete 10 VCC & Ductwork	90		
6	Delete BIM Requirements	90		
7	Delete COBie Requirements	90		
8	Downgrade to LEED USGBC Silver Rating	180		
9	Delete Clean Rooms	240		
10	Remove BAS Integration Requirement	90		
Add Options				
1	Parking Lot	240		
2	Cleanroom Capability	90		
3	Telecom Cabling & Equipment	240		
4	AV Cabling & Equipment	240		
5	Security Cabling & Equipment	240		
6	Provide Trane BAS system	90		

Sub-total:	$ -	$ -

TOTAL OPTIONS BID (NET):	$ -

Value Engineering Suggestions

MSL
GC Price Proposal Form

Please list below any Value Engineering suggestions you would like to make to the Government.

The Value amounts you provide are for comparison purposes only and will NOT be used to adjust your bid. Any VE suggestions the Government wishes to pursue will be addressed after contract award as changes to the contract.

	VE Scope	Value ($)
1		
2		
3		
4		
5		

6		
7		

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0003	05/11/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0003

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 11 May 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0003.

2. On May 24, 2016 GSA will host a Pre-Proposal Conference for the Phase II solicitation and a Small Business Networking Session.

Pre-Proposal Conference & Site Tour

The outline for the day is as follows:
Pre-Proposal Conference and Site Tour – 10 am to Noon
Location: NASA Integrated Engineering Services Building
Langley Research Center
10 West Taylor Street, Room 262
Building 2102
Hampton, Virginia 23681

Offerors can bring up to five people. Provide names of those attending to the GSA Contracting Officer to the attention of Raymond J. Porter at raymondj.porter@gsa.gov. Provide names of those attending to GSA Contracting Officer by close of business on 13 May 2016.

Please note that all will be required to stop by the NASA Badge and Pass Office for badges.
Location: NASA Langley Research Center
Badge and Pass Office
Langley Boulevard Bldg. 1308
Hampton, Virginia 23681

Small Business Networking Session
The outline for the day is as follows:
Small Business Networking Session – 2 pm to 4 pm
Location: National Institute of Aerospace
100 Exploration Way
Hampton Virginia 23666

The facilitator for the Small Business Networking Session shall be Joanne W. Tompkins whose contact information is provided:

Joanne W. Tompkins
Director of Procurement Assistance
Crater Procurement Assistance Center
1964 Wakefield Street
Petersburg, Virginia 23805
804-861-1667
jwtompkins@craterptac.org

3. Please be advised that the Justification and Approval that was incorporated into Amendment 0002 with the Request for Proposal package for Phase II of the project for the Trane Building Automation Software Suite is hereby deleted and is not applicable for this project.

4. All firms are required to utilize the attached Bid Form for Specification Section 002213.

5. All firms are required to utilize the attached project RFI log for all Request For Information.

6. All other terms and conditions remain unchanged.

BID ITEMS

MSL

GC Price Proposal Form

CONSTRUCTION						
Spec	**Paragraph**	**Item**	**Unit**	Unit Price	No. Units	Extension
002213	0001A	Entire Work less Bid Items 0001B, 0001C, and 0001D				
002213	0001B	Test Piling	Linear Feet			
002213	0001B	Driven Piling	Linear Feet			
002213	0001C	Pile Load Test	Each			
002213	0001D	Unsuitable Soil	Cubic Yard		3,000	
					TOTAL BASE BID	

RFI Log

Response #:

RFI #	Date Rec'd	Bidder	Bidder Qtn No.	Spec Reference	Bidder Question	GSA Response
22						
23						
24						
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AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0004	05/17/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICITATION NO.
	☐	9B. DATED *(SEE ITEM 11)*
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED *(SEE ITEM 13)*
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

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E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

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		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0004

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 17 May 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0004.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. All other terms and conditions remain unchanged.

Measurement Systems Laboratory (MSL)
Phase II Solicitation

May 12, 2016

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
01		Please advise what the deadline is for RFIs.	The deadline for the submission of RFI's is 13 June 2016
02	00 22 13 Supplementary Instructions to Bidders and 01 23 60 Options	The bid items listed in Section 00 22 13 indicate 0001A Price for the entire work, complete, but excluding 0001B, 0001C, and 0001D which are listed as unit prices. Section 01 23 60 list ten (10) deductive alternates and seven (7) additive alternates. Please advise if we are to create our own bid form to provide pricing for the alternate options or will GSA provide a revised bid form.	A new bid form specifically for Bid Items is provided.
03	LS-001 and Q-201E	Please provide specifications for Paint Spray Booths	See Specification 11 53 00 - Section 2.2.2
04	Q-201F	Drawing refers to RQ Drawing Series for the HIRF consultant drawings. Amendment 0002 revises this floor plan. Please confirm there are no RQ Drawings.	The RQ drawings are included in the set, but they will be revised.
05	CD101 and CD104	Will demolition of Buildings 1192, 1192C, 1192D, 1192E and 1213 be complete prior to award of this contract	All facilities have been demolished under separate contract as stated.
06	G-004	If the parking option/alternate is not awarded, will the contractor still have access to existing parking lot for construction use during the contract?	Based on the General Contractors proposed plan NASA will consider the use of the back 3rd of Parking Lot 1268/grassed area to within 30' of the Power Station fenceline.
07	Phase II RFP	How should changes in proposed personnel from Phase I be addressed in Phase II?	Refer to Appendix A, Techical Evaluation Factors/Minimum Standards for Phase I, Factor II, Project Team Qualifications. "In the event that any substitutions in key personnel are proposed, the Offeror shall provide to the Contracting Officer the information required for that position as stated in the Key Personnel Minimum Requirements and Phase I Submittal Requirements. Written notification and submittal of a change in the Offeror's Key Personnel must be identified timely to allow for proper evaluation by the Government." The changes in personnel and requisite documentation shall be submitted with the Phase II Technical Proposal.
08	C101 The Agreement and FAR 52.219-9	This Small Business Subcontracting Plan FAR is incorporated by reference. Please advise if a plan is required to be submitted with the proposal. If so, will GSA provide an example or template?	A subcontracting plan is required per the project solicitation. Please see C201 The Solicitation. The subcontracting methodology form was provided in the C201 The Solicitation package posted to FedBizOpps.
10	General	If project team members have changed since the phase 1 proposal how would the GSA like this documented?	Please see response to RFI #07
11	General	What is the deadline for submitting RFIs?	Please see response to RFI #01

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0005	05/26/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED (SEE ITEM 11)
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

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12. ACCOUNTING AND APPROPRIATION DATA (If required)

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☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

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		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0005

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 26 May 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0005.

2. The NASA MSL Phase II pre-proposal conference which was held on 24 May 2016 at the NASA Integrated Engineering Services Building located at the Langley Research Center in Hampton Virginia attendee sign in sheet and PowerPoint presentation is incorporated in this amendment.

3. The NASA MSL Small Business Networking Session which was held on 24 May 2016 at the National Institute of Aerospace located in Hampton Virginia attendee sign in sheet and PowerPoint presentation is incorporated in this amendment

4. All other terms and conditions remain unchanged.

NASA GSA AECOM HILL Hill International

NASA ReVITALization Project ⇨ Measurement Systems Laboratory (MSL)
Pre-Proposal Conference
May 25, 2016

Sign-In Sheet

[redacted] (b) (3) (A)

NAME	Check Here if Address is same as above	ADDRESS (if Different than above)	CITY/ STATE/ZIP (if Different than above)	PHONE NUMBER	EMAIL ADDRESS
[redacted] (b) (6)	✓			[redacted] (b) (6)	
	✓				

NASA GSA AECOM HILL Hill International

NASA ReVITALization Project ⇨ Measurement Systems Laboratory (MSL)
Pre-Proposal Conference

May 25, 2016

Sign-In Sheet

[redacted] (b) (3) (A)

NAME	Check Here if Address is same as above	ADDRESS (if Different than above)	CITY/ STATE/ZIP (if Different than above)	PHONE NUMBER	EMAIL ADDRESS
[redacted] (b) (6)	✓			[redacted] (b) (6)	
	✓				
	✓				

NASA GSA AECOM HILL Hill International

NASA ReVITALization Project ⇨ Measurement Systems Laboratory (MSL)
Pre-Proposal Conference
May 25, 2016

Sign-In Sheet

[redacted] (b) (3) (A)

NAME	Check Here if Address is same as above	ADDRESS (if Different than above)	CITY/ STATE/ZIP (if Different than above)	PHONE NUMBER	EMAIL ADDRESS
[redacted] (b) (6)	✓			[redacted] (b) (6)	
	✓				
	✓				
	✓				

NASA GSA AECOM HILL Hill International

NASA ReVITALization Project ⇨ Measurement Systems Laboratory (MSL)
Pre-Proposal Conference

May 25, 2016

Sign-In Sheet

W.M Jordan Company
11010 Jefferson Avenue, P.O. Box 1337
Newport News, VA 23601

NAME	Check Here if Address is same as above	ADDRESS (if Different than above)	CITY/ STATE/ZIP (if Different than above)	PHONE NUMBER	EMAIL ADDRESS
[redacted] (b) (6)	✓			[redacted] (b) (6)	
	✓				
	✓				

National Aeronautics
and Space Administration

U.S. General Services Administration

NASA Revitalization Project

Measurement Systems Laboratory (MSL)

Langley Research Center

Hampton, Virginia

Design-Bid-Build

Pre-Proposal Conference, Phase II

May 24, 2016

Today's Agenda

10:00am – 11:00am:	**Presentation and Questions/Answers**
11:00am – 12:00pm:	**Site Tour**
2:00pm – 4:00pm:	**Small Business Networking Session**

GC: TBD

Presentation Agenda

- Introductions
- NASA Revitalization Background
- Recap: Measurement Systems Laboratory Project
- Proposal Overview
- Timeline
- Security, Access and Badge Procedures
- Questions & Answers

GC: TBD

Introduction: Gov't Representatives

U.S. General Services Administration

- **Anthony Dell'Arciprete** Program Manager
- **Bill Faustman** Project Manager
- **Ray Porter** Contracting Officer

U.S. National Aeronautics & Space Administration

- **William Abrams** Design Project Manager
- **Gary Stergin** Construction Project Manager
- **Chris Hudgins** Deputy Project Manager
- **Floyd Quintana** Program Manager

GC: TBD

Introduction: Project Contractors

A/E Firm: AECOM

- **Ed Weaver** Program Manager

Construction Management Firm: Hill International

- **Jim Beckett** Project Executive

GC: TBD

NASA Revitalization Plan Overview

Speaker: Floyd Quintana, NASA

- NASA Revitalization Plan

GC: TBD

NASA Video

NASA Video 1

GC: TBD

NASA Revitalization Plan Overview

GC: TBD

Creating Langley's Future…It's VITAL

Langley creates innovative solutions to the grand challenges of earth science, space exploration and flight in all atmospheres, for the benefit of all humankind.

Heritage

- "Mother Center"
- NACA
- National Aeronautics Lab
- Unitary Plan
- Birth of Space Program

Present

- New Town
- Revitalize Langley
- Lab Consolidation
- Diversified Portfolio
- Repair by Replacement
- Recapitalization

Future

- Enables full spectrum of R&D
- Promotes collaboration and productivity
- Flexible and adaptive to changing mission needs
- Environmentally sustainable
- Embraces future work environments

NASA GSA AECOM Hill International GC: TBD

Aging Infrastructure Poses Risk to Mission

- **Agency-wide, more than 80 percent of NASA's infrastructure and facilities by value are beyond their design life – thus more likely to be unsuitable for current and future missions.**
  - **Aging, Apollo-era legacy infrastructure is inefficient and costly to maintain and operate.**
  - **Assets over 40 years old (typical design life is 30 years) pose a risk to NASA's unique research and development mission.**
- **Risk severity rises as assets age beyond 40.**
  - **To control risk, control the share and average age of assets >40**
- **Maintenance backlog continues to grow.**

Whitlow—"NASA Facility Strategy Presentation" at the 2011 Facilities Engineering Conference

LaRC's oldest building is 80 years old and the Center average is around 44 years old—We are proactively revitalizing the Center's core infrastructure to meet future missions.

GC: TBD

Overarching Revitalization Decisions

- Sustain / enhance essential in-house experimental capability
- Enable multi-disciplinary integrated systems capability
- Incorporate Computational Simulation as a cross-cutting capability in everything we do
- Continually assess the needs of NASA's missions and divest of facilities (even larger ones) when it no longer makes sense for the mission and the national good

GC: TBD

Katherine G. Johnson Computational Research Facility (CRF)

- **Current Status**
  - Construction is 27% complete. This project consolidates our computer data centers into a single location resulting in improved efficiencies in the areas of power consumption, cooling and humidity control requirements, reliability and capacity optimization
- **Future Work**
  - Current Contract Completion date: January 1, 2017
  - Continue working site utilities, parking lot and steel installation

GC: TBD

ViTAL – Vibrant Transformation to Advance Langley

Goal: Re-ViTALize LaRC

Transform the Center to enable LaRC to make vital contributions to NASA missions – both current and future – by establishing a stimulating work environment, modernizing infrastructure and investing in new capabilities to meet the accelerating pace of science and technology trends.

Revitalization success through strategic workforce partnerships with GSA and USACE enables LaRC to focus our critical hires toward the Agency Mission.

NASA GSA AECOM Hill International GC: TBD

NASA Video

NASA Video 2

GC: TBD

Recap: Pre-Proposal Conference

Speakers: Anthony Dell'Arciprete, GSA
Ray Porter, GSA

- **Design-Bid-Build Services**
- **Measurement Systems Laboratory (MSL)**
- **2 Phase Source Selection Process**
  - Completed 1st Phase
  - Announced Short-Listed Firms

GC: TBD

Proposal Overview: Phase 2

Criteria

- Project Management Delivery Plan
- Project Labor Agreements
- Price

GC: TBD

Upcoming Design Amendment

- Changes from HIRF to WISE3R
- This will be Sole Source Justification:
  - ETS-Lindgren –An ESCO Technologies Company

GC: TBD

Timeline

Speaker: Ray Porter, GSA

All Proposals Due to:
Ray Porter, GSA Mid-Atlantic Region
The Dow Building
100 S. Independence Mall West
Philadelphia, PA 19106

- **Due: June 20, 2016 at 1:00PM**
  5 CD Copies of Technical Proposal
  1 CD Copy of Price Proposal
  Do Not Send Fax or PDFs

GC: TBD

Timeline - Continued

- **Interactive Discussions:**
  - **Week of July 11, 2016: 2 Sessions per Day - AM & PM. Firms will be Notified of Their Time Slot Shortly**
  - **Each Firm Not to Exceed 1 Hour Presentation + ½ Hour for Q&A**

GC: TBD

Timeline - Continued

- **July 18 – 29, 2016:** Project Team Review: Consensus/Best Value
- **August 18, 2016:** GSA Will Notify Offerors
- **September 16, 2016:** Notice To Proceed

GC: TBD

Security & Access - Overview

Speaker: Anthony Dell'Arciprete, GSA

- GSA will Provide Security Clearances for ePM Access
- NASA will Provide Security Clearances for Access to Langley Research Center
- GSA and NASA will work with Successful Offeror Following Award for All Clearances

GC: TBD

Security & Access: ePM

- ePM Access Guidelines HSPD-12
- Will Work with Successful Offeror for Clearance and Workflow Set-Up

GC: TBD

Construction Contractor Access & Badging

Speaker: Gary Stergin, NASA

Background

NASA Langley Research Center is a United States Government federally owned and operated research campus and shares a common border with the U.S. Air Force, Air Combat Command Center (Joint Base Langley-Eustis).

GC: TBD

Construction Contractor Access & Badging

Center access and security is managed by the Security Services Branch (SSB), Center Operations Directorate with support from military police as well as federal and local law enforcement agencies. The Badge and Pass Office is located within the SSB and will manage the issuance of contractor badges and center access.

The Badge and Pass Office is located outside the main NASA gate (Building 1308) and operates from 6:30am – 3:00pm, Monday thru Friday.

GC: TBD

Construction Contractor Access & Badging

Access Requirements

- All NASA and Contract personnel are required to have and visibly display, approved badges while working on NASA property.

- Contract personnel who are approved by the SSB will be required to enroll at the Badge and Pass Office before starting on-site work.
  - Once fully badged, contract personnel are free to report directly to job site for daily work by entering through one of the two access gates and showing their badge to the officer on duty.

GC: TBD

Construction Contractor Access & Badging

Access Requirements *--continued*

- **Construction contractors are issued badges for a maximum of six months and can be renewed for additional time once certain security criteria is met.**

  - **Renewed six month terms OR initial long term badge requests will require additional time for in depth background security investigations and must be signed by permanently badged civil servant or contract personnel (requirements still evolving).**

GC: TBD

Construction Contractor Access & Badging

Access Requirements *–continued*

- **All personnel who work on an active construction site are required to attend LaRC's Construction Safety Briefing prior to beginning work and every six months thereafter.**

  - **Construction Safety Briefings are offered daily at 7:30am in Building 1238, which lasts approximately 90 minutes. Once completed, the LF 227 (Contractor Badge Request) form will be signed and dated by safety representative.**

Construction Contractor Access & Badging

Access Requirements *–continued*

- **U.S. Citizens - once badged are allowed to freely move about the LaRC in execution of their contracted duties.**
  - **Personal data required for badge issuance includes: full name; SSN; date/city/state of birth; residential address; phone number; email address. Must produce <u>two</u> forms of identification, one of which <u>must</u> be a federal or state issued picture identification AND (voter card, social security card, passport, birth certificate, etc.).**

Construction Contractor Access & Badging

Access Requirements *–continued*

- **Non-U.S. Citizens – once badged must be escorted at all times by a permanently badged employee.**
  - **Personal data required for badge issuance includes: full name; date and place of birth; residential address; phone number; email address.**
  - **Additional personal information will be required and country entry status will be verified prior to approval.**
  - **Not allowed access to LaRC until there is a completed/approved LF140, which can take between 20 – 60 days based on country of origin.**
- **Contract Employees must be able to provide two forms of identification and a valid visa and passport or Permanent Resident card**

Construction Contractor Access & Badging

Badging Process

1. Prime contractor (GC) is required to maintain current list of approved contract employees with a POC name and phone number.
   - Best practice is to allow CM Contractor (MTI) to manage this process.
2. Contract employee list will be provided to CM who will have an IDMAX account and will enter required data into IDMAX.

GC: TBD

Construction Contractor Access & Badging

Badging Process *–continued*

3. The IDMAX request will be sent forward to the NASA sponsor who approves the request and sends forward to the SSB who then has 5 days to process.
4. After 5 days, the contract employee can then report to the Badge and Pass Office for enrollment and issuance of one day badge and LF 227.
   - Verification of two ID's, photo, fingerprinting and signature will be performed.

Construction Contractor Access & Badging

Badging Process – *continued*

5. **The contract employee can use the one day badge to enter LaRC to attend Safety Briefing at building 1238 where employee will also get the LF 227 validated proving the Safety Briefing was completed.**
6. **Contract employee shall ensure the LF 227 is completed and signed before returning to the Badge and Pass Office for issuance of the six month construction badge.**

Construction Contractor Access & Badging

Badging Process *–continued*

7. **Once the six month badge is issued, employee (U.S. citizen) is allowed to freely enter the NASA LaRC access gates during regular working hours (6:00am – 6:00pm) for execution of his/her construction project.**
   - **<u>Note:</u> Extending the six month badge requires a repeat of this process, including another safety briefing.**

GC: TBD

Construction Contractor Access & Badging

Badging Process – Temporary Badges

- **Temporary badges (not to exceed 30 days) can be issued to U.S citizen visitors using the NASA LF 103 process and must be signed by a permanently badged NASA or contract employee.**
- **The temporary badge process is for non-contract employee visitors <u>only</u>.**
- **Temporary visitors are only required to show one form of identification, but it must be a state or federal photo ID (drivers license, Government ID, etc.).**

Site Tour

Speaker: TBD, NASA

- **11:00am-12:00pm**
  - **Maximum Allowance: 5 People Per Firm**
  - **Tour Protocols**
  - **Photographs Okay**

GC: TBD

National Aeronautics
and Space Administration

U.S. General Services Administration

Questions & Answers

Thank You For
Joining Us Today

GC: TBD

Small Business Networking Session

TODAY:

2:00PM – 4:00PM

National Institute of Aerospace (NIA) Building

100 Exploration Way

Hampton, VA 23666

GC: TBD

MAY 24, 2016

SMALL BUSINESS NETWORKING SESSION
NASA MEASUREMENT SYSTEMS LABORATORY

PRINT NAME	ORGANIZATION	EMAIL
[redacted] (b) (6)	Atlantic Testing	[redacted] (b) (6)
	CMG Contracting	
	PNC Bank	
	Allied Trailers	
	Horizon Construction Development LLC	
	Keta Technologies	
	Baron Communication INC	
	PNC Bank	
	McLean Endeavors, LLC	
	JLGOV	
	PNC Bank	
	York River Electric	
	ECS Mid-Atlantic	
	Peninsula Merchant Services@gmail.com	

am
es.
com

MAY 24, 2016

SMALL BUSINESS NETWORKING SESSION
NASA MEASUREMENT SYSTEMS LABORATORY

PRINT NAME	ORGANIZATION	EMAIL
[redacted] (b) (6)	J+B HARTIGAN	[redacted] (b) (6)
	PNC Bank	
	PNC Bank	
	BAY ELECTRIC Co.	
	SECURITY 101 Hampton Rds	

NASA

CRATER PTAC
GOVERNMENT CONTRACTING ASSISTANCE

GSA

MAY 24, 2016

SMALL BUSINESS NETWORKING SESSION
NASA MEASUREMENT SYSTEMS LABORATORY

PRINT NAME	ORGANIZATION	EMAIL
[redacted] (b) (6)	[redacted] (b) (3) (A)	[redacted] (b) (6)
	Doors on Demand LLC	
	MJS Construction	
	Pro Window Inc	
	RJ Smith Construction	
	GET Solutions, Inc.	
	Horizon Construction Development	
	American Office	
	AMERICAN OFFICE	
	The Askew Group, LLC	
	MidAtlantic Metal Solutions	
	MEADOWS CMPO, INC.	
	B. WILLIAMS RESOURCES	
	JD Communications LLC	
	PRO-MIT	

MAY 24, 2016

SMALL BUSINESS NETWORKING SESSION
NASA MEASUREMENT SYSTEMS LABORATORY

PRINT NAME	ORGANIZATION	EMAIL
[redacted] (b) (6)	OUTSHINE Contractors LLC	[redacted] (b) (6)
Gary STERGIAN	NASA	
[redacted] (b) (6)	[redacted] (b) (3) (A)	[redacted] (b) (6)
	Bay Diesel + Generator	
	JKB Hartigan Inc	
	W. M. Jordan Company	
	"	
	WM JORDAN COMPANY	
Randy MANNING	LARC - OTP	randy.a.manning@nasa.gov
[redacted] (b) (6)	[redacted] (b) (3) (A)	[redacted] (b) (6)
	TRILOGY SECURED SVS.	
	Sterney	
	IBM	
	GET Solutions, Inc.	
	ALGOVLLC	
	TST Roofing	

Small Business Networking Session

Potential Sub-Contracting Opportunities Related to:

NASA Langley Research Center

Measurement Systems Laboratory (MSL)

Hampton, Virginia

May 24, 2016 **2:00PM – 4:00PM**

At the National Institute of Aerospace (NIA) Building - Hampton, VA

Today's Agenda

- Introductions
- Measurement Systems Laboratory Project
- Small Business Networking Session

Introduction: Gov't Representatives

U.S. General Services Administration

- **Anthony Dell'Arciprete** Program Manager
- **Bill Faustman** Project Manager
- **Ray Porter** Contracting Officer

U.S. National Aeronautics & Space Administration

- **William Abrams** Design Project Manager
- **Gary Stergin** Construction Project Manager
- **Chris Hudgins** Deputy Project Manager
- **Floyd Quintana** Program Manager
- **Randy Manning** Small Business Liaison

Crater Procurement Technical Assistance Center

- **Joanne Tompkins** Director

Introduction: Short Listed Firms

Future Construction for the
NASA Measurement Systems Laboratory Project

- (b) (3) (A) [redacted]
- [redacted]
- **W.M. Jordan Company**
- (b) (3) (A) [redacted]

NASA Measurement Systems Lab

NASA Measurement Systems Lab

- **175,000 gross sq.ft. New Construction at NASA Langley Research Center (LaRC), Hampton, VA**
- **Facility Will House Sensor-Related Instrumentation Development Labs and Laser Instrumentation Development Labs**
- **Research Efforts in this New Facility will Represent Core Mission of NASA LaRC**
- **Project Team is Currently in Procurement Process for Identifying Awardee for Construction Phase**
  - **Estimated Award Date: Mid-August 2016**

Procurement Technical Assistance Center

Speaker: Joanne Tompkins

- Created by Congress in 1985 to increase the number of businesses capable of doing business with local, state and federal governments.
- 97 PTACs with over 300 locations operating in all 50 states
- Free one on one assistance with registrations, certifications, market research, assist clients in finding potential prime and subcontracting opportunities.

Small Business Networking Session

Thank You For Joining Us Today

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0006	06/02/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0006

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 2 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0006.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
13	Civil Dwgs	Drawings CG102 and 103, CD 106 and 107, CS102 and 103 reference the parking lot add alternate. Please provide a more specific delineation of what is to be included in the base bid and what is the add alternate	The Base Bid is shown on sheet CS104. The Add Alternate is as shown on sheets CD106, CD107, CS102, CS103, CG102 and CG103 and as described in the Parking Lot Add Alternate note.
14	Dwg L403, L502	Detail 7/L403 calls for precast veneer and coping for bioretention planter #5. Detail 5/L502 calls for cast stone. Please clarify if this is cast stone or precast.	The precast/cast stone is meant to be the same product, consistent with the building façade material.
15	Dwg L403	Detail 6/L403 calls for a brick veneer on knee wall. Please confirm if this is correct and if it should be installed on both sides of the knee wall.	Correct, the knee wall at the entrance to Bldg. 1268 is to be brick veneer, both sides, as shown on detail #6 on L403.
16	Dwg L503	On detail 1/L503 the concrete subbase foundation for the benches is labelled concrete pavers. Please clarify.	Label is incorrect. Benches are to have a concrete foundation in the minimum size shown if no slab is provided below the bench location condition otherwise. Bench locations where concrete subslabs are present only require anchor bolts embedded the depth shown. Bench foundations within brick mulch should be slightly subsurface (1") as to not be expressed at the surface.
17	Dwg A202	Detail 2/A202 calls out the façade as IGU3F. Please confirm that the façade should be TRP1 in this area.	The façade should be TRP1 in this area, not IGU3F.
18	Dwg CG501	The sequence of construction on drawing CG501. Sequence #3 seems to be erroneously added since it is already included as #12. Please confirm #3 is to be deleted from the sequence of construction.	Yes, sequence of construction note #3 should be deleted.
19	Dwg CD101, CD104, CD108	Drawings CD101, CD104, and CD108 indicates that demolition of Buildings 1192, 1192C, 1192D, 1192E, and associated site and utility features will be performed by others under separate contract. Should it be assumed that the foundations for these buildings and associated site features will be demolished and removed by others as well? If removal of foundations is to be included as part of this bid please provide as-builts so scope or work can be determined.	The drawings for the demolition of Buildings 1192, 1192C, 1192D, 1192E and associated site and utility features are provided in the Bid Set as Reference Drawings RC-003 – RC-006. No as-builts were provided.
20	Dwg CD101	Drawing CD101 indicates existing underground foundation limits West of Building 1192E. Will these foundations be demolished and removed by others as well? If removal of foundations is to be included as part of this bid please provide as-builts so scope or work can be determined.	The drawings for the demolition of Building 1168 are provided in the Bid Set as Reference Drawings RC-001 and RC-002. No as-builts were provided.
22	Dwg A433	Detail 3 on drawing A433 references a ceiling hung cable supported custom dichroic mobile. Please provide more information on this custom dichroic mobile, such as manufacturer used in basis of design, for accurate pricing purposes.	As stated on 3/A433, the mobile is to be a custom-made piece for the space. The components are as indicated on 3/A433 as well as in detail 14/A541
23	Dwg A711A, A735, A740	On drawing A711A, in between row line G.6 and G.8, on column line 7, there is a dichroic glass blade display. This is also shown on detail 15 on page A735 and on detail 6 on page A740. Drawings state "blade display signage… length to be determined with final graphic". Please provide more information on final graphic, length, and basis of design.	Blades are NASA-provided aluminum wind-tunnel artifacts - GC to provide and coordinate the base, mounting, installation, and display signage. Final display signage information is to be provided by NASA - the height and construction of the signage is as indicated on 6/A740.
24	083419.10 20	Door (b) (5) is listed as fire rated, drawn as standard coiling fire door; however the specification calls for accordion folding door. Please clarify door type.	Door (b) (5) is a fire-rated overhead coiling door as indicated on the door schedule. The specification section indicated in the question is in reference to the accordion folding fire doors at (b) (5)
25	Dwg A503	Detail 10 on A503 does not show sufficient side room to allow the guide rail cover plate to be installed at the top of the jamb. The interior tube steel and wall can not be tight against the guide rail at the top of the door.	Documents indicate design intent. It is the responsibility of the GC to coordinate construction/field conditions.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
26	Floor Plans	Note 19 on the floor plans identifies tie-off points. Details or descriptions of the tie-off points could not be located. Please provide information regarding this item.	Tie-off points are as indicated on A102B, A105A, A106A, and A106B. Provide OSHA compliant roof tie off system for use by workers on the roofs.
27	01 35 26	Specification Section 01 35 26 – 1.19 discusses the requirements of asbestos abatement. Please confirm if any asbestos containing materials are anticipated to be encountered? Please provide location, type, and quantity that may be encountered?	No asbestos containing materials are anticipated to be encountered on this project.
28	01 35 26	Specification Section 01 35 26 – 1.19 discusses the procedures for the removal and/or reinstallation of transite panels. Please confirm if any transite panels are expected to be encountered? Please provide location and/or services that may be affected.	No transite panels are anticipated to be encountered on this project.
29	13 20 00	Please verify that the following specification is a requirement of this RFP: Section 13 20 00 page 29 paragraph 3.6.3.2 "All Type A clean areas shall be maintained to a level that can pass a felt test inspection by the Owner, or his representative. Where such inspection detects contamination, the work shall be stopped until satisfactory clean-up is completed."	Confirmed - work is to be as specified.
30	13 20 00	Please describe the "post-installation support services" referenced in section 13 20 00 page 6 paragraph 1.6.	Refer to part 3 of specification section 12 30 00 for all close out and training requirements.
31	Dwg E221A	Please verify that the statement on E-211A is correct RM (b) (5) Common Electronics Fabrication (column 9-11 & C-D) "COORDINATE WITH CLEAN ROOM MANUFACTURER FOR ALL REQUIRMENTS WITHIN THIS AREA". All other documents do not state this is a Cleanroom. If this is a Cleanroom, please send updated documents indicating the contract requirements.	Room (b) (5) Common Electronics Fabrication is NOT a cleanroom. The note on E211A will be revised.
32	07 81 00	Steel fireproofing note 1 on the S-100 series drawings states that "all steel designated with a "FP" designation shall be fireproofed as required to achieve a (b) (5) rating. Reference architectural and life safety plans for requisite UL assemblies…." The fire protection notes on drawing G-002 state "Provide (b) (5) spray on fire proofing for all (b) (5) Please clarify.	Roof structures shall be fire rated as follows: (b) (5)
33	Dwg A601	The Door Schedule General Notes on A601 states for door manufacturer to paint exterior portion of door and frame and field paint the interior portion. This is not a typical application. Can this requirement be changed to field paint entire door and frame.	All doors are to be finished per the Door Schedule Notes on A-601 and as noted in 08 11 13 section 2.8.
34	Dwg Q-001	Q-001 Lab Casework, General Information – Paint: States Architect to select color. Confirm colors to be selected will be a standard color and not custom.	Refer to specification section 12 36 10, Paragraph 2.2.1 "…Color of finish shall be as selected by the Contracting Officer from the manufacturer's standard colors."
35	Dwg Q401	On drawing G401, various finishes are noted to be selected by architect or contracting officer. Please confirm colors will be selected from manufacturer's standard colors and that custom colors are not required.	Refer to specification section 12 36 10, Paragraph 2.2.1 "…Color of finish shall be as selected by the Contracting Officer from the manufacturer's standard colors."
36	Dwg G403	Please confirm NIC under Spec. No. column means Not in Contract for the General Contractor.	Refer to Legends and Abbreviations, drawing No. Q-0001.
37	Dwg S001	S001 Notes state that up to 2 feet of existing fill may be required to be removed to achieve stable subgrade. Please confirm that this note applies to the unsuitable fill unit price cost for unsuitable soil included on the bid form?	

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
38	Structural Dwgs	The structrual drawings are missing section information throughout. Please provide.	Please provide an RFI requesting specific information that you feel is lacking. Structural sections have been provided as a part of the Structural drawing set.
39	Dwg A711B	Please provide information for the heavy duty steel floor plate shown around the HIRF lab on drawings A711B.	Please see Amendment 0002. Area to be revised.
43	01 10 00	Spec Section 01 10 00, 1.14 Work Restrictions state to perform work that results in disruption to operations after hours, weekends, ... Please define the work considered to be disruptive to operations so it can be priced accordingly.	Please amend specification 01 10 00 paragraph 1.14.B with the addition of the following: "Examples of work considered to be disruptive include but are not limited to noises that prevent normal conversation within adjacent buildings; vibrations that might interfere with ongoing NASA experiments or testing; odors that cause discomfort or disruption to Center employees; and any other activities that would adversely impact the efficient operation of the Center or impair the Center from fulfilling its mission."
46	Structural Dwgs, Laboratory Dwgs	Various details in the Laboratory drawings (2/Q201A, 3/Q201C, 2/Q205A, etc.) show a powder coated or pre-finished overhead structural frame and references the architectural and structural drawings. Information about the overhead structural frame could not be located. Please provide information on this system. Additionally, detail 3 on Q401 shows the structure 3' OC, however, concrete framing plan note 14 on the S100 drawings states 6' OC. Please clarify.	Information regarding the structural frame is located on the structural drawings, including a basis of design, as well as in Specification Section 05 50 13. The structural drawings indicate the insert system spacing into the concrete, the spacing of the grid elements suspended below is as indicated on the A and Q drawings.
47	10 22 43	Please provide a basis of design for the ceiling supported frosted glass marker board sliding panels. Please provide the number of panels and configuration for the system.	Configuration is as indicated in 10 22 43 and 1/A541. Assume the following panel quantities: First Floor: 8 panels Second - Fourth Floors: 9 panels/floor

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
48	CD108	Contractor Parking -Work Note states "Mill asphalt and Provide Asphalt overlay on Parking Lot at the completion of the project. Maintain Current grades, Adjust Rim of existing catch basin as necessary. Re- stripe parking lot to current condition. Replace broken or damaged curb". Please clarify scope – the existing lot is concrete not asphalt and milling is not practical. Please quantify extent of existing curb that is considered broken or damaged.	The intention of the note is to restore the parking lot to its condition prior to using it as a staging area. Please revise the note as shown below. SHEET CD108 DELETE NOTE: "MILL ASPHALT AND PROVIDE ASPHALT OVERLAY ON PARKING LOT AT THE COMPLETION OF THE PROJECT. MAINTAIN CURRENT GRADES, ADJUST RIM OF EXISTING CATCH BASIN AS NECESSARY. RE-STRIPE PARKING LOT TO CURRENT CONDITION. REPLACE BROKEN OR DAMAGED CURB" REPLACE WITH NOTE: "PROVIDE PRE-CONSTRUCTION PHOTOGRAPHS OF THE STAGING AREA IN ACCORDANCE WITH SECTION 01 32 33 "PHOTOGRAPHIC DOCUMENTATION". UPON COMPLETION OF WORK, THE STAGING AREA SHALL BE CLEANED OF ALL DEBRIS, INCLUDING CATCH BASIN STRUCTURES LOCATED IN THE AREA. CLEAN THE PAVEMENT USING A POWER SWEEPER AND VACUUM. RE-ESTABLISH (PAINT) ALL PAVEMENT MARKINGS WITHIN THE STAGING AREA AT THE LOCATIONS EXISTING PRIOR TO THE USE OF THE AREA. MATERIALS AND CONSTRUCTION MUST BE IN ACCORDANCE WITH SECTION 32 17 23.00 20 "PAVEMENT MARKINGS", EXCEPT MARKING SHALL NOT BE RETROREFLECTIVE. ALL CONSTSTRUCTION WITHIN THE STAGING AREA SHALL BE SATISFACTORILY REPAIRED OR REPLACED PER SECTION 01 50 00 'TEMPORARY FACILITIES AND CONTROLS'.
49	CS101 Benches #38	Draw show a total of 4. Note say typical of 3. Please advise?	Note should read Typical of 4 - see also L202.
50	CS101	Rectangular on North West corner of site is not identified – please clarify what is required?	Rectangle is the Building ID Sign - see L101.
51	CS101	Note #10 identifies as concrete sidewalk. This conflicts with drawing LP201 which call area to be Lawn- please advise?	Area is to be as indicated on LP201.
52	Architectural Dwgs	Please clarify the floor base type to be used at all restrooms. There is a conflict between the restroom elevation and finish floorplans. Restroom plans (A-410 & A-411) show ceramic tile floor base at all locations. The finish plans (A-711A – A-715B) show terrazzo base at all locations.	In the Base Bid, the wall base is to be terrazzo at all restrooms. For Deduct Alternate 2, provide ceramic tile wall base at all restrooms.
53	Architectural Dwgs	Please clarify which material is to be used at the base of the building. The elevations show granite in the material legend but the arrows label that same material as cast stone cladding (See detail 7 on A-511 as a reference). There is also no mention of granite in the specification.	The base of the building is to be a cast stone base per the details, and per Specification Section 04 20 00. All references to granite should read 'CAST STONE'.
58	Architectural Dwgs	What is the required finish on the lab side of the partitions surrounding the clean rooms on level 1 between columns 1-8/C-D? Per the partition schedule, these walls are shown as (b) (5) rated, which will require the drywall seams to be taped and finished. Please clarify whether the lab side of these partitions will require a primed or painted finish.	The lab side of these partitions are to be painted PT-2 like all other laboratory partitions - see Finish Plans.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
59	Architectural Dwgs	Are the concrete floors within the clean rooms on level 1 between columns 1-8/C-D required to be sealed? Per deduct alternate #9, providing a warm lit shell at the clean room locations will require the floors to be sealed concrete. Please clarify whether the concrete floor will still need to be sealed if deduct alternate #9 is not exercised.	If deduct alternate #9 is not exercised, the floors for the cleanrooms are to be as specified in 13 20 00.
60	Architectural Dwgs	Details 2 and 3 on A511 show the exterior horizontal sun shading devices. The details call for a perforated infill panel to match the curtainwall. Please advise if there is a basis of design for the sun shading devices or provide information on the size, shape, and density for the perforations.	The sun shading devices are as indicated in 08 44 00 section 2.1.13. The perforation pattern is to be selected by the Architect from the Manufacturer's full range of round hole perforations.
61	Architectural Dwgs	Please confirm the only STC Rated door assemblies are the ones noted in the Comments column on A-601/A-602/A-603 (Door Schedule). Per A-601, Door Schedule General Note #8 states, "All Doors in a STC Rated Partition shall have a minimum STC 45 rating". Per the Door Schedule comments column, there are 3 STC 45 and 1 STC 50 rated door assemblies called out. However, per the Partition Schedule, there are many more STC Rated Partitions that do not have STC Rated Door Assemblies as part of the door schedule.	All doors in STC rated partitions are to have a minimum STC 45 rating per Door Schedule General Note #8. The doors specifically called-out with STC ratings on the Door Schedule are part of the Secure Work Area.
64	Sheet A441	Detail 5/A441 shows a precast terrazzo tread/riser based on Wausau E-31. Wausau E-31 ranges in thickness from 1/2" to 1". This tread riser/thickness appears to be 1-1/2" thick. The Wausau rep recommends 3/4" thick. Please advise if you want the thickness shown in 5/A-441 (approximately 1-1/2") or a size that is available using E-31.	Wausau E-31 ranges in thickness from 3/4" to 2". Precast terrazzo tread/rise thickness is shown as design intent - final thickness will be based on the final product selected to meet the requirements of 09 66 23 Section 2.11.
66		WD-1 is utilized on the finish floor plans, but not provided for on A-701 finish legend. Please identify the wood material on the walls around the Elevator 1 & 2 core areas.	All WD-1 references should read WW-1. See A-701 for WW-1 information.
67		RB-3 resilient base is utilized on the floor plan, but not provided for on A-701 finish legend. Please identify the material.	RB-3 references are in error. RB-3 will be removed from A-701. RB-2 is to be provided within all laboratories. RB-1 is to be provided at all other locations noted with resilient base on the finish plans.
68		EP-2 flooring is utilized on the floor plan, but not provided for on A-701 finish legend. Please identify the material.	EP-2 references are in error. Replace all EP-2 references with SC-1. The finish plans will be updated.
69		EP-3 flooring is utilized on the floor plan, but not provided for on A-701 finish legend. Please identify the material.	EP-3 references are in error. Replace all EP-3 references with EP-1. The finish plans will be updated.
70		PT-5 wall finish designation is used in the restrooms, however, PT-5 on A-701 finish legend is flat black paint to be used above Unistrut in the labs. Please advise.	Finish Plans will be revised to the following: Rooms 101, 103, 113, 115, 129, 131, 201, 203, 213, 215, 229, 231, 301, 303, 313, 315, 329, 331, 401, 403, 413, 415, 429, 431 wall paint is to be PT-1
71		SP-1 flooring is utilized in the large Elevator 3, but is not provided for on A-701 finish legend. Please identify the material.	Finishes for Elevator 3 are to be provided per 14 21 13 Section 2.1.1
73	230923.132	The contract documents do not appear to provide the level of participation required for BAS Controls.What is the level of BIM coordination and participation required for DDC Controls Contractor? Please indicate the minimum trade size conduit, conduit rack system widths devices, panels etc., which will be required by your BIM manager / Contract for BAS controls. Typically we provide the following, "BIM participation as provided by JCI: We will attend weekly coordination meetings with all trades. Drawing of all models in BIM software will be done by others. JCI will provide input and required device dimensions/revits where appropriate."	The type of objects required to be modeled and coordinated are indicated in Vol 1, Section 01 78 25 BIM, Level Of Development (LOD) section. If the object types are specified in the LOD then they must be modeled and coordinated regardless of their size. For instance, see page 591 of the Vol 1 PDF, section D5020.30 Power Distribution, that indicates which types of objects are required and to what Level Of Development they should be modeled. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
74	E-301, E-600A, E-600B	Confirm the equipment tags shown on Drawing E-301 for XFMR B and XFMR A are incorrectly noted and should be switched.	Equipment tags for XFMR "A" and XFMR "B" on drawing E-301 are incorrect, and should be switched. Also, it shall be noted that Switchboard "A" was incorrectly specified on the Switchboard schedule on drawing E-800. Switchboard "A" shall increase in size from 2500A to 3000A.
75	E-600A, E-800	Confirm the circuit designations shown on drawing E-600A are to correspond to the CKT number on Drawing E-800	Circuit numberings on drawing E-600A are to correspond with circuit numbering on drawing E-800.
76	E-600A, E-600B, E-800	Confirm Circuit 29 (designated for a Surge Protective Device) on SWB-B was been moved to SWB - A	The Surge Protective Device (SPD) on circuit 29 of Switchboard "B" has been moved to circuit [redacted] SPD shall be fed from a [redacted] (b) (5) [redacted]
77	E-600B, E-800	Confirm CKT 4 on SWB-C is designated as a space and does not require a 100A Breaker	Circuit number 4 of Switchboard "C" shall be designated as a space with a minimum frame size of 250A per note indicated on Switchboard "C" schedule on drawing E-800.
78	E-600B, E-800	Drawing E-600B indicates a 100A Breaker feeding Panel (b) (5) off Circuit [redacted] Drawing E-800 SWB - C panel schedule indicates a 250A breaker. Which is correct?	Switchboard "C", circuit [redacted] feeding panel (b) (5) shall be 100A frame, 100A trip circuit breaker.
79	E-600B, E-800	Drawing E-600B indicates 25A Breakers feeding [redacted] (b) (5) [redacted] on both circuits [redacted] (b) (5) [redacted] Drawing E-800 SWB - C panel schedule indicates 15A breakers for both of these circuits. Which drawing is shown correctly?	Breakers feeding [redacted] (b) (5) [redacted] shall be 15A trip.
80	E-800	Drawing E-800 (SWB - C) Circuit [redacted] indicates the panel designation to be (b) (5) This should read, [redacted] (b) (5) [redacted] correct?	Panelboard designation shall be [redacted] (b) (5) [redacted]
81	E-600B, E-800	Drawing E-600B indicates a 100A Breaker feeding Panel (b) (5) off Circuit [redacted] Drawing E-800 SWB - C panel schedule indicates a 250A breaker. Which is correct?	Switchboard "C", circuit [redacted] feeding panel (b) (5) shall be 100A frame, 100A trip circuit breaker.
82	E-600B, E-800	Drawing E-800 (SWB - C) Circuit [redacted] indicates a Surge Protective Device circuit designation. E-600B does not indicate this circuit. Please clarify	Switchboard "C" shall not have a Surge Protective Device. Circuit [redacted] shall be provided with 250A frame, 100A trip circuit breaker labeled as spare.
83	E-800	Drawing E-800 does not indicate there is to be a load on circuits 26, 27 and 30. Please verify this is correct.	Switchboard "C"—Circuit 26 load: 17.4kVA, Circuit 27 load: 17.4kVA, Circuit 30 load: 28.3kVA.
84	E-800	Drawing E-800 does not indicate there is to be a load on circuit19. Please verify this is correct.	Switchboard "B"—Circuit 19 load: 22.0kVA
85	70523	Refer to section 3.3.5 of the specifications that states " Hold Excluded Building Areas at the Outdoor Pressure Level". Please confirm the extent of the test envelope and areas of the building that need to be excluded from the air barrier testing.	The test envelope is to include the entire building. No areas of the building are to be excluded from the air barrier testing. Section 3.3.5 will be deleted from 07 05 23.
86		Please confirm if the buiding needs to comply with DOD Minimum Antiterrorism Standards and what the blast mitigation criteria is as there is no information in the contract documents on the ATFP requirements for the project	See response to question #09.
87	A-411	Utility shelves (Toilet Acc. W) are shown in the smaller Janitors closets (119A, 219B, 319B, 419B) per detail 16/A-411. Should a shelf also be included in Janitors Closets 155, 369 and 469?	Yes. Please provide the shelf in Janitors Closets 155, 369, and 469 as well.
88	A-411	Detail 2/A-411. Should the box in the Womens room located opposite from the toilet accessory L in the mens room near the door also be called out as toilet accessory L?	Yes. Please provide the L accessory by the door in both toilet rooms. The L designation along the back wall (column line D.7) should read 'K'. 2/A-411 will be updated.
89		No locations were found for corner guards on the project. Please confirm desired locations.	Corner guards are as indicated in details 8/A-416, and 11 & 12/A521.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
90	A-734	Please confirm the breakout space markerboard shown on detail 9/A-734 occurs only on the 2nd floor.	No. The breakout space 9/A-734, noted on A-712A, occurs in the same stacked location on floors 2, 3, and 4.
91	P-102B	Please show piping to the ES/EW-1 indicated on drawing P-102B at column D19 (or delete the note if it is incorrect)	There is no ES/EW-1 at column D19. Please disregard this text.
92	A-410/ A-411	Toilet accessory 'X' for the sufrace mounted towel bar is not shown on any toilet room elevation. Please advise if this toilet accessory is to be installed, and if so please provide location.	Toilet accessory 'X' is to be installed in each Shower Room - 129 & 131 - along CL E, adjacent to 'T'.
93	A-621	The following rooms are shown on signage schedule A-621 to receive type K signs, which are designated for stairs. This appears to be in error, please advise on the correct sign type for these rooms: 457, 461, 463, 465, 469, 471, 473, 475, 479	Rooms 457, 461, 463, 465, 469, 471, 473, 475, & 479 are to receive sign type E. Sign type K was indicated in error.
94	A-601, A-602, A-603	Door schedules on A-601, A-602, A-603 list several HM door frames, however no spec is provided. Please provide.	See Steel Doors and Frames - 08 11 13.
95	A-601	Door schedule on A-601 lists door 107C-A and 107C-B as "frameless" frame type. Detail 13 A-603 offers information. Please provide additonal information (spec, additional details, etc).	See Door Hardware - 08 71 00 Section 3.5.
96	A-601	The first row of the door schedule on A-601 is incomplete. There is no door number, room name, door type, frame type, fire rating, details, or hardware group. However, other cells are completed. Please provide.	Kindly disregard this row - it was included in error.
99	E-600B, E-600C, E-600A	General note 5 on drawings E-600B and E-600C are currently located in a position that makes the note unreadable. Please reposition note 5 or confirm that the verbiage remains the same as note 5 on drawing E-600A	General note 5 shall be repositioned. For drawings E-600A, E-600B, and E-600C, General Note 5 shall read as follows: PER NEC ARTICLE 701, LEGALLY REQUIRED STAND-BY SYSTEMS AND THE LIFE SAFETY SYSTEM ANALYSIS FOR THIS PROJECT, 701.2 DEFINITIONS, AECOM HAS DEFINED THE "EMERGENCY SYSTEMS" FOR MSL AS THOSE SERVING THE FOLLOWING: [redacted] (b) (5) [redacted]
100	04200, S-501/18, S-502/11	The architectural elevations and Detail 18 on S-501 call for a cast stone veneer at the base of the structure. The key on the elevations and detail 11 on S-502 call for Granite. There is no specification for Granite. Please confirm that all locations where granite is called for on site is to be cast stone	See response to #53.
101	A-521	Are the only locations for the corner guards to be at the columns as shown in details 11, 12 on A-521?	See response to #89.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
102	A-521	Please clarify if the wings of the corner guards should be 2" as per the specifications or 3 1/2" per the drawings? Also the specifications appear to require corner guards to color match adjacent walls where the drawings show them to be stainless steel - please advise.	The corner guards are to be 3 1/2" stainless steel.
103		Deduct Option #2 requests for a price to delete Terrazzo stair treads/risers. What material should we assume will replace the terrazzo? Or will it be assumed to be bare/sealed concrete?	See 01 23 60 section 3.1
104	A-105A	A single leaf door at Column Line 7, south of column line H.2 does not have a door tag. Please provide additional information on this door.	Door south of CL H.2. at CL 7 is to be a swinging door/gate in the screenwall - it is to match the finish and construction of the adjacent screenwall.
105	A-472,A-410	Detail 12/A-472 indicates a stainless steel shelf in the restrooms. Details 11/410 and 10/410 show the elevation, but no lengths are indicated. 1/A-410 does show a dashed line above the toilets and urinal, please confirm this is the stainless steel shelf.	See 2/ A-410 tag 'Z'.
110		The contract documents do not appear to provide the level of BIM participation required for BAS Controls.What is the level of BIM coordination and participation required for DDC Controls Contractor? Please indicate the minimum trade size conduit, conduit rack system widths devices, panels etc., which will be required by your BIM manager / Contract for BAS controls. Typically we provide the following, "BIM participation as provided by JCI: We will attend weekly coordination meetings with all trades. Drawing of all models in BIM software will be done by others. JCI will provide input and required device dimensions/revits where appropriate."	See response to question #73.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0007	06/03/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0007

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 3 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0007.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. The NASA LOI Level of Information Specification is incorporated with this amendment.

4. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
09	08 11 16	Specification section 08 11 16 references [redacted] (b) (5) [redacted] for Blast Resistant Glazing. Could you tell us the standoff distance? Level of protection? Is this project subject to DOD requirement and if so, what version?	Per GSA/NASA direction, this project is not subject to DOD requirements. It is following the Interagency Security Committee (ISC) Standard, Physical Security Criteria for Federal Facilities dated 4/12/2010. The project has been designated as Facility Security Level (b) (5) Low Level of Protection.

NASA
LOI
LEVEL OF INFORMATON SPECIFICATION

For:
B2104
MEASUREMENT SYSTEMS LABORATORY
NASA LANGLEY RESEARCH CENTER, HAMPTON, VA

Developed by
NAS LaRC GIS Team, COD

This NASA **LOI** narrows the extent of required product asset types and components to be provided in the COBie Type, Component, and Document tables as specified in Division One Section 01 79 00 CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE of this contract.

The "COBie Product Assets in Scope" sheet of this workbook lists all product asset types by OmniClass number that NASA is interested in tracking for Operation and Maintenance purposes for all projects. For your convenience NASA has highlighted in green product asset types that NASA anticipates will be included in this specific project:

B2104 Measurement Systems Laboratory (MSL)

However, the contractor is ultimately responsible for including any product asset types not currently highlighted in green, or components of this product asset types which become added to the project scope as the design and construction of the project progresses or as a result of a modification or amendment to the construction contract.

Each of these highlighted product asset types has a corresponding sheet named by the NASA product asset type 3 letter prefix. Within each of these sheets each component of the product asset type and the precise information that NASA wishes to be added to it within the source Revit Families and mapped to the COBie schema is listed. Any columns/fields currently not populated within these sheets are those which the Contractor must populate throughout construction. Any columns field currently populated already are those which reflect the product asset information in the construction documents. The contractor is responsible to update any of the prepopulated product asset information that changes or is added to the project scope as the design and construction of the project progresses or as a result of a modification or amendment to the construction contract.

Example:
COBie product Asset 23-17 11 13 25 is "Overhead Metal Doors." Within the DOR sheet you will find the product assets listed with this OmniClass number. Row 3 of the table lists the description for each required Revit Family parameter, and the row 2 of the table lists the corresponding required COBie schema table and column location. Note that is not necessary to name the Revit Family parameters as they are named in this LOI document. However, if a different naming of parameters is used, the Contractor must provide a mapping table which maps the alternate Revit Shared Parameters to the Parameters specified in this document.

	A	B	C	D	E	F	G	H	I	J	K
1		Equipment Record Data Fields NASA Form 491				MSL Asset Specs					
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.manufacturer	type.modelnumber
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	MANUFACTURER	CL_MODELNUM
4	Assets	1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00641	29300261	DOOR/POWER ASSIST (RM-170E)		
5		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00642	29300262	DOOR/POWER ASSIST (RM-169)		
6		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00643	29300263	DOOR/POWER ASSIST (RM-163)		
7		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00644	29300264	DOOR/POWER ASSIST (RM-163)		
8		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00645	29300265	DOOR/POWER ASSIST (SOUTHEAST ENTRANCE)		
9		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00646	29300266	DOOR/POWER ASSIST (SOUTHWEST ENTRANCE)		
10		1013	DOOR	23-17 21 15 11 13	08 34 19 10 20	2104	DOR00647	29300267	DOOR/FIRE/ACCORDIAN (STR 1 LEVEL 1)		
11		1013	DOOR	23-17 21 15 11 13	08 34 19 10 20	2104	DOR00648	29300268	DOOR/FIRE/ACCORDIAN (STR 1 LEVEL 2)		
12		1013	DOOR	23-17 21 15 11 13	08 34 19 10 20	2104	DOR00649	29300269	DOOR/FIRE/ACCORDIAN (STR 1 LEVEL 3)		
13		1013	DOOR	23-17 21 15 11 13	08 34 19 10 20	2104	DOR00650	29300270	DOOR/FIRE/ACCORDIAN (STR 1 LEVEL 4)		

If there is an asset and corresponding OmniClass number that you cannot find on one of the tabs, contact NASA to provide that specific information to you.

Information captured as specified in this document shall be in accordance with the corresponding master spec technical division section of this contract. For your convenience we have added a master spec section cross reference column labeled "Master Spec ID."

Populated attributes for product asset specification, such as "Fan Speed", "Volume" are required either exactly as specified, or as an equivalent attribute. If equivalent attributes will be provided, the Contractor must provide a mapping table to show how their equivalent attributes map to the required attributes.

At a COBie deliverable milestone to be specified in the project schedule, the contractor must transform all product asset information specified in this LOI document into a COBie compliant format both in the source Revit model and in the exported Microsoft Excel file. Product asset information specified in this LOI document shall not be the extent of the entire COBie data set that is required but instead should be included as part of the larger COBie data set required in this contract.

This Document was Created by Errol Plata and Barry Danforth of NASA LaRC's COD.

2010-06-24 OmniClass Number	2010-06-24 OmniClass Level	2010-06-24 OmniClass Title	Currently Tracked (Yes/No)	Included in This Project (Yes/No)	Comment
23-11 23 19	Level 3	Parking Gates	n		
23-11 25 15	Level 3	Perimeter Gates	n		
23-11 25 15 11	Level 4	Drop Arm Gates	n		
23-11 25 15 11 11	Level 5	Anti Ram Drop Arm Gates	n		
23-11 25 15 13	Level 4	Rolling Gates	n		
23-11 25 15 15	Level 4	Sliding Gates	n		
23-11 25 15 15 11	Level 5	Anti Ram Sliding Gates	n		
23-11 25 15 15 13	Level 5	Anti Climb Sliding Gates	n		
23-11 25 15 17	Level 4	Swinging Gates	n		
23-11 25 15 19	Level 4	Folding Gates	n		
23-11 29 35	Level 3	Bollards	y		
23-11 29 35 11	Level 4	Active Anti Ram Bollards	n		
23-11 29 35 13	Level 4	Passive Anti Ram Bollards	n		
23-11 29 35 15	Level 4	Architectural Bollards	n		
23-13 39 00	Level 2	Roof Coverings, Claddings, Linings	y		
23-13 41 17	Level 3	Roof Vents	n		
23-13 41 17 11	Level 4	Roof Relief Vents	n		
23-13 41 17 13	Level 4	Roof Ridge Vents	n		
23-13 41 17 15	Level 4	Roof Smoke Vents	y		
23-13 41 17 17	Level 4	Gravity Roof Vents	n		
23-13 41 17 19	Level 4	Automatic Roof Vents	n		
23-13 41 17 21	Level 4	Fire Vents	y		
23-15 11 17	Level 3	Operable Partitions	n		
23-15 11 17 11	Level 4	Horizontally Sliding Partitions	n		
23-15 11 17 13	Level 4	Folding Panel Partitions	n		
23-15 11 17 15	Level 4	Accordion Folding Partitions	n		
23-15 11 17 17	Level 4	Coiling Partitions	n		
23-15 11 17 19	Level 4	Vertically Sliding Room Dividers	n		
23-17 11 13 19	Level 4	Sliding Metal Doors	n		
23-17 11 13 21	Level 4	Folding Metal Doors	n		
23-17 11 13 23	Level 4	Revolving Metal Doors	n		
23-17 11 13 25	Level 4	Overhead Metal Doors	y		
23-17 11 15 25	Level 4	Sliding Wood Doors	n		
23-17 11 15 27	Level 4	Folding Wood Doors	n		
23-17 11 15 29	Level 4	Revolving Wood Doors	n		
23-17 11 15 31	Level 4	Overhead Wood Doors	n		
23-17 11 15 31 11	Level 5	Roller Shutter Overhead Wood Doors	n		
23-17 11 15 31 13	Level 5	Sectional Overhead Wood Doors	n		
23-17 11 19 11	Level 4	Fiberglass Composite Doors	n		
23-17 11 19 15	Level 4	Folding Composite Doors	n		
23-17 11 19 19	Level 4	Revolving Composite Doors	n		
23-17 11 19 21	Level 4	Overhead Composite Doors	y		
23-17 11 19 21 11	Level 5	Roller Shutter Overhead Composite Doors	y		
23-17 11 19 21 13	Level 5	Sectional Overhead Composite Doors	y		
23-17 11 23 19	Level 4	Revolving All Glass Doors	n		
23-17 11 31	Level 3	Fire Doors	y		
23-17 11 31 11	Level 4	Fire Rated Doors	y		
23-17 11 31 11 11	Level 5	Fire Rated Overhead Doors	y		
23-17 11 31 11 13	Level 5	Fire Rated Rolling Doors	y		
23-17 11 31 11 15	Level 5	Fire Rated Hinged Doors	y		
23-17 11 31 11 17	Level 5	Fire Rated Hinged Doors	y		
23-17 11 31 11 19	Level 5	Fire Rated Revolving Doors	y		
23-17 11 33	Level 3	Temperature Rate of Rise Fire Rated Doors	y		

23-17 11 33 11	Level 5	Temperature Rate of Rise Fire Rated Overhead Doors	y		
23-17 11 33 13	Level 5	Temperature Rate of Rise Fire Rated Rolling Doors	y		
23-17 11 33 15	Level 5	Temperature Rate of Rise Fire Rated Sliding Doors	y		
23-17 11 33 17	Level 5	Temperature Rate of Rise Fire Rated Hinged Doors	y		
23-17 11 33 19	Level 5	Temperature Rate of Rise Fire Rated Revolving Doors	y		
23-17 11 35	Level 3	Fire Shutters	y		
23-17 21 15	Level 3	Fire and Smoke Shutters and Curtains	y		
23-17 21 15 11	Level 4	Fire Shutters	y		
23-17 21 15 11 11	Level 5	Vertical Fire Shutters	y		
23-17 21 15 11 13	Level 5	Horizontal Fire Shutters	y		
23-17 21 15 13	Level 4	Smoke Curtains	y		
23-17 21 15 13 11	Level 5	Water Spray Smoke Curtains	y		
23-17 21 15 15	Level 4	Smoke Shutters	y		
23-19 29 11 27	Level 4	Portable Buildings	n		
23-19 29 11 29	Level 4	Mobile Buildings	n		
23-19 29 17	Level 4	Building Modules (Prefab Factory Made Shipped to Site)	n		
23-19 31 00	Level 2	Room Units (Prefab Factory Made Shipped to Site)	n		Prefabricated rooms ready for placement on
23-19 31 11	Level 3	General Purpose Room Units	n		
23-19 31 11 11	Level 4	Prefabricated General Purpose Rooms	n		
23-19 31 13	Level 3	Storage Room Units	n		
23-19 31 15	Level 3	Special Purpose Rooms	n		
23-19 31 15 11	Level 4	Athletic Rooms	n		
23-19 31 15 11 11	Level 5	Handball Racquetball Courts	n		
23-19 31 15 13	Level 4	Conservatories	n		
23-19 31 15 13 11	Level 5	Solarium Specialties	n		
23-19 31 15 15	Level 4	Planetariums	n		
23-19 31 15 17	Level 4	Saunas	n		
23-19 31 15 19	Level 4	Steam Baths	n		
23-19 31 17	Level 3	Sanitary Room Units	n		
23-19 31 17 11	Level 4	Bathroom Units	n		
23-19 31 17 13	Level 4	Lavatory Units	n		
23-19 31 19	Level 3	Controlled Environment Rooms	n		
23-19 31 19 11	Level 4	Clean Rooms	n		
23-19 31 19 13	Level 4	Insulated Rooms	n		
23-19 31 19 13 11	Level 5	Cold Storage Rooms	n		
23-19 31 19 15	Level 4	Sound Conditioned Rooms	n		
23-19 31 19 15 11	Level 5	Practice Booths	n		
23-19 31 19 17	Level 4	Hyperbaric Rooms	n		
23-19 31 19 19	Level 4	Radiation Protected Rooms	n		
23-19 31 19 19 11	Level 5	Electromagnetic Shielded Rooms	n		
23-19 31 19 19 13	Level 5	RF Shielded Rooms	n		
23-19 31 19 19 13	Level 5	RF Shielded Rooms	n		
23-19 31 19 19 15	Level 5	BO Shielded Rooms	n		
23-19 31 19 19 17	Level 5	Radio Frequency Protected Rooms	n		
23-19 31 19 19 19	Level 5	X Ray Protected Rooms	n		
23-19 31 19 19 21	Level 5	Nuclear Radiation Protected Rooms	n		
23-19 31 19 19 23	Level 5	High Energy Magnetic Pulse Protected Rooms	n		
23-21 21 00	Level 2	Food Service Equipment and Furnishings	n		
23-21 21 11	Level 3	Commercial Food Services Cabinets	n		
23-21 21 11 11	Level 4	Commercial Hot Cabinets	n		
23-21 21 11 13	Level 4	Commercial Cold Cabinets	n		
23-21 21 11 15	Level 4	Commercial Combination Hot Cold Cabinets	n		
23-21 21 11 17	Level 4	Commercial Pastry Cabinets	n		
23-21 21 11 19	Level 4	Commercial Warming Cabinets	n		
23-21 21 11 21	Level 4	Commercial Snack Cabinets	n		
23-21 21 13	Level 3	Commercial Food Cooking Equipment	n		

23-21 21 13 11	Level 4	Commercial Bain Maries	n		
23-21 21 13 13	Level 4	Commercial Beverage Equipment	n		
23-21 21 13 13 11	Level 5	Commercial Coffee Makers	n		
23-21 21 13 13 13	Level 5	Commercial Coffee Warmers	n		
23-21 21 13 13 15	Level 5	Commercial Iced Tea Makers	n		
23-21 21 13 15	Level 4	Commercial Broilers	n		
23-21 21 13 15 11	Level 5	Commercial Steam Broilers	n		
23-21 21 13 15 13	Level 5	Commercial Infra Red Broilers	n		
23-21 21 13 15 15	Level 5	Commercial Gas Broilers	n		
23-21 21 13 17	Level 4	Commercial Food Cookers	n		
23-21 21 13 17 11	Level 5	Commercial Food Induction Cookers	n		
23-21 21 13 17 13	Level 5	Commercial Pasta Cookers	n		
23-21 21 13 17 15	Level 5	Commercial Food Pressure Cookers	y		
23-21 21 13 17 17	Level 5	Commercial Rice Cookers	n		
23-21 21 13 19	Level 4	Commercial Crepe Machines	n		
23-21 21 13 21	Level 4	Commercial Fryers	n		
23-21 21 13 21 11	Level 5	Commercial Deep Fryers	n		
23-21 21 13 21 13	Level 5	Commercial Pressure Fryers	n		
23-21 21 13 23	Level 4	Commercial Frying Pans	n		
23-21 21 13 23 11	Level 5	Commercial Tilting Frying Pans	n		
23-21 21 13 25	Level 4	Commercial Griddles	n		
23-21 21 13 27	Level 4	Commercial Grills	n		
23-21 21 13 27 11	Level 5	Commercial Barbecue Grills	n		
23-21 21 13 27 13	Level 5	Commercial Char Broiler Grills	n		
23-21 21 13 27 15	Level 5	Commercial Hot Dog Grills	n		
23-21 21 13 29	Level 4	Commercial Kettles	n		
23-21 21 13 29 11	Level 5	Commercial Poacher Kettles	y		
23-21 21 13 29 13	Level 5	Commercial Salmon Kettles	y		
23-21 21 13 31	Level 4	Commercial Ovens	y		
23-21 21 13 31 11	Level 5	Commercial Barbeque Ovens	y		
23-21 21 13 31 13	Level 5	Commercial Combination Convection Ovens	y		
23-21 21 13 31 15	Level 5	Commercial Convection Ovens	y		
23-21 21 13 31 17	Level 5	Commercial Microwave Ovens	y		
23-21 21 13 31 19	Level 5	Commercial Pastry Ovens	y		
23-21 21 13 31 21	Level 5	Commercial Pizza Ovens	y		
23-21 21 13 31 23	Level 5	Commercial Proofer Ovens	y		
23-21 21 13 31 25	Level 5	Commercial Smoker Ovens	y		
23-21 21 13 33	Level 4	Commercial Popcorn Machines	y		
23-21 21 13 35	Level 4	Commercial Rotisseries	y		
23-21 21 13 39	Level 4	Commercial Food Steamers	y		
23-21 21 13 39 11	Level 5	Commercial High Pressure Food Steamer	y		
23-21 21 13 41	Level 4	Commercial Skillets	y		
23-21 21 13 41 11	Level 5	Commercial Tilt Skillets	y		
23-21 21 13 43	Level 4	Commercial Stoves	y		
23-21 21 13 45	Level 4	Commercial Toasters	y		
23-21 21 13 45 11	Level 5	Commercial Toaster Conveyors	y		
23-21 21 13 47	Level 4	Commercial Waffle Irons	y		
23-21 21 13 49	Level 4	Commercial Small Specialized Cooking Equipment	y		
23-21 21 15	Level 3	Commercial Food Services Warming Equipment	y		
23-21 21 15 11	Level 4	Commercial Food Warmers	y		
23-21 21 15 13	Level 4	Commercial Food Warmer Stations	y		
23-21 21 15 15	Level 4	Commercial Hot Plates	y		
23-21 21 15 17	Level 4	Commercial Steam Tables	y		
23-21 21 17	Level 3	Commercial Food Services Cooling Equipment	y		
23-21 21 17 11	Level 4	Commercial Refrigerated Tables	y		
23-21 21 19	Level 3	Commercial Dishwasher Equipment	y		

23-21 21 19 11	Level 4	Commercial Dishwashers	y		
23-21 21 19 11 11	Level 5	Commercial Steam Dishwashers	y		
23-21 21 19 11 13	Level 5	Commercial Dishwasher Conveyors	y		
23-21 21 19 11 15	Level 5	Commercial Dishwasher Tray Conveyors	y		
23-21 21 21	Level 3	Commercial Food Disposal Equipment	y		
23-21 21 21 11	Level 4	Commercial Waste Disposal Units	y		
23-21 21 21 13	Level 4	Commercial Garbage Disposals	y		
23-21 21 21 15	Level 4	Commercial Garbage Pulpers	y		
23-21 21 23	Level 3	Commercial Food Display Equipment	y		
23-21 21 25	Level 3	Commercial Food and Beverage Dispensing Equipment	y		
23-21 21 25 11	Level 4	Commercial Soda Fountain Equipment	y		
23-21 21 25 13	Level 4	Commercial Bottled Water Dispensers	y		
23-21 21 25 15	Level 4	Commercial Bowl and Plate Dispensers	y		
23-21 21 25 17	Level 4	Commercial Bread Dispensers	y		
23-21 21 25 19	Level 4	Commercial Cappuccino or Espresso Dispensers	y		
23-21 21 25 21	Level 4	Commercial Carbonated Beverage Dispensers	y		
23-21 21 25 23	Level 4	Commercial Coffee Dispensers	y		
23-21 21 25 25	Level 4	Commercial Condiment Dispensers	y		
23-21 21 25 27	Level 4	Commercial Cream Dispensers	y		
23-21 21 25 29	Level 4	Commercial Cup Dispensers	y		
23-21 21 25 31	Level 4	Commercial Cup and Saucer Dispensers	y		
23-21 21 25 33	Level 4	Commercial Bubbler Dispensers	y		
23-21 21 25 35	Level 4	Commercial Drinking Glass Dispensers	y		
23-21 21 25 37	Level 4	Commercial Flatware Dispensers	y		
23-21 21 25 39	Level 4	Commercial Hot Chocolate Dispensers	y		
23-21 21 25 41	Level 4	Commercial Hot Water Dispensers	y		
23-21 21 25 43	Level 4	Commercial Ice Cream Dispensers	y		
23-21 21 25 45	Level 4	Commercial Milk Dispensers	y		
23-21 21 25 47	Level 4	Commercial Milkshake Dispensers	y		
23-21 21 25 49	Level 4	Commercial Non Carbonated Beverage Dispensers	y		
23-21 21 25 49 11	Level 5	Commercial Refrigerated Non Carbonated Beverage Dispensers	y		
23-21 21 25 51	Level 4	Commercial Plate Dispensers	y		
23-21 21 25 53	Level 4	Commercial Saucer Dispensers	y		
23-21 21 25 55	Level 4	Commercial Slush Dispensers	y		
23-21 21 25 57	Level 4	Commercial Soft Serve Ice Cream Dispensers	y		
23-21 21 25 59	Level 4	Commercial Syrup Pump Dispensers	y		
23-21 21 25 61	Level 4	Commercial Tray Dispensers	y		
23-21 21 25 63	Level 4	Commercial Water Filter System	y		
23-21 21 25 65	Level 4	Commercial Filtration Equipment	y		
23-21 21 27	Level 3	Commercial Refrigerators And Freezers	y		
23-21 21 27 11	Level 4	Commercial Blast Chillers	y		
23-21 21 27 13	Level 4	Commercial Freezers	y		
23-21 21 27 13 11	Level 5	Commercial Blast Freezers	y		
23-21 21 27 13 13	Level 5	Commercial Chest Freezers	y		
23-21 21 27 13 15	Level 5	Commercial Flammable Liquid Freezers	y		
23-21 21 27 13 17	Level 5	Commercial Freeze Drying Equipment	y		
23-21 21 27 13 19	Level 5	Commercial Plate Freezers	y		
23-21 21 27 13 21	Level 5	Commercial Sub Zero Freezers	y		
23-21 21 27 13 23	Level 5	Commercial Upright Freezers	y		
23-21 21 27 13 25	Level 5	Commercial Upright Reach In Freezers	y		
23-21 21 27 13 27	Level 5	Commercial Upright Pass Through Freezers	y		
23-21 21 27 13 29	Level 5	Commercial Upright Roll In Freezers	y		
23-21 21 27 13 31	Level 5	Commercial Walk In Freezers	y		
23-21 21 27 15	Level 4	Commercial Refrigerators	y		
23-21 21 27 15 11	Level 5	Commercial Flammable Liquid Refrigerators	y		
23-21 21 27 15 13	Level 5	Commercial Liquid Nitrogen Refrigerators	y		

23-21 21 27 15 15	Level 5	Commercial Refrigerated Containers	y		
23-21 21 27 15 17	Level 5	Commercial Refrigerated Tanks	y		
23-21 21 27 15 19	Level 5	Commercial Refrigerated Vessels	y		
23-21 21 27 15 21	Level 5	Commercial Upright Refrigerators	y		
23-21 21 27 15 23	Level 5	Commercial Upright Reach In Refrigerators	y		
23-21 21 27 15 25	Level 5	Commercial Upright Pass Through Refrigerators	y		
23-21 21 27 15 27	Level 5	Commercial Upright Roll In Refrigerators	y		
23-21 21 27 15 29	Level 5	Commercial Walk In Refrigerators	y		
23-21 21 27 17	Level 4	Commercial Refrigerator Freezers	y		
23-21 21 27 19	Level 4	Commercial Food Storage Coolers	y		
23-21 21 27 19 11	Level 5	Commercial Walk In Coolers	y		
23-21 21 29	Level 3	Commercial Ice Machines	y		
23-21 21 29 11	Level 4	Commercial Block Ice Makers	y		
23-21 21 29 13	Level 4	Commercial Cube Ice Makers	y		
23-21 21 29 15	Level 4	Commercial Flaker Ice Makers	y		
23-21 21 29 17	Level 4	Commercial Ice Dispensers	y		
23-21 21 29 19	Level 4	Commercial Ice Shaver Dispensers	y		
23-21 21 29 21	Level 4	Commercial Ice Maker Bins	y		
23-21 21 31	Level 3	Commercial Food Preparation Equipment	y		
23-21 21 31 11	Level 4	Commercial Food Mixers	y		
23-21 21 31 13	Level 4	Commercial Food Peelers	y		
23-21 21 31 15	Level 4	Commercial Food Processors	y		
23-21 21 31 17	Level 4	Commercial Food Service Stations	y		
23-21 21 31 19	Level 4	Commercial Food Slicers	y		
23-21 21 31 19 11	Level 5	Commercial Electric Food Slicers	y		
23-21 21 31 19 13	Level 5	Commercial Mechanical Food Slicers	y		
23-21 21 31 23	Level 4	Commercial Drink Making Equipment	y		
23-21 21 39	Level 3	Commercial Food Service Delivery Equipment	y		
23-21 21 39 11	Level 4	Commercial Food Delivery Conveyors	y		
23-21 21 39 13	Level 4	Commercial Food Delivery Carts	y		
23-21 21 39 15	Level 4	Commercial Restaurant Turntables	y		
23-21 21 41	Level 3	Commercial Food Service Ventilation Equipment	y		
23-21 21 41 11	Level 4	Commercial Food Hood Equipment	y		
23-21 21 41 11 11	Level 5	Commercial Food Service Hoods	y		
23-21 21 41 13	Level 4	Commercial Food Ventilation Equipment	y		
23-21 21 41 13 11	Level 5	Commercial Food Ventilation Fire Suppression Systems	y		
23-21 21 41 13 13	Level 5	Commercial Catering Ventilation	y		
23-21 21 43	Level 3	Commercial Food Processing Equipment	y		
23-21 21 45	Level 3	Commercial Food Weighing Equipment	y		
23-21 21 47	Level 3	Commercial Food Wrapping Equipment	y		
23-21 25 15 11	Level 4	Planetarium Projectors	n		
23-21 25 17 11	Level 4	Telescopes	n		
23-21 25 21 11	Level 4	Library Stack Systems	n		
23-21 29 15 11	Level 4	Bowling Alley Equipment	n		
23-21 29 15 19	Level 4	Scoreboard	n		
23-21 29 19 17	Level 4	Sauna Equipment	n		
23-21 29 19 19	Level 4	Steam Room Equipment	n		
23-21 29 19 21	Level 4	Shooting Range Equipment	n		
23-21 29 19 23	Level 4	Swimming Pool Equipment	n		
23-21 29 21	Level 3	Pools	n		
23-21 29 21 11	Level 4	Leisure Whirlpools	n		
23-21 29 21 13	Level 4	Hot Tubs	n		
23-21 29 21 15	Level 4	Swimming Pools	n		
23-21 29 21 17	Level 4	Lap Pools	n		
23-21 39 00	Level 2	Commercial Washing and Waste Disposal Equipment	n		
23-21 39 11	Level 3	Commercial Washing Equipment	n		

23-21 39 11 11	Level 4	High Pressure Washing Equipment	n		
23-21 41 00	Level 2	Commercial Laundry Equipment	n		
23-21 41 11	Level 3	Commercial Clothes Airers	n		
23-21 41 11 11	Level 4	Commercial Clothes Dryers	n		
23-21 41 11 13	Level 4	Commercial Clothes Stands	n		
23-21 41 11 15	Level 4	Commercial Clothes Lines	n		
23-21 41 13	Level 3	Commercial Combination Laundry Washer Dryers	n		
23-21 41 15	Level 3	Commercial Dry Cleaning Equipment	n		
23-21 41 17	Level 3	Commercial Laundry Dispensers	n		
23-21 41 17 11	Level 4	Commercial Dry Laundry Detergent Dispensers	n		
23-21 41 17 13	Level 4	Commercial Liquid Laundry Detergent Dispensers	n		
23-21 41 17 15	Level 4	Commercial Dryer Sheet Dispensers	n		
23-21 41 19	Level 3	Commercial Dry Cleaning Machines	n		
23-21 41 21	Level 3	Commercial Laundry Extractors	n		
23-21 41 23	Level 3	Commercial Flat Work Ironers	n		
23-21 41 23 11	Level 4	Commercial Electric Flat Work Ironers	n		
23-21 41 23 13	Level 4	Commercial Gas Flat Work Ironers	n		
23-21 41 23 15	Level 4	Commercial Steam Flat Work Ironers	n		
23-21 41 25	Level 3	Commercial Ironing and Pressing Machines	n		
23-21 41 27	Level 3	Commercial Laundry Folding Machines	n		
23-21 41 29	Level 3	Commercial Laundry Conveyors	n		
23-21 41 31	Level 3	Commercial Laundry Dryers	n		
23-21 41 31 11	Level 4	Commercial Electric Laundry Dryers	n		
23-21 41 31 13	Level 4	Commercial Gas Laundry Dryers	n		
23-21 41 31 15	Level 4	Commercial Steam Laundry Dryers	n		
23-21 41 33	Level 3	Commercial Laundry Presses	n		
23-21 41 33 11	Level 4	Commercial Electric Laundry Presses	n		
23-21 41 33 13	Level 4	Commercial Gas Laundry Presses	n		
23-21 41 33 15	Level 4	Commercial Steam Laundry Presses	n		
23-21 41 35	Level 3	Commercial Laundry Spreader Feeders	n		
23-21 41 37	Level 3	Commercial Laundry Steam Tunnels	n		
23-21 41 39	Level 3	Commercial Laundry Tubs	n		
23-21 41 41	Level 3	Commercial Washing Machines	n		
23-21 41 41 11	Level 4	Commercial Front Loading Laundry Washers	n		
23-21 41 41 13	Level 4	Commercial Side Loading Laundry Washers	n		
23-21 41 41 15	Level 4	Commercial Top Loading Laundry Washers	n		
23-21 41 41 17	Level 4	Commercial Tunnel Laundry Washers	n		
23-23 00 00	Level 1	Conveying Systems and Material Handling Products	y		
23-23 11 00	Level 2	Vertical Transportation Equipment	y		
23-23 11 11	Level 3	Elevators	y		
23-23 11 11 11	Level 4	Traction Elevators	y		
23-23 11 11 11 11	Level 5	Freight Traction Elevators	y		
23-23 11 11 11 13	Level 5	Passenger Traction Elevators	y		
23-23 11 11 11 17	Level 5	Service Traction Elevators	y		
23-23 11 11 13	Level 4	Hydraulic Elevators	y		
23-23 11 11 13 11	Level 5	Freight Hydraulic Elevators	y		
23-23 11 11 13 13	Level 5	Passenger Hydraulic Elevators	y		
23-23 11 11 13 15	Level 5	Residential Hydraulic Elevators	y		
23-23 11 11 13 17	Level 5	Service Hydraulic Elevators	y		
23-23 11 11 15	Level 4	Pneumatic Elevators	y		
23-23 11 11 15 11	Level 5	Pneumatic Passenger Elevators	y		
23-23 11 11 17	Level 4	Rack and Pinion Elevators	y		
23-23 11 11 19	Level 4	Elevator Cabs	y		
23-23 11 11 21	Level 4	Elevator Equipment and Controls	y		
23-23 11 11 21 11	Level 5	Elevator Doors	y		
23-23 11 11 21 13	Level 5	Elevator Controls	y		

23-23 11 13	Level 4	Escalators	y		
23-23 13 00	Level 2	Lifting Equipment	y		
23-23 13 11	Level 3	Lifts	y		
23-23 13 11 11	Level 4	Boom Lifts	y		
23-23 13 11 13	Level 4	Fork Lifts	y		
23-23 13 11 15	Level 4	Man Lifts	y		
23-23 13 11 17	Level 4	Patient Lifts	y		
23-23 13 11 17 11	Level 5	Installed Patient Lifts	y		
23-23 13 11 17 13	Level 5	Portable Patient Lifts	y		
23-23 13 11 19	Level 4	Platform Lifts	y		
23-23 13 11 19 11	Level 5	Elevating Platform Lifts	y		
23-23 13 11 19 13	Level 5	Inclined Platform Lifts	y		
23-23 13 11 19 15	Level 5	Scissor Platform Lifts	y		
23-23 13 11 21	Level 4	Scaffold Lifts	y		
23-23 13 11 23	Level 4	Stage Screen Lifts	y		
23-23 13 11 25	Level 4	Wheel Chair Lifts	y		
23-23 13 11 25 11	Level 5	Hydraulic Wheel Chair Lifts	y		
23-23 13 11 25 11 11	Level 6	Hydraulic Wheel Chair Rail Lifts	y		
23-23 13 11 25 11 13	Level 6	Hydraulic Wheel Chair Stair Lifts	y		
23-23 13 11 25 11 15	Level 6	Hydraulic Wheel Chair Vertical Lifts	y		
23-23 13 11 25 13	Level 5	Mechanical Wheel Chair Lifts	y		
23-23 13 11 25 13 11	Level 6	Mechanical Wheel Chair Rail Lifts	y		
23-23 13 11 25 13 13	Level 6	Mechanical Wheel Chair Stair Lifts	y		
23-23 13 11 25 13 15	Level 6	Mechanical Wheel Chair Vertical Lifts	y		
23-23 15 00	Level 2	Horizontal Transportation Equipment	y		
23-23 15 11	Level 3	Moving Walks	n		
23-23 15 13	Level 3	People Movers	n		
23-23 15 13 11	Level 4	Monorails	n		
23-23 15 13 13	Level 4	Duorails	n		
23-23 15 13 15	Level 4	Maglevs	n		
23-23 15 15	Level 3	Jetways	n		
23-23 15 17	Level 3	Transportation Gangways	n		
23-23 17 00	Level 2	Materials Handling	y		
23-23 17 11	Level 3	Dumbwaiters	y		
23-23 17 11 11	Level 4	Manual Dumbwaiters	y		
23-23 17 11 13	Level 4	Hydraulic Dumbwaiters	y		
23-23 17 11 15	Level 4	Traction Dumbwaiters	y		
23-23 17 13	Level 3	Material Transport	y		
23-23 17 13 11	Level 4	Automated Document Filing and Retrieval	n		
23-23 17 13 13	Level 4	Automated Guided Vehicles	n		
23-23 17 13 13 11	Level 5	Guided Vehicle Material Handling	y		
23-23 17 13 13 13	Level 5	Track Vehicle Material Handling	y		
23-23 17 21	Level 3	Pneumatic Tube Systems	y		
23-23 17 21 11	Level 4	Pneumatic Tubes	y		
23-23 17 21 13	Level 4	Pneumatic Tube Controls	y		
23-23 17 21 15	Level 4	Pneumatic Tube Vacuum Boxes	y		
23-23 17 21 17	Level 4	Document Conveying Systems	y		
23-23 17 23	Level 3	Cranes	y		
23-23 17 23 11	Level 4	Hydraulic Cranes	y		
23-23 17 23 11 11	Level 5	Hydraulic Bridge Cranes	y		
23-23 17 23 11 11 11	Level 6	Top Running Hydraulic Overhead Cranes	y		
23-23 17 23 11 11 13	Level 6	Underslung Hydraulic Overhead Cranes	y		
23-23 17 23 11 13	Level 5	Hydraulic Gantry Cranes	y		
23-23 17 23 11 15	Level 5	Hydraulic Jib Cranes	y		
23-23 17 23 11 17	Level 5	Hydraulic Mobile Cranes	y		
23-23 17 23 11 19	Level 5	Hydraulic Terrain Cranes	y		

23-23 17 23 11 21	Level 5	Hydraulic Top Running Overhead Cranes	y		
23-23 17 23 11 23	Level 5	Hydraulic Tower Cranes	y		
23-23 17 23 11 25	Level 5	Hydraulic Track Cranes	y		
23-23 17 23 11 27	Level 5	Hydraulic Underslung Overhead Cranes	y		
23-23 17 23 11 29	Level 5	Hydraulic Workshop Cranes	y		
23-23 17 23 13	Level 4	Mechanical Cranes	y		
23-23 17 23 13 11	Level 5	Mechanical Bridge Cranes	y		
23-23 17 23 13 11 11	Level 6	Top Running Mechanical Overhead Cranes	y		
23-23 17 23 13 11 13	Level 6	Underslung Mechanical Overhead Cranes	y		
23-23 17 23 13 13	Level 5	Mechanical Gantry Cranes	y		
23-23 17 23 13 15	Level 5	Mechanical Jib Cranes	y		
23-23 17 23 13 17	Level 5	Mechanical Mobile Cranes	y		
23-23 17 23 13 19	Level 5	Mechanical Terrain Cranes	y		
23-23 17 23 13 21	Level 5	Mechanical Top Running Overhead Cranes	y		
23-23 17 23 13 23	Level 5	Mechanical Tower Cranes	y		
23-23 17 23 13 25	Level 5	Mechanical Track Cranes	y		
23-23 17 23 13 27	Level 5	Mechanical Underslung Overhead Cranes	y		
23-23 17 23 13 29	Level 5	Mechanical Workshop Cranes	y		
23-23 17 23 15	Level 4	Electric Cranes	y		
23-23 17 23 15 11	Level 5	Electric Bridge Cranes	y		
23-23 17 23 15 13	Level 5	Top Running Electric Overhead Cranes	y		
23-23 17 23 15 15	Level 5	Underslung Electric Overhead Cranes	y		
23-23 17 23 15 17	Level 5	Electric Gantry Cranes	y		
23-23 17 23 15 19	Level 5	Electric Jib Cranes	y		
23-23 17 23 15 21	Level 5	Electric Mobile Cranes	y		
23-23 17 23 15 23	Level 5	Electric Terrain Cranes	y		
23-23 17 23 15 25	Level 5	Electric Top Running Overhead Cranes	y		
23-23 17 23 15 27	Level 5	Electric Tower Cranes	y		
23-23 17 23 15 29	Level 5	Electric Track Cranes	y		
23-23 17 23 15 31	Level 5	Electric Underslung Overhead Cranes	y		
23-23 17 23 15 33	Level 5	Electric Workshop Cranes	y		
23-23 17 25	Level 3	Derricks	y		
23-23 17 27	Level 3	Hoists	y		
23-23 17 27 11	Level 4	Fixed Hoists	y		
23-23 17 27 11 11	Level 5	Pneumatic Fixed Hoists	y		
23-23 17 27 11 13	Level 5	Electric Fixed Hoists	y		
23-23 17 27 11 15	Level 5	Manual Fixed Hoists	y		
23-23 17 27 11 17	Level 5	Hydraulic Fixed Hoists	y		
23-23 17 27 13	Level 4	Trolley Hoists	y		
23-23 17 27 13 11	Level 5	Pneumatic Trolley Hoists	y		
23-23 17 27 13 13	Level 5	Electric Trolley Hoists	y		
23-23 17 27 13 15	Level 5	Manual Trolley Hoists	y		
23-23 17 27 13 17	Level 5	Hydraulic Trolley Hoists	y		
23-23 19 00	Level 2	Turntables	n		
23-23 19 11	Level 3	Stage Turntables	n		
23-23 19 13	Level 3	Exhibit and Display Turntables	n		
23-23 19 15	Level 3	Vehicular Turntable	n		
23-23 21 00	Level 2	Parking Systems	n		
23-23 21 11	Level 3	Car Parking Systems	n		
23-23 23 00	Level 2	Loading Dock Equipment	n		
23-23 23 13	Level 3	Dock Levelers	n		
23-23 23 13 11	Level 4	Powered Dock Levelers	n		
23-23 23 13 13	Level 4	Manual Dock Levelers	n		
23-23 23 13 15	Level 4	Hydraulic Dock Levelers	n		
23-23 23 15	Level 3	Loading Dock Lifts	n		
23-23 23 15 11	Level 4	Powered Loading Dock Lifts	n		

23-23 23 15 13	Level 4	Manual Loading Dock Lifts	n		
23-23 23 23	Level 3	Loading Dock Vehicle Restraints	y		
23-23 23 23 11	Level 4	Electric Loading Dock Vehicle Restraints	y		
23-23 23 23 13	Level 4	Electro Magnetic Loading Dock Vehicle Restraints	y		
23-23 23 23 15	Level 4	Hydraulic Loading Dock Vehicle Restraints	y		
23-25 21 13 19	Level 4	Emergency Resuscitation Products	y		
23-25 21 13 19 11	Level 5	Diefibrillators	y		
23-25 21 13 19 11 11	Level 6	Acute Care Defibrillators	y		
23-25 21 13 19 11 13	Level 6	Acute Care Defibrillator With Monitors	y		
23-25 21 13 19 11 15	Level 6	Automatic Defibrillators	y		
23-25 21 13 19 11 17	Level 6	Defibrillator with Cardioscopes	y		
23-25 21 13 19 11 19	Level 6	Portable Defibrillators	y		
23-25 21 13 19 13	Level 5	Defibrillator Analyzers	y		
23-25 21 13 19 15	Level 5	Emergency Aspirators	y		
23-25 21 13 19 17	Level 5	Emergency Resuscitators	y		
23-25 21 13 19 17 11	Level 6	Emergency Manual Resuscitators	y		
23-25 21 13 19 17 13	Level 6	Emergency Pulmonary Resuscitators	y		
23-25 21 13 19 17 15	Level 6	Emergency Oxygen Powered Resuscitators	y		
23-25 65 00	Level 2	Biological Protection and Preservation Products	y		
23-25 65 11	Level 3	Biological Safety Cabinets	y		
23-25 65 11 17	Level 4	Cryogenic Freezers	y		
23-25 65 11 19	Level 4	Biological Freezers	y		
23-25 65 11 21	Level 4	Biological Refrigerators	y		
23-25 67 00	Level 2	Hazardous Materials Products	y		
23-25 67 13	Level 3	Hazardous Materials Refrigerators and Freezers	y		
23-25 67 13 11	Level 4	Flammable Material Storage Refrigerators	y		
23-25 67 13 13	Level 4	Flammable Material Storage Freezers	y		
23-25 67 13 15	Level 4	Flammable Material Storage Refrigerator Freezers	y		
23-25 67 13 17	Level 4	Explosion Proof Refrigerators	y		
23-25 67 13 19	Level 4	Explosion Proof Refrigerator Freezers	y		
23-25 69 00	Level 2	Laboratory and Scientific Products	y		
23-25 69 11	Level 3	Laboratory Furnishings	y		
23-25 69 11 15	Level 4	Laboratory Fume hoods	y		
23-25 69 11 15 11	Level 5	Bench Fume hoods	y		
23-25 69 11 15 11 11	Level 6	Horizontal Laminar Flow Bench Fume hoods	y		
23-25 69 11 15 13	Level 5	Floor Standing Fume hoods	y		
23-25 69 11 15 13 11	Level 6	Horizontal Laminar Flow Free Standing Fume hoods	y		
23-25 69 11 15 13 13	Level 6	Explosion Proof Floor Standing Fume hoods	y		
23-25 69 11 15 13 15	Level 6	Perchloric Floor Standing Fume Hoods	y		
23-25 69 11 15 15	Level 5	Histopathology Staining Fume Hoods	y		
23-25 69 11 15 17	Level 5	Horizontal Laminar Flow Fume Hoods	y		
23-25 69 13	Level 3	Laboratory And Scientific Equipment	y		
23-25 69 13 13	Level 4	Optical Equipment	n		
23-25 69 13 13 11	Level 5	Telescopes	n		
23-25 69 13 13 13	Level 5	Binoculars	n		
23-25 69 13 13 15	Level 5	Videoscopes	n		
23-25 69 13 13 17	Level 5	Fiberscopes	n		
23-25 69 13 15	Level 4	Laboratory Disruption Equipment	n		
23-25 69 13 15 11	Level 5	French Pressure Cells	n		
23-25 69 13 15 13	Level 5	Homogenizers	n		
23-25 69 13 15 15	Level 5	Laboratory Blenders	n		
23-25 69 13 15 17	Level 5	Laboratory Crushers	n		
23-25 69 13 15 19	Level 5	Laboratory Disintegrators	n		
23-25 69 13 15 21	Level 5	Laboratory Emulsifiers	n		
23-25 69 13 15 23	Level 5	Laboratory Mills	n		
23-25 69 13 15 25	Level 5	Laboratory Presses	n		

23-25 69 13 15 27	Level 5	Laboratory Pulverizers	n		
23-25 69 13 15 29	Level 5	Laboratory Tissue Grinders	n		
23-25 69 13 17	Level 4	Laboratory Heating Drying Equipment	n		
23-25 69 13 17 11	Level 5	Laboratory Dry Baths	n		
23-25 69 13 17 13	Level 5	Bunsen Burner	n		
23-25 69 13 17 15	Level 5	Laboratory Hotplates	n		
23-25 69 13 17 17	Level 5	Laboratory Incinerators	n		
23-25 69 13 17 19	Level 5	Laboratory Infrared Dryers	n		
23-25 69 13 17 21	Level 5	Laboratory Spirit Burners	n		
23-25 69 13 17 23	Level 5	Laboratory Temperature Cycling Chambers	n		
23-25 69 13 17 25	Level 5	Laboratory Thermal Cyclers	n		
23-25 69 13 17 27	Level 5	Laboratory Warming Cabinets	n		
23-25 69 13 17 29	Level 5	Stirring Hotplates	n		
23-25 69 13 21	Level 4	Laboratory Cooling Equipment	n		
23-25 69 13 21 11	Level 5	Liquid Nitrogen Dewars	n		
23-25 69 13 21 13	Level 5	Ultra Cold Upright Cabinets	n		
23-25 69 13 21 15	Level 5	Ultra Cold Freezers	n		
23-25 69 13 21 17	Level 5	Ultralow Upright Cabinets	n		
23-25 69 13 21 19	Level 5	Ultralow Freezers	y		
23-25 69 13 21 21	Level 5	Ultra Cold Chest Freezers	y		
23-25 69 13 21 23	Level 5	Ultralow Chest Freezers	y		
23-25 69 13 21 25	Level 5	Liquid Nitrogen Freezers	y		
23-25 69 13 21 27	Level 5	Laboratory Cold Water Circulators	y		
23-25 69 13 21 29	Level 5	Chromatography Refrigerators	y		
23-25 69 13 21 31	Level 5	Laboratory Plate Freezers	y		
23-25 69 13 21 33	Level 5	Laboratory Cold Traps	y		
23-25 69 13 23	Level 4	Centrifuges	y		
23-25 69 13 23 11	Level 5	Benchtop Centrifuges	y		
23-25 69 13 23 13	Level 5	Centrifuge Buckets	y		
23-25 69 13 23 15	Level 5	Centrifuge Rotors	y		
23-25 69 13 23 17	Level 5	Cytology Centrifuges	y		
23-25 69 13 23 19	Level 5	Floor Centrifuges	y		
23-25 69 13 23 21	Level 5	Microcentrifuges	y		
23-25 69 13 23 23	Level 5	Microhematocrit Centrifuges	y		
23-25 69 13 23 25	Level 5	Refrigerated Benchtop Centrifuges	y		
23-25 69 13 23 27	Level 5	Refrigerated Floor Centrifuges	y		
23-25 69 13 23 29	Level 5	Refrigerated Microcentrifuges	y		
23-25 69 13 23 31	Level 5	Serological Centrifuges	y		
23-25 69 13 23 31 11	Level 6	Multiple Speed Serological Centrifuges	y		
23-25 69 13 23 33	Level 5	Tabletop Centrifuges	y		
23-25 69 13 23 35	Level 5	Ultracentrifuges	y		
23-25 69 13 23 37	Level 5	Vacuum Centrifuges	y		
23-25 69 13 25	Level 4	Incubators	n		
23-25 69 13 25 11	Level 5	CO2 Incubators	n		
23-25 69 13 25 13	Level 5	Cooled Biological Oxygen Demand BOD Incubators	n		
23-25 69 13 25 15	Level 5	Dry Wall Dual Chamber Carbon Dioxide Incubators	n		
23-25 69 13 25 17	Level 5	Dry Wall Dual Chamber Carbon Dioxide Incubators With Humidity Control	n		
23-25 69 13 25 19	Level 5	Dry Wall Dual Chamber Three Gas Incubators	n		
23-25 69 13 25 21	Level 5	Dry Wall Dual Chamber Three Gas Incubators With Humidity Control	n		
23-25 69 13 25 23	Level 5	Dry Wall Single Chamber Carbon Dioxide Incubators	n		
23-25 69 13 25 25	Level 5	Dry Wall Single Chamber Carbon Dioxide Incubators With Humidity Control	n		
23-25 69 13 25 27	Level 5	Dry Wall Single Chamber Three Gas Incubators	n		
23-25 69 13 25 29	Level 5	Dry Wall Single Chamber Three Gas Incubators With Humidity Control	n		
23-25 69 13 25 31	Level 5	Forced Air General Purpose Incubators	n		
23-25 69 13 25 33	Level 5	Gravity Convection General Purpose Incubators	n		
23-25 69 13 25 35	Level 5	Mechanical Convection General Purpose Incubators	n		

23-25 69 13 25 37	Level 5	Multipurpose Incubators	n		
23-25 69 13 25 39	Level 5	Plate Incubators	n		
23-25 69 13 25 41	Level 5	Refrigerated Incubators	n		
23-25 69 13 25 43	Level 5	Shaking Incubators	n		
23-25 69 13 25 45	Level 5	Water Jacketed Dual Chamber Carbon Dioxide Incubators	n		
23-25 69 13 25 47	Level 5	Water Jacketed Dual Chamber Carbon Dioxide Incubators With Humidity Control	n		
23-25 69 13 25 49	Level 5	Water Jacketed Dual Chamber Three Gas Incubators	n		
23-25 69 13 25 51	Level 5	Water Jacketed Dual Chamber Three Gas Incubators With Humidity Control	n		
23-25 69 13 25 53	Level 5	Water Jacketed Single Chamber Carbon Dioxide Incubators	n		
23-25 69 13 25 55	Level 5	Water Jacketed Single Chamber Carbon Dioxide Incubators With Humidity Control	n		
23-25 69 13 25 57	Level 5	Water Jacketed Single Chamber Three Gas Incubators	n		
23-25 69 13 25 59	Level 5	Water Jacketed Single Chamber Three Gas Incubators With Humidity Control	n		
23-25 69 13 27	Level 4	Laboratory Ovens	y		
23-25 69 13 27 11	Level 5	Laboratory Ageing Ovens	y		
23-25 69 13 27 13	Level 5	Laboratory Cleanroom Ovens	y		
23-25 69 13 27 15	Level 5	Laboratory Drying Cabinets	y		
23-25 69 13 27 17	Level 5	Laboratory Drying Ovens	y		
23-25 69 13 27 19	Level 5	Laboratory Gravity Convection Ovens	y		
23-25 69 13 27 21	Level 5	Laboratory Induction Dryers	y		
23-25 69 13 27 23	Level 5	Laboratory Mechanical Convection Ovens	y		
23-25 69 13 27 25	Level 5	Laboratory Vacuum Ovens	y		
23-25 69 13 29	Level 4	Laboratory Distillers	y		
23-25 69 13 29 11	Level 5	Laboratory Water Distillers	y		
23-27 11 00	Level 2	General Instruments and Controls	y		
23-27 11 11	Level 3	Temperature Measuring Instrument And Controls	y		
23-27 11 11 11	Level 4	Temperature Alarm Modules	y		
23-27 11 11 13	Level 4	Temperature Control Modules	y		
23-27 11 11 15	Level 4	Temperature Controllers	y		
23-27 11 11 15 11	Level 5	Digital Temperature Controllers	y		
23-27 11 11 15 13	Level 5	Electric Temperature Controllers	y		
23-27 11 11 15 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 11 15 17	Level 5	Hydraulic Temperature Controllers	y		
23-27 11 11 17	Level 4	Temperature Detectors	y		
23-27 11 11 17 11	Level 5	Thermocouple Detectors	y		
23-27 11 11 17 13	Level 5	RTD Detectors	y		
23-27 11 11 19	Level 4	Temperature Indicators	y		
23-27 11 11 21	Level 4	Temperature Recorders	y		
23-27 11 11 23	Level 4	Temperature Sensors	y		
23-27 11 11 23 11	Level 5	Thermocouple Probes	y		
23-27 11 13	Level 3	Pressure Measuring Instrument And Controls	y		
23-27 11 13 11	Level 4	Pressure Alarm Modules	y		
23-27 11 13 13	Level 4	Pressure Control Modules	y		
23-27 11 13 15	Level 4	Pressure Controllers	y		
23-27 11 13 15 11	Level 5	Digital Pressure Controllers	y		
23-27 11 13 15 13	Level 5	Electric Pressure Controllers	y		
23-27 11 13 15 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 13 15 17	Level 5	Hydraulic Pressure Controllers	y		
23-27 11 13 17	Level 4	Pressure Detectors	y		
23-27 11 13 19	Level 4	Pressure Indicators	y		
23-27 11 13 21	Level 4	Pressure Recorders	y		
23-27 11 13 23	Level 4	Pressure Sensors	y		
23-27 11 13 25	Level 4	Differential Pressure Alarm Modules	y		
23-27 11 13 27	Level 4	Differential Pressure Control Modules	y		
23-27 11 13 29	Level 4	Differential Pressure Controllers	y		
23-27 11 13 29 11	Level 5	Digital Differential Pressure Controllers	y		
23-27 11 13 29 13	Level 5	Electric Differential Pressure Controllers	y		

23-27 11 13 29 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 13 29 17	Level 5	Hydraulic Differential Pressure Controllers	y		
23-27 11 13 31	Level 4	Differential Pressure Detectors	y		
23-27 11 13 33	Level 4	Differential Pressure Indicators	y		
23-27 11 13 35	Level 4	Differential Pressure Recorders	y		
23-27 11 13 37	Level 4	Differential Pressure Sensors	y		
23-27 11 15	Level 3	Flow Measuring Instrument And Controls	y		
23-27 11 15 11	Level 4	Flow Alarm Modules	y		
23-27 11 15 13	Level 4	Flow Control Modules	y		
23-27 11 15 15	Level 4	Flow Controllers	y		
23-27 11 15 15 11	Level 5	Digital Flow Controllers	y		
23-27 11 15 15 13	Level 5	Electric Flow Controllers	y		
23-27 11 15 15 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 15 15 17	Level 5	Hydraulic Flow Controllers	y		
23-27 11 15 17	Level 4	Flow Detectors	y		
23-27 11 15 19	Level 4	Flow Indicators	y		
23-27 11 15 21	Level 4	Flow Recorders	y		
23-27 11 15 23	Level 4	Flow Sensors	y		
23-27 11 17	Level 3	Concentration Measuring Instrument And Controls	y		
23-27 11 17 11	Level 4	Humidity Concentration Measuring Instruments	y		
23-27 11 17 13	Level 4	Carbon Dioxide (CO^2) Concentration Measuring Instruments	y		
23-27 11 17 15	Level 4	Ozone Concentration Measuring Instruments	y		
23-27 11 17 17	Level 4	Other Gas Concentration Measuring Instruments	y		
23-27 11 19	Level 3	Heat Measuring Instrument And Controls	y		
23-27 11 19 11	Level 4	Heat Detectors	y		
23-27 11 19 13	Level 4	Heating Controllers	y		
23-27 11 19 13 11	Level 5	Digital Heating Controllers	y		
23-27 11 19 13 13	Level 5	Electric Heating Controllers	y		
23-27 11 19 13 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 19 13 17	Level 5	Hydraulic Heating Controllers	y		
23-27 11 19 15	Level 4	Heating Programmers	y		
23-27 11 19 17	Level 4	Heating Optimizers	y		
23-27 11 21	Level 3	Level Measuring Instrument And Controls	y		
23-27 11 21 11	Level 4	Level Alarm Modules	y		
23-27 11 21 13	Level 4	Level Control Modules	y		
23-27 11 21 15	Level 4	Level Controllers	y		
23-27 11 21 15 11	Level 5	Digital Level Controllers	y		
23-27 11 21 15 13	Level 5	Electric Level Controllers	y		
23-27 11 21 15 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 21 15 17	Level 5	Hydraulic Level Controllers	y		
23-27 11 21 17	Level 5	Level Detectors	y		
23-27 11 21 19	Level 4	Level Indicators	y		
23-27 11 21 19 11	Level 5	Level Gage Glasses	y		
23-27 11 21 19 13	Level 4	Level Bull's Eyes	y		
23-27 11 21 21	Level 4	Level Recorders	y		
23-27 11 21 23	Level 4	Level Sensors	y		
23-27 11 23	Level 3	Weighing Instrument And Controls	y		
23-27 11 23 11	Level 4	Weight Alarm Modules	y		
23-27 11 23 13	Level 4	Weight Control Modules	y		
23-27 11 23 15	Level 4	Weight Detectors	y		
23-27 11 23 17	Level 4	Weight Indicators	y		
23-27 11 23 19	Level 4	Weight Recorders	y		
23-27 11 23 21	Level 4	Weight Sensors	y		
23-27 11 25	Level 3	Metal Concentration Instrument And Controls	y		
23-27 11 25 11	Level 4	Metal Detectors	y		
23-27 11 27	Level 3	Gas Instrument And Controls	y		

23-27 11 27 11	Level 4	Gas Alarm Modules	y		
23-27 11 27 13	Level 4	Gas Control Modules	y		
23-27 11 27 15	Level 4	Gas Controllers	y		
23-27 11 27 15 11	Level 5	Digital Gas Controllers	y		
23-27 11 27 15 13	Level 5	Electric Gas Controllers	y		
23-27 11 27 15 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 27 15 17	Level 5	Hydraulic Gas Controllers	y		
23-27 11 27 17	Level 4	Gas Detectors	y		
23-27 11 27 17 11	Level 5	Air Pollution Detectors	y		
23-27 11 27 17 13	Level 5	Radon Detectors	y		
23-27 11 27 17 15	Level 5	Carbon Dioxide Detectors	y		
23-27 11 27 17 17	Level 5	Hydrogen Detectors	y		
23-27 11 27 17 19	Level 5	Oxygen Detectors	y		
23-27 11 27 17 21	Level 5	Halon Detectors	y		
23-27 11 27 19	Level 4	Gas Indicators	y		
23-27 11 27 21	Level 4	Gas Analyzers	y		
23-27 11 29	Level 3	Infrared Instrument And Controls	y		
23-27 11 29 11	Level 4	Photoelectric Cells	y		
23-27 11 29 13	Level 4	Infrared Control Modules	y		
23-27 11 29 15	Level 4	Infrared Controllers	y		
23-27 11 29 15 11	Level 5	Digital Infrared Controllers	y		
23-27 11 29 15 13	Level 5	Electric Infrared Controllers	y		
23-27 11 29 15 15	Level 5	Pneumatic Hating Controllers	y		
23-27 11 29 15 17	Level 5	Hydraulic Infrared Controllers	y		
23-27 13 00	Level 2	Control and Monitoring Boards Panels	y		
23-27 13 11	Level 3	Internal Climate Monitoring and Control Panel	y		
23-27 13 13	Level 3	Building Control Systems	y		
23-27 13 13 11	Level 4	Building Automated Control Panels	y		
23-27 13 13 13	Level 4	Building Automated Systems	y		
23-27 13 13 15	Level 4	Building Monitoring Control Panels	y		
23-27 13 15	Level 3	Process Control Panels	y		
23-27 13 15 11	Level 4	Gaseous Waste Monitoring and Control Panels	y		
23-27 15 00	Level 2	Building Automation and Control	y		
23-27 15 11	Level 3	Building Clock Controls	y		
23-27 15 13	Level 3	Building Door Controls	y		
23-27 15 15	Level 3	Elevator Monitoring and Controls	y		
23-27 15 17	Level 3	Energy Monitoring and Controls	y		
23-27 15 19	Level 3	Building Environmental Controls	y		
23-27 15 21	Level 3	Building Lighting Controls	y		
23-27 15 21 11	Level 4	Building Lighting Control Panel	y		
23-27 15 21 13	Level 4	Lighting Relay Control Panel	y		
23-27 15 23	Level 3	HVAC Controls	y		
23-27 15 23 11	Level 4	HVAC Main Control Panels	y		
23-27 15 23 13	Level 4	HVAC Local Control Panels	y		
23-27 15 23 15	Level 4	HVAC Control Clocks	y		
23-27 15 25	Level 3	Equipment Control Panel	y		
23-27 17 00	Level 2	Pumps	y		
23-27 17 11	Level 3	Axial Split Pumps	y		
23-27 17 13	Level 3	Centrifugal Pumps	y		
23-27 17 15	Level 3	Diaphragm Pumps	y		
23-27 17 17	Level 3	Duplex Pumps	y		
23-27 17 19	Level 3	Gear Pumps	y		
23-27 17 21	Level 3	Liquid Ring Pumps	y		
23-27 17 23	Level 3	Macerator Pumps	y		
23-27 17 23 11	Level 4	Combined Macerator Pumps	y		
23-27 17 25	Level 3	Progressive Cavity Pumps	y		

23-27 17 27	Level 3	Ram Pumps	y		
23-27 17 29	Level 3	Reciprocating Pumps	y		
23-27 17 31	Level 3	Rotary Pumps	y		
23-27 17 31 11	Level 4	Rotary Cam Pumps	y		
23-27 17 31 13	Level 4	Rotary Lobe Pumps	y		
23-27 17 31 15	Level 4	Rotary Screw Pumps	y		
23-27 17 31 17	Level 4	Rotary Vane Pumps	y		
23-27 17 33	Level 3	Rotating Piston Pumps	y		
23-27 17 35	Level 3	Sewage Ejectors	y		
23-27 17 35 11	Level 4	Submersible Sewage Ejectors	y		
23-27 17 37	Level 3	Simplex Pumps	y		
23-27 17 39	Level 3	Sliding Vane Pumps	y		
23-27 17 41	Level 3	Turbine Pumps	y		
23-27 17 43	Level 3	Worm Gear Pumps	y		
23-27 17 45	Level 3	Pump Components	y		
23-27 19 00	Level 2	Engines	y		
23-27 19 11	Level 3	Reciprocating Engines	y		
23-27 19 13	Level 3	Rotary Engines	y		
23-27 19 15	Level 3	Turbine Engines	y		
23-27 21 00	Level 2	Compressors	y		
23-27 21 11	Level 3	Axial Flow Compressors	y		
23-27 21 13	Level 3	Centrifugal Compressors	y		
23-27 21 15	Level 3	Reciprocating Compressors	y		
23-27 21 15 11	Level 4	Diaphragm Reciprocating Compressors	y		
23-27 21 15 13	Level 4	Double Acting Reciprocating Compressors	y		
23-27 21 15 15	Level 4	Single Acting Reciprocating Compressors	y		
23-27 21 17	Level 3	Rotary Compressors	y		
23-27 21 17 11	Level 4	Rotary Liquid Ring Compressors	y		
23-27 21 17 13	Level 4	Rotary Lobe Compressors	y		
23-27 21 17 15	Level 4	Rotary Screw Compressors	y		
23-27 21 17 17	Level 4	Rotary Scroll Compressors	y		
23-27 21 17 19	Level 4	Rotary Vane Compressors	y		
23-27 23 00	Level 2	Heat Exchangers	y		
23-27 23 11	x	Heat Exchanger Economizers	y		
23-27 23 13	Level 3	Plate and Frame Heat Exchangers	y		
23-27 23 13 11	Level 4	Plate and Frame Regenerative Heat Exchangers	y		
23-27 23 15	Level 3	Shell and Tube Heat Exchangers	y		
23-27 23 15 11	Level 4	Shell and Tube Regenerative Heat Exchangers	y		
23-27 23 17	Level 3	Tube and Fin Heat Exchangers	y		
23-27 23 19	Level 3	Spiral Heat Exchangers	y		
23-27 23 19 11	Level 4	Heat Exchangers for Ventilation Air	y		
23-27 23 21	Level 3	Adiabatic Wheel Heat Exchangers	y		
23-27 23 23	Level 3	Plate and Fin Heat Exchangers	y		
23-27 23 23 11	Level 4	Straight Fin Plate and Fin Heat Exchangers	y		
23-27 23 23 13	Level 4	Offset Fin Plate and Fin Heat Exchangers	y		
23-27 23 23 15	Level 4	Wavy Fin Plate and Fin Heat Exchangers	y		
23-27 23 25	Level 3	Fluid Heat Exchangers	y		
23-27 25 00	Level 2	Heaters for Supplied Liquids	y		
23-27 25 11	Level 3	Liquid Electric Heaters	y		
23-27 25 13	Level 3	Liquid Gas Heaters	y		
23-27 25 15	Level 3	Liquid Steam Heaters	y		
23-27 25 17	Level 3	Liquid Fuel Oil Heaters	y		
23-27 25 17 11	Level 4	Fuel Oil Pre Heaters	y		
23-27 27 00	Level 2	Pressure Reducing Stations	y		
23-27 27 11	Level 3	Multiple Stage Pressure Reducing Stations	y		
23-27 27 13	Level 3	Single Stage Pressure Reducing Stations	y		

23-27 29 15	Level 3	Specialized Tanks	y		
23-27 29 15 11	Level 4	Cryogenic Tanks	y		
23-27 29 15 13	Level 4	Flash Tanks	y		
23-27 29 15 13 11	Level 5	Steam Flash Tanks	y		
23-27 29 15 15	Level 4	Septic Tanks	y		
23-27 29 15 17	Level 4	Siphon Tanks	y		
23-27 29 17	Level 3	Storage Constructions (Tanks)	y		
23-27 29 17 11	Level 4	Water Towers	y		
23-27 29 17 13	Level 4	Silos	y		
23-27 29 17 15	Level 4	Storage Bunkers	y		
23-27 29 19	Level 3	Tanks	y		
23-27 29 19 11	Level 4	Multiple Wall Tanks	y		
23-27 29 19 11 11	Level 5	Multiple Walled Pressure Tanks	y		
23-27 29 19 11 13	Level 5	Multiple Walled Vacuum Tanks	y		
23-27 29 19 11 15	Level 5	Multiple Walled Vented Tanks	y		
23-27 29 19 13	Level 4	Single Walled Tanks	y		
23-27 29 19 13 11	Level 5	Single Walled Pressure Tanks	y		
23-27 29 19 13 13	Level 5	Single Walled Vacuum Tanks	y		
23-27 29 19 13 15	Level 5	Single Walled Vented Tanks	y		
23-27 29 21	Level 3	Tank Containments	y		
23-27 29 21 11	Level 4	Aboveground Tank Containments	y		
23-27 29 21 11 11	Level 5	Aboveground Primary Tank Containments	y		
23-27 29 21 11 13	Level 5	Aboveground Secondary Tank Containments	y		
23-27 29 21 11 15	Level 5	Aboveground Tertiary Tank Containments	y		
23-27 29 21 13	Level 4	Underground Tank Containments	y		
23-27 29 21 13 11	Level 5	Underground Primary Tank Containments	y		
23-27 29 21 13 13	Level 5	Underground Secondary Tank Containments	y		
23-27 29 21 13 15	Level 5	Underground Tertiary Tank Containments	y		
23-27 29 25	Level 3	Tank Components	y		
23-27 29 25 11	Level 4	Overflow Regulators	y		
23-27 29 25 13	Level 4	Fill and Valve Caps	y		
23-27 29 25 15	Level 4	Tank Vents	y		
23-27 31 00	Level 2	Valves	y		
23-27 31 11	Level 3	Backflow Preventors	y		
23-27 31 13	Level 3	Balancing Valves	y		
23-27 31 13 11	Level 4	Gate Balancing Valves	y		
23-27 31 13 13	Level 4	Butterfly Balancing Valves	y		
23-27 31 13 15	Level 4	Plug Balancing Valves	y		
23-27 31 13 17	Level 4	Globe Balancing Valves	y		
23-27 31 13 19	Level 4	Check Balancing Valves	y		
23-27 31 13 21	Level 4	Diaphragm Balancing Valves	y		
23-27 31 15	Level 3	Ball Valves	y		
23-27 31 17	Level 3	Butterfly Valves	y		
23-27 31 17 11	Level 4	Lug Pattern Butterfly Valves	y		
23-27 31 17 13	Level 4	Wafer Pattern Butterfly Valves	y		
23-27 31 19	Level 3	Check Valves	y		
23-27 31 19 11	Level 4	Ball Check Valves	y		
23-27 31 19 13	Level 4	Clapper CheckValves	y		
23-27 31 19 15	Level 4	Cone Type Check Valves	y		
23-27 31 19 17	Level 4	Demand Check Valves	y		
23-27 31 19 19	Level 4	Diaphragm Check Valves	y		
23-27 31 19 21	Level 4	Lift Check Valves	y		
23-27 31 19 23	Level 4	Spring Type Check Valves	y		
23-27 31 19 25	Level 4	Stop Check Valves	y		
23-27 31 19 27	Level 4	Swing Check Valves	y		
23-27 31 21	Level 3	Diaphragm Valves	y		

23-27 31 23	Level 3	Float Valves	y		
23-27 31 25	Level 3	Gate Valves	y		
23-27 31 27	Level 3	Globe Valves	y		
23-27 31 29	Level 3	Mixing Valves	y		
23-27 31 29 11	Level 4	Manual Mixing Valves	y		
23-27 31 29 13	Level 4	Pressure Balanced Controlled Mixing Valves	y		
23-27 31 29 15	Level 4	Thermostatically Controlled Mixing Valves	y		
23-27 31 31	Level 3	Needle Valves	y		
23-27 31 33	Level 3	Orifice Valves	y		
23-27 31 35	Level 3	Pinch Valves	y		
23-27 31 37	Level 3	Plug Drain Valves	y		
23-27 31 39	Level 3	Plug Valves	y		
23-27 31 41	Level 3	Poppet Valves	y		
23-27 31 43	Level 3	Post Indicator Valves	y		
23-27 31 45	Level 3	Preaction Valves	y		
23-27 31 45 11	Level 4	Electronic Actuated Preaction Valves	y		
23-27 31 45 13	Level 4	Water Seal Enabled Preaction Valves	y		
23-27 31 47	Level 3	Pressure Regulating Valves	y		
23-27 31 49	Level 3	Relief Valves	y		
23-27 31 49 11	Level 4	Pressure Relief Valves	y		
23-27 31 49 13	Level 4	Pressure Temperature Relief Valves	y		
23-27 31 51	Level 3	Rupture Disks	y		
23-27 31 53	Level 3	Safety Valves	y		
23-27 31 53 11	Level 4	Pressure Safety Valves	y		
23-27 31 53 13	Level 4	Pressure Temperature Safety Valves	y		
23-27 31 55	Level 3	Sentinel Valves	y		
23-27 31 57	Level 3	Slider Valves	y		
23-27 31 59	Level 3	Slush Valves	y		
23-27 31 61	Level 3	Thermostatic Expansion Valves	y		
23-27 31 63	Level 3	Valves Boxes	y		
23-27 33 00	Level 2	Valve Actuators	y		
23-27 33 11	Level 3	Electrical Valve Actuators	y		
23-27 33 11 11	Level 4	Solenoid Valve Actuators	y		
23-27 33 13	Level 3	Hydraulic Valve Actuators	y		
23-27 33 15	Level 3	Motor Operated Valve Actuators	y		
23-27 33 17	Level 3	Pneumatic Valve Actuators	y		
23-27 35 00	Level 2	Variable Speed Drives	y		
23-27 35 11	Level 3	Hydraulic Variable Speed Drives	y		
23-27 35 11 11	Level 4	Hydrodynamic Variable Speed Drives	y		
23-27 35 11 13	Level 4	Hydrostatic Variable Speed Drives	y		
23-27 35 11 15	Level 4	Hydroviscous Variable Speed Drives	y		
23-27 35 13	Level 3	Variable Pitch Drives	y		
23-27 35 13 11	Level 4	Pulley Variable Pitch Drives	y		
23-27 35 13 13	Level 4	Traction Variable Pitch Drives	y		
23-27 35 15	Level 3	Transmission Devices	y		
23-27 35 15 11	Level 4	Fluid Drive Transmissions	y		
23-27 35 15 13	Level 4	Gear Boxes	y		
23-27 37 00	Level 2	Liquid Traps	y		
23-27 37 11	Level 3	Grease Traps	y		
23-27 37 13	Level 3	Oil Traps	y		
23-27 37 15	Level 3	Steam Traps	y		
23-27 37 15 11	Level 4	Disc Steam Traps	y		
23-27 37 15 13	Level 4	Float and Thermostatic Steam Traps	y		
23-27 37 15 15	Level 4	Float Steam Trap	y		
23-27 37 15 17	Level 4	Inverted Basket Steam Traps	y		
23-27 37 15 19	Level 4	Orifice Steam Traps	y		

23-27 55 00	Level 2	Liquid Treatment Components	y		
23-27 55 11	Level 3	Liquid Filters	y		
23-27 55 11 11	Level 4	Water Filters	y		
23-27 55 13	Level 3	Liquid Sterilizers	y		
23-27 55 15	Level 3	Liquid Salinators	y		
23-27 55 17	Level 3	Liquid Chlorinators	y		
23-27 55 19	Level 3	Liquid Ionizers	y		
23-27 55 21	Level 3	Liquid Deionizers	y		
23-27 55 23	Level 3	Liquid Deaerators	y		
23-27 55 23 11	Level 4	Centrifugal Liquid Deaerators	y		
23-27 55 23 13	Level 4	Spray Type Liquid Deaerators	y		
23-27 55 23 15	Level 4	Tray Type Liquid Deaerators	y		
23-27 55 25	Level 3	Liquid Disinfecting Ultraviolet Lighting	y		
23-27 55 27	Level 3	Liquid Softeners	y		
23-27 55 27 11	Level 4	Water Softeners	y		
23-27 55 29	Level 3	Liquid Strainers	y		
23-27 55 29 11	Level 4	Basket Strainers	y		
23-27 55 29 13	Level 4	Conical Strainers	y		
23-27 55 29 15	Level 4	Tee Strainers	y		
23-27 55 29 17	Level 4	Y Strainers	y		
23-27 55 29 19	Level 4	Reverse Osmosis Units	y		
23-27 55 29 21	Level 4	Solid Separators	y		
23-27 55 31	Level 3	Liquid Chemical Feeders	y		
23-27 55 31 11	Level 4	Liquid Chemical Feeders	y		
23-27 55 31 13	Level 4	Solid Chemical Feeders	y		
23-27 55 31 15	Level 4	Gas Chemical Feeders	y		
23-27 55 33	Level 3	Liquid Treatment Package Units	y		
23-27 55 33 11	Level 4	Water Treatment Package Units	y		
23-27 55 35	Level 3	Liquid Separators	y		
23-27 55 35 11	Level 4	Centrifuge Liquid Separators	y		
23-27 55 35 13	Level 4	Demister Pad Liquid Separators	y		
23-27 55 35 15	Level 4	Electrical Cyclone Liquid Separators	y		
23-27 55 35 17	Level 4	Hydro Cyclone Liquid Separators	y		
23-27 55 35 19	Level 4	Mechanical Liquid Separators	y		
23-27 55 35 21	Level 4	Mist Eliminator Liquid Separators	y		
23-27 55 35 23	Level 4	Tangential Liquid Separators	y		
23-27 55 35 25	Level 4	Magnetic Electronic Water Treatment	y		
23-27 55 35 27	Level 4	Oil Water Curtain Separators	y		
23-27 57 00	Level 2	Gas Treatment Components	y		
23-27 57 11	Level 3	Vapor Traps	y		
23-27 57 13	Level 3	Extractors	y		
23-27 57 15	Level 3	Air Injectors	y		
23-27 57 17	Level 3	Air Ejectors	y		
23-27 57 19	Level 3	Air Scrubbers	y		
23-27 57 19 11	Level 4	Dual Throat Air Scrubbers	y		
23-27 57 19 13	Level 4	Multiple Venture Air Scrubbers	y		
23-27 57 19 15	Level 4	Packed Bed Air Scrubbers	y		
23-27 57 21	Level 3	Supply Gas Treatment	y		
23-27 57 21 11	Level 4	Steam Treatment	y		
23-27 57 21 13	Level 4	Fuel Gas Treatment	y		
23-27 57 21 13 11	Level 5	Gas Filters	y		
23-27 57 23	Level 3	Electronic Air Purifiers	y		
23-27 57 25	Level 3	Mechanically Aided Air Scrubbers	y		
23-27 57 27	Level 3	Air Filters	y		
23-27 57 27 11	Level 4	Air Filter Components	y		
23-27 57 27 11 11	Level 5	Air Filter Media	y		

23-27 57 27 11 13	Level 5	Control Air Filter Assemblies	y		
23-27 57 27 13	Level 4	High Efficiency Air Filters	y		
23-27 57 27 15	Level 4	ULPA Filters	y		
23-27 57 27 17	Level 4	HEPA Filters	y		
23-27 57 27 19	Level 4	Bag Filters	y		
23-27 57 27 21	Level 4	Air Filter Housings	y		
23-27 57 27 23	Level 4	Air Charcoal Filters	y		
23-27 57 27 25	Level 4	Roll Type Filters	y		
23-27 57 29	Level 3	Dust Collectors	y		
23-27 57 31	Level 3	Electronic Air Cleaners	y		
23-27 57 33	Level 3	Air Fresheners	y		
23-27 57 35	Level 3	Air Treatment Components	y		
23-27 57 35 11	Level 4	Air Deodorization Products	y		
23-27 57 35 13	Level 4	Moisture Absorbents	y		
23-27 59 11	Level 3	Recycling Balers	n		
23-27 59 11 11	Level 4	Recycling Cardboard Balers	n		
23-27 59 11 13	Level 4	Recycling Paper Balers	n		
23-27 59 11 15	Level 4	Recycling Plastic Balers	n		
23-27 59 11 17	Level 4	Recycling Wood Balers	n		
23-27 59 15	Level 3	Recycling Compactors	n		
23-27 59 15 11	Level 4	Cardboard Compactors	n		
23-27 59 15 13	Level 4	Metal Compactors	n		
23-27 59 15 15	Level 4	Paper Compactors	n		
23-27 59 15 17	Level 4	Plastic Compactors	n		
23-27 59 15 19	Level 4	Trash Compactors	n		
23-27 59 15 21	Level 4	Wood Compactors	n		
23-27 61 00	Level 2	Incinerators	n		
23-27 61 11	Level 3	Trash Incinerators	n		
23-27 61 13	Level 3	Document Incinerators	n		
23-27 71 00	Level 2	Building Maintenance Equipment	n		
23-27 71 11	Level 3	Window Washing Systems	n		
23-27 71 13	Level 3	Building Maintenance Cradles and Platforms	n		
23-27 71 15	Level 3	Roof Trolley Systems	n		
23-27 71 17	Level 3	Traveling Ladder Systems	n		
23-27 71 19	Level 3	Ancillary Building Maintenance Items	y		
23-27 71 19 11	Level 4	Building Safety Tracks	y		
23-27 71 19 13	Level 4	Anchors for Building Maintenance	y		
23-27 71 21	Level 3	Fall Arrest Systems	y		
23-29 25 00	Level 2	Fire Fighting Equipment	y		
23-29 25 11	Level 3	Fire Fighting Terminals	y		
23-29 25 11 11	Level 4	Fire Fighting Terminal Components	y		
23-29 25 11 13	Level 4	Water Fire Fighting Terminals	y		
23-29 25 11 15	Level 4	Gaseous Fire Fighting Terminals	y		
23-29 25 11 17	Level 4	Foam Fire Fighting Terminals	y		
23-29 25 11 19	Level 4	Powder Fire Fighting Terminals	y		
23-29 25 11 21	Level 4	Fire Fighting Media	y		
23-29 25 11 23	Level 4	Fire Fighting Gas Terminals	y		
23-29 25 13	Level 3	Fire Hydrants	y		
23-29 25 15	Level 3	Fire Hose Equipment	y		
23-29 25 15 19	Level 4	Fire Hose Connectors	y		
23-29 25 15 19 11	Level 5	Fire Fighting Standpipes	y		
23-29 25 15 19 13	Level 5	Fire Fighting Pumper Connections	y		
23-29 27 00	Level 2	Fire Ventilation Equipment	y		
23-29 27 11	Level 3	Fire Fighting Smoke Extractors	y		
23-29 29 15	Level 3	Fire Switches	y		
23-29 29 15 11	Level 4	Pressure Fire Alarm Water Flow Switches	y		

23-29 29 15 13	Level 4	Paddle Fire Alarm Water Flow Switches	y		
23-29 29 15 15	Level 4	Fire Tamper Switches	y		
23-29 31 00	Level 2	Fire Notification Appliances	y		
23-29 31 11	Level 3	Fire Alarm Annunicator Panels	y		
23-29 31 11 11	Level 4	Audible Fire Alarm Annunicator Panels	y		
23-29 31 11 13	Level 4	Visible Fire Alarm Annunicator Panels	y		
23-29 31 11 15	Level 4	Combination Fire Alarm Annunicator Panels	y		
23-29 31 13	Level 3	Fire Alarm Control Panels	y		
23-29 31 13 11	Level 4	Main Fire Alarm Control Panels	y		
23-29 31 13 13	Level 4	Secondary Fire Alarm Control Panels	y		
23-29 31 13 15	Level 4	Fire Alarm Audio Control Panels	y		
23-29 31 13 17	Level 4	Fire Alarm Smoke Control Panels	y		
23-29 31 15	Level 3	Audible Fire Notification Devices	y		
23-29 31 15 11	Level 4	Audible Fire Notification Devices Bell	y		
23-29 31 15 13	Level 4	Audible Fire Notification Devices Horn	y		
23-29 31 15 15	Level 4	Audible Fire Notification Devices Chime	y		
23-29 31 15 17	Level 4	Audible Fire Notification Devices Speaker	y		
23-29 31 17	Level 3	Visible Fire Notification Devices	y		
23-29 31 17 11	Level 4	Visible Fire Notification Device Lights	y		
23-29 31 19	Level 3	Combination Audible and Visible Fire Notification Devices	y		
23-29 31 21	Level 3	Fire Alarm Communicators	y		
23-29 31 23	Level 3	Fire Alarm Central Stations	y		
23-29 31 23 11	Level 4	Fire Alarm Central Station Transmitters	y		
23-29 31 23 13	Level 4	Fire Alarm Central Station Receivers	y		
23-29 31 23 15	Level 4	Fire Alarm Central Station Combination Transmitter and Receivers	y		
23-29 31 25	Level 3	Fire Alarm Event Recorders	y		
23-29 31 27	Level 3	Fire Alarm Event Printers	y		
23-29 31 29	Level 3	Fire Alarm Remote Controllers	y		
23-29 31 31	Level 3	Fire Alarm Remote Amplifiers	y		
23-29 31 33	Level 3	Fire Pump Controllers	y		
23-29 31 35	Level 3	Jockey Pump Controllers	y		
23-29 33 00	Level 2	Fire Suppression System Components	y		
23-29 33 11	Level 3	Water Based Suppression Equipment			Added 2015 01 30
23-29 33 11 11	Level 4	Pendant Sprinkler Heads			Added 2015 01 30
23-29 33 11 11 11	Level 5	Wet Pendant Sprinkler Heads			Added 2015 01 30
23-29 33 11 11 13	Level 5	Dry Pendant Sprinkler Heads			Added 2015 01 30
23-29 33 11 11 15	Level 5	Open Pendant Sprinkler Heads			Added 2015 01 30
23-29 33 11 13	Level 4	Upright Sprinkler Heads			Added 2015 01 30
23-29 33 11 13 11	Level 5	Wet Upright Sprinkler Heads			Added 2015 01 30
23-29 33 11 13 13	Level 5	Dry Upright Sprinkler Heads			Added 2015 01 30
23-29 33 11 13 15	Level 5	Open Upright Sprinkler Heads			Added 2015 01 30
23-29 33 11 15	Level 4	Side Wall Sprinkler Heads			Added 2015 01 30
23-29 33 11 15 11	Level 5	Wet Side Wall Sprinkler Heads			Added 2015 01 30
23-29 33 11 15 13	Level 5	Dry Side Wall Sprinkler Heads			Added 2015 01 30
23-29 33 11 17	Level 4	Dry Pipe Valves			Added 2015 01 30
23-29 33 11 19	Level 4	Water Mist Systems			Added 2015 01 30
23-29 33 13	Level 3	Non Water Based Suppression Equipment			Added 2015 01 30
23-29 33 13 11	Level 4	Clean Agent Gaseous Suppression Equipment			Added 2015 01 30
23-29 33 13 13	Level 4	Carbon Dioxide Suppression Equipment			Added 2015 01 30
23-29 33 13 15	Level 4	Halon Suppression Equipment			Added 2015 01 30
23-29 33 13 17	Level 4	Wet Chemical Fire Suppression Equipment			Added 2015 01 30
23-29 33 13 19	Level 4	Dry Chemical Fire Suppression Equipment			Added 2015 01 30
23-29 33 13 21	Level 4	Foam Fire Suppression Equipment			Added 2015 01 30
23-29 33 15	Level 3	Fire Blankets			Added 2015 01 30
23-29 35 00	Level 2	Fire Rescue Component			Added 2015 01 30
23-29 35 11	Level 3	Evacuation Chairs			Added 2015 01 30

23-29 35 13	Level 3	Evacuation Slides			Added 2015 01 30
23-29 37 00	Level 2	Occupational Safety and Health Equipment			Added 2015 01 30
23-29 37 11	Level 3	Emergency Drench Hoses			Added 2015 01 30
23-29 37 13	Level 3	Emergency Eye Wash Stations			Added 2015 01 30
23-29 37 13 11	Level 4	Counter Top Eye Wash Stations			Added 2015 01 30
23-29 37 13 13	Level 4	Floor Mounted Eye Wash Stations			Added 2015 01 30
23-29 37 13 15	Level 4	Combination Emergency Eye Wash Stations			Added 2015 01 30
23-29 37 13 17	Level 4	Dedicated Emergency Eye Wash Stations			Added 2015 01 30
23-29 37 15	Level 3	Emergency Showers			Added 2015 01 30
23-29 37 15 11	Level 4	Combination Emergency Showers			Added 2015 01 30
23-29 37 15 13	Level 4	Dedicated Emergency Showers			Added 2015 01 30
23-29 39 00	Level 2	Environmental Safety Equipment	y		
23-29 39 11	Level 3	Environmental Spill Kits	y		
23-29 39 13	Level 3	Pollution Monitoring and Control	y		
23-29 39 13 11	Level 4	Air Pollution Monitoring Systems	y		
23-29 39 13 13	Level 4	Water Pollution Monitoring Systems	y		
23-29 39 15	Level 3	Built In Failure Detection	y		
23-29 39 15 11	Level 4	Infiltration Detection	y		
23-29 39 15 13	Level 4	Service Leak Detection	y		
23-29 39 15 13 11	Level 5	Gas Leak Detection Agents	y		
23-29 39 15 13 13	Level 5	Water Leak Detection	y		
23-31 29 00	Level 2	Hot Water Heaters	y		
23-31 29 11	Level 3	23-31 29 11	y		
23-31 29 11 11	Level 4	23-31 29 11 11	y		
23-31 29 11 13	Level 4	23-31 29 11 13	y		
23-31 29 13	Level 3	Hot Water Tank Heaters	y		
23-31 29 13 11	Level 4	Hot Water Tank Electric Heaters	y		
23-31 29 13 13	Level 4	Hot Water Tank Gas Heaters	y		
23-31 29 13 15	Level 4	Hot Water Tank Steam Heaters	y		
23-31 29 13 17	Level 4	Hot Water Tank Fuel Oil Heaters	y		
23-31 29 13 11	Level 4	Hot Water Tank Electric Heaters	y		
23-33 11 00	Level 2	Commercial Boilers	y		
23-33 11 11	Level 3	Boiler Controls	y		
23-33 11 11 11	Level 4	Boiler Control Panels	y		
23-33 11 11 13	Level 4	Boiler Burner Controls	y		
23-33 11 13	Level 2	Condensing Boilers	y		
23-33 11 15	Level 3	Fire Tube Boilers	y		
23-33 11 15 11	Level 4	High Pressure Steam Fire Tube Boilers	y		
23-33 11 15 13	Level 4	High Temperature Hot Water Fire Tube Boilers	y		
23-33 11 15 15	Level 4	Low Pressure Steam Fire Tube Boilers	y		
23-33 11 15 17	Level 4	Low Temperature Hot Water Fire Tube Boilers	y		
23-33 11 17	Level 3	Flexible Tube Boilers	y		
23-33 11 17 11	Level 4	High Pressure Steam Flexible Tube Boilers	y		
23-33 11 17 13	Level 4	High Temperature Hot Water Flexible Tube Boilers	y		
23-33 11 17 15	Level 4	Low Pressure Steam Flexible Tube Boilers	y		
23-33 11 17 17	Level 4	Low Temperature Hot Water Flexible Tube Boilers	y		
23-33 11 19	Level 3	Sectionalized Cast Iron Boilers	y		
23-33 11 19 11	Level 4	Low Pressure Steam Sectionalized Cast Iron Boilers	y		
23-33 11 19 13	Level 4	Low Temperature Hot Water Sectionalized Cast Iron Boilers	y		
23-33 11 21	Level 3	Water Tube Boilers	y		
23-33 11 21 11	Level 4	High Pressure Steam Water Tube Boilers	y		
23-33 11 21 13	Level 4	High Temperature Hot Water Water Tube Boilers	y		
23-33 11 21 15	Level 4	Low Pressure Steam Water Tube Boilers	y		
23-33 11 21 17	Level 4	Low Temperature Hot Water Water Tube Boilers	y		
23-33 11 22	Level 3	Electric Boilers	y		
23-33 11 23	Level 3	Boiler Components	y		

23-33 11 23 11	Level 4	Boiler Joint Fillers and Sealants	y		
23-33 11 23 13	Level 4	Boiler Fuel Burners	y		
23-33 11 23 15	Level 4	Boiler Fuel Oil Filters	y		
23-33 11 23 17	Level 4	Boiler Nozzles	y		
23-33 11 23 19	Level 4	Boiler Induction Blowers	y		
23-33 11 23 21	Level 4	Boiler Fuel Gas Heat Recovery Devices	y		
23-33 11 23 23	Level 4	Boiler Draft Fans	y		
23-33 13 00	Level 2	Furnaces	y		
23-33 13 11	Level 3	Furnace Controls	y		
23-33 13 11 11	Level 4	Furnace Control Panels	y		
23-33 13 11 13	Level 4	Furnace Burner Controls	y		
23-33 13 13	Level 3	Coal Fired Furnaces	y		
23-33 13 15	Level 3	Electric Resistance Furnaces	y		
23-33 13 17	Level 3	Natural Gas Fired Furnaces	y		
23-33 13 19	Level 3	Gasoline Fired Furnaces	y		
23-33 13 21	Level 3	Fuel Oil Fired Furnaces	y		
23-33 13 23	Level 3	Oil Fired Furnaces	y		
23-33 13 25	Level 3	Propane Fired Furnaces	y		
23-33 13 27	Level 3	Furnace Components	y		
23-33 13 27 11	Level 4	Furnace Joint Fillers and Sealants	y		
23-33 13 27 13	Level 4	Furnace Fuel Burners	y		
23-33 13 27 15	Level 4	Furnace Fuel Oil Filters	y		
23-33 13 27 17	Level 4	Furnace Nozzles	y		
23-33 15 00	Level 2	HVAC Heating Units	y		
23-33 15 11	Level 3	Propane HVAC Heaters	y		
23-33 15 11 11	Level 4	Indoor Propane HVAC Heaters	y		
23-33 15 11 13	Level 4	Outdoor Propane HVAC Heaters	y		
23-33 15 13	Level 3	Heating Stoves	y		
23-33 15 13 11	Level 4	Cast Iron Heating Stoves	y		
23-33 15 13 13	Level 4	Stone Heating Stoves	y		
23-33 15 13 15	Level 4	Welded Steel Heating Stoves	y		
23-33 15 13 17	Level 4	Heating Stove Components	y		
23-33 15 13 17 11	Level 5	Heating Stove Fenders	y		
23-33 15 13 17 13	Level 5	Heating Stove Hoods	y		
23-33 15 13 17 15	Level 5	Heating Stove Pipes	y		
23-33 15 15	Level 3	Specialized Surface Heating Products	y		
23-33 15 15 11	Level 4	Heating Sheets	n		
23-33 15 15 11 11	Level 5	Heating Sheets for Walls	n		
23-33 15 15 11 13	Level 5	Heating Sheets for Ceilings	n		
23-33 15 15 11 15	Level 5	Embedded Electric Heating Sheets	n		
23-33 15 15 11 17	Level 5	Heating Sheets for Glazing	n		
23-33 15 15 13	Level 4	Heating Cables	y		
23-33 15 15 15	Level 4	Pipe Heat Tape	y		
23-33 15 15 17	Level 4	Cable Heat Trace	y		
23-33 15 15 19	Level 4	Heated Ceiling Panels	y		
23-33 15 15 21	Level 4	Pipe Heat Tracing	y		
23-33 15 17	Level 3	Fuel Fired HVAC Heaters	y		
23-33 15 17 11	Level 4	Fuel Fired HVAC Duct Heaters	y		
23-33 15 17 13	Level 4	Fuel Fired HVAC Radiant Heaters	y		
23-33 15 17 15	Level 4	Fuel Fired HVAC Unit Heaters	y		
23-33 15 17 17	Level 4	Fuel Fired HVAC Air Heaters	y		
23-33 15 19	Level 3	Forced Air Fuel Fired HVAC Heaters	y		
23-33 15 19 11	Level 4	Forced Air Fuel Fired HVAC Duct Heaters	y		
23-33 15 19 13	Level 4	Forced Air Fuel Fired HVAC Radiant Heaters	y		
23-33 15 19 15	Level 4	Forced Air Fuel Fired HVAC Unit Heaters	y		
23-33 15 19 17	Level 4	Forced Air Fuel Fired HVAC Air Heaters	y		

23-33 15 21	Level 3	Hydronic HVAC Heaters	y		
23-33 15 21 11	Level 4	Cast Iron Radiators	y		
23-33 15 21 13	Level 4	Finned Tube Radiators	y		
23-33 15 21 15	Level 4	Plate Radiators	y		
23-33 15 21 17	Level 4	Radiation Heating Panels	y		
23-33 15 23	Level 3	Forced Air Hydronic HVAC Heaters	y		
23-33 15 23 11	Level 4	Forced Air Cast Iron Radiators	y		
23-33 15 23 13	Level 4	Forced Air Finned Tube Radiators	y		
23-33 15 23 15	Level 4	Forced Air Plate Radiators	y		
23-33 15 23 17	Level 4	Forced Air Radiation Heating Panels	y		
23-33 15 25	Level 3	Electric HVAC Heaters	y		
23-33 15 25 11	Level 4	Halogen Electric HVAC Heaters	y		
23-33 15 25 13	Level 4	Infrared Plate HVAC Heaters	y		
23-33 15 25 15	Level 4	Ultraviolet HVAC Heaters	y		
23-33 15 25 17	Level 4	Electric HVAC Resitive Unit Heaters	y		
23-33 15 27	Level 3	Forced Air Electric HVAC Heaters	y		
23-33 15 27 11	Level 4	Forced Air Halogen Electric HVAC Heaters	y		
23-33 15 27 13	Level 4	Forced Air Infrared Plate HVAC Heaters	y		
23-33 15 27 15	Level 4	Forced Air Ultraviolet HVAC Heaters	y		
23-33 15 27 17	Level 4	Forced Air Electric HVAC Resitive Unit Heaters	y		
23-33 15 29	Level 3	HVAC Steam Hot Water Converters	y		
23-33 17 00	Level 2	Heat Pumps	y		
23-33 17 11	Level 3	Packaged Heat Pumps	y		
23-33 17 11 11	Level 4	Air Source Packaged Heat Pumps	y		
23-33 17 11 13	Level 4	Water Source Packaged Heat Pumps	y		
23-33 17 13	Level 3	Split System Heat Pumps	y		
23-33 17 13 11	Level 4	Air Source Split System Heat Pumps	y		
23-33 17 13 13	Level 4	Water Source Split System Heat Pumps	y		
23-33 19 00	Level 2	Cooling and Freeze Components	y		
23-33 21 00	Level 2	Chillers	y		
23-33 21 11	Level 3	Absorption Chillers	y		
23-33 21 11 11	Level 4	Direct Fired Absorption Chillers	y		
23-33 21 11 13	Level 4	Steam Absorption Chillers	y		
23-33 21 13	Level 3	Chillers	y		
23-33 21 13 11	Level 4	Central Package Unit Chillers	y		
23-33 21 13 13	Level 4	Centrifugal Chillers	y		
23-33 21 13 13 11	Level 5	Packaged Centrifugal Chillers	y		
23-33 21 13 13 13	Level 5	Split System Centrifugal Chillers	y		
23-33 21 13 15	Level 4	Reciprocating Chillers	y		
23-33 21 13 15 11	Level 5	Packaged Reciprocating Chillers	y		
23-33 21 13 15 13	Level 5	Split System Reciprocating Chillers	y		
23-33 21 13 17	Level 4	Rotary Chillers	y		
23-33 21 13 17 11	Level 5	Packaged Rotary Chillers	y		
23-33 21 13 17 13	Level 5	Split System Rotary Chillers	y		
23-33 21 13 19	Level 4	Rotary Screw Chillers	y		
23-33 21 13 19 11	Level 5	Packaged Rotary Screw Chillers	y		
23-33 21 13 19 13	Level 5	Split System Rotary Screw Chillers	y		
23-33 21 13 21	Level 4	Screw Chillers	y		
23-33 21 13 21 11	Level 5	Packaged Screw Chillers	y		
23-33 21 13 21 13	Level 5	Split System Screw Chillers	y		
23-33 21 13 23	Level 4	Scroll Chillers	y		
23-33 21 13 23 11	Level 5	Packaged Scroll Chillers	y		
23-33 21 13 23 13	Level 5	Split System Scroll Chillers	y		
23-33 23 00	Level 2	Cooling Towers	y		
23-33 23 11	Level 3	Mechanical Draft Cooling Towers	y		
23-33 23 13	Level 3	Natural Draft Cooling Towers	y		

23-33 25 00	Level 2	Air Handling Units	y		
23-33 25 11	Level 3	Built Up Air Handling Units	y		
23-33 25 11 11	Level 4	Built Up Indoor Air Handling Units	y		
23-33 25 11 13	Level 4	Built Up Rooftop Air Handling Units	y		
23-33 25 13	Level 3	Customized Air Handling Units	y		
23-33 25 13 11	Level 4	Customized Indoor Air Handling Units	y		
23-33 25 13 13	Level 4	Customized Rooftop Air Handling Units	y		
23-33 25 15	Level 3	Heating and Ventilating Units	y		
23-33 25 17	Level 3	Modular Air Handling Units	y		
23-33 25 17 11	Level 4	Modular Indoor Air Handling Units	y		
23-33 25 17 13	Level 4	Modular Rooftop Air Handling Units	y		
23-33 25 19	Level 3	Pre Fabricated Air Handling Units	y		
23-33 27 00	Level 2	Air Humidity Control Equipment	y		
23-33 27 11	Level 3	Air Washers	y		
23-33 27 11 11	Level 4	Convection Air Washers	y		
23-33 27 11 13	Level 4	Evaporative Air Washers	y		
23-33 27 13	Level 3	Dehumidifiers	y		
23-33 27 13 11	Level 4	Dehumidifiers	y		
23-33 27 13 11 11	Level 5	Swimming Pool Dehumidification Units	y		
23-33 27 13 13	Level 4	Permanently Installed Dehumidifiers	y		
23-33 27 13 15	Level 4	Portable Dehumidifiers	y		
23-33 27 15	Level 3	Air Humidifiers	y		
23-33 27 17	Level 3	Vaporizers	y		
23-33 29 21	Level 3	Diffuser Firestop Flaps	y		
23-33 29 23	Level 3	Fire Dampers	y		
23-33 29 23 11	Level 4	Manual Fire Dampers	y		
23-33 29 23 13	Level 4	Automatic Fire Dampers	y		
23-33 29 25	Level 3	Smoke Dampers	y		
23-33 29 25 11	Level 4	Manual Smoke Dampers	y		
23-33 29 25 13	Level 4	Automatic Smoke Dampers	y		
23-33 29 39	Level 3	Fire Shutters for Air Ductwork	y		
23-33 31 00	Level 2	Air Circulators	y		
23-33 31 11	Level 3	Air Curtains	y		
23-33 31 11 11	Level 4	Heated Air Curtains	y		
23-33 31 11 13	Level 4	Non Heated Air Curtains	y		
23-33 31 13	Level 3	Blowers	y		
23-33 31 13 11	Level 4	Permanently Installed Blowers	y		
23-33 31 13 13	Level 4	Portable Blowers	y		
23-33 31 15	Level 3	Exhaust Hoods	y		
23-33 31 15 11	Level 4	Canopy Exhaust Hoods	y		
23-33 31 15 13	Level 4	Chemical Fume Hoods	y		
23-33 31 15 15	Level 4	Perchloric Acid Fume Hoods	y		
23-33 31 15 17	Level 4	Radio Isotope Fume Hoods	y		
23-33 31 15 19	Level 4	Snorkel Exhaust Hoods	y		
23-33 31 15 21	Level 4	Grease Exhaust Hoods	y		
23-33 31 17	Level 3	Exhaust Hood Fire Suppression System	y		
23-33 31 17 11	Level 4	Chemical Exhaust Hood Fire Suppression Systems	y		
23-33 31 17 13	Level 4	Gas Exhaust Hood Fire Suppression Systems	y		
23-33 31 19	Level 3	Fans	y		
23-33 31 19 11	Level 4	Axial Fans	y		
23-33 31 19 11 11	Level 5	Axial Plug Fans	y		
23-33 31 19 11 13	Level 5	Axial Vane Fans	y		
23-33 31 19 11 15	Level 5	Ceiling Fans	y		
23-33 31 19 11 17	Level 5	Propeller Fans	y		
23-33 31 19 11 19	Level 5	Tube Axial Fans	y		
23-33 31 19 11 21	Level 5	Variable Pitch Axial Vane Fans	y		

23-33 31 19 13	Level 4	Centrifugal Fans	y		
23-33 31 19 13 11	Level 5	Centrifugal Plug Fans	y		
23-33 31 19 13 13	Level 5	Double Inlet Centrifugal Fans	y		
23-33 31 19 13 15	Level 5	Single Inlet Centrifugal Fans	y		
23-33 31 21	Level 3	Power Ventilators	y		
23-33 31 21 11	Level 4	Centrifugal Power Ventilators	y		
23-33 31 21 11 11	Level 5	Down Blast Centrifugal Power Ventilators	y		
23-33 31 21 11 13	Level 5	Up Blast Centrifugal Power Ventilators	y		
23-33 31 21 13	Level 4	Propeller Power Ventilators	y		
23-33 31 21 13 11	Level 5	Down Blast Propeller Power Ventilators	y		
23-33 31 21 13 13	Level 5	Up Blast Propeller Power Ventilators	y		
23-33 33 00	Level 2	HVAC Fan Coil Units	y		
23-33 33 11	Level 3	Fan Coil Units	y		
23-33 33 11 11	Level 4	Fan Coil Cooling Units	y		
23-33 33 11 11 11	Level 5	2 Pipe Fan Coil Cooling Units	y		
23-33 33 11 11 13	Level 5	4 Pipe Fan Coil Cooling Units	y		
23-33 33 11 13	Level 4	Fan Coil Heating Units	y		
23-33 33 11 13 11	Level 5	2 Pipe Fan Coil Cooling Units	y		
23-33 33 11 13 13	Level 5	4 Pipe Fan Coil Cooling Units	y		
23-33 33 11 15	Level 4	Fan Coil Heating and Cooling Units	y		
23-33 33 11 15 11	Level 5	2 Pipe Fan Coil Heating and Cooling Units	y		
23-33 33 11 15 13	Level 5	4 Pipe Fan Coil Heating and Cooling Units	y		
23-33 35 00	Level 2	HVAC Coils	y		
23-33 35 11	Level 3	HVAC Coils	y		
23-33 35 11 11	Level 4	HVAC Glycol Coils	y		
23-33 35 11 13	Level 4	HVAC Steam Coils	y		
23-33 35 11 15	Level 4	HVAC Water Coils	y		
23-33 37 00	Level 2	Refrigerant Condensing Units	y		
23-33 37 11	Level 3	Packaged Refrigerant Coils and Fan Units	y		
23-33 37 13	Level 3	Refrigerant Condensing Coils	y		
23-33 37 15	Level 3	Refrigerant Evaporators	y		
23-33 39 00	Level 2	Air Conditioning Equipment	y		
23-33 39 11	Level 3	Air Conditioners	y		
23-33 39 11 11	Level 4	Room Air Conditioners	y		
23-33 39 13	Level 3	High Pressure Air Conditioning Units	y		
23-33 39 15	Level 3	Make Up Air Units	y		
23-33 39 15 11	Level 4	Make Up Air Units With Heat	y		
23-33 39 15 13	Level 4	Make Up Air Units Without Heat	y		
23-33 39 17	Level 3	Packaged Air Conditioners	y		
23-33 39 17 11	Level 4	Dual Pack Packaged Air Conditioners	y		
23-33 39 17 11 11	Level 5	Air Cooled Dual Pack Packaged Air Conditioners	y		
23-33 39 17 11 13	Level 5	Water Cooled Dual Pack Packaged Air Conditioners	y		
23-33 39 17 13	Level 4	Single Pack Packaged Air Conditioners	y		
23-33 39 17 13 11	Level 5	Air Cooled Single Pack Packaged Air Conditioners	y		
23-33 39 17 13 13	Level 5	Water Cooled Single Pack Packaged Air Conditioners	y		
23-33 39 17 13 15	Level 5	Unitary Air Conditioning Equipment	y		
23-33 39 19	Level 3	Packaged Terminal Air Conditioning Units	y		
23-33 39 19 11	Level 4	Fixed Packaged Terminal Air Conditioners	y		
23-33 39 19 11 11	Level 5	Air Cooled Fixed Packaged Terminal Air Conditioners	y		
23-33 39 19 11 13	Level 5	Water Cooled Fixed Packaged Terminal Air Conditioners	y		
23-33 39 19 13	Level 4	Portable Packaged Terminal Air Conditioners	y		
23-33 39 19 13 11	Level 5	Air Cooled Portable Packaged Terminal Air Conditioners	y		
23-33 39 19 13 13	Level 5	Water Cooled Portable Packaged Terminal Air Conditioners	y		
23-33 39 19 15	Level 4	Window Packaged Terminal Air Conditioners	y		
23-33 39 19 15 11	Level 5	Air Cooled Window Packaged Terminal Air Conditioners	y		
23-33 39 19 15 13	Level 5	Water Cooled Window Packaged Terminal Air Conditioners	y		

23-33 39 21	Level 3	Split System Air Conditioning Units	y		
23-33 41 00	Level 2	HVAC Air Terminals	y		
23-33 41 11	Level 3	Fan Powered Terminal Air Units	y		
23-33 41 11 11	Level 4	Mixing Fan Powered Terminal Air Units	y		
23-33 41 11 11 11	Level 5	Single Duct Mixing Fan Powered Terminal Air Units	y		
23-33 41 11 11 13	Level 5	Dual Duct Mixing Fan Powered Terminal Air Units	y		
23-33 41 11 13	Level 4	Non Mixing Fan Powered Terminal Air Units	y		
23-33 41 11 13 11	Level 5	Single Duct Mixing Fan Powered Terminal Air Units	y		
23-33 41 11 13 13	Level 5	Dual Duct Mixing Fan Powered Terminal Air Units	y		
23-33 41 13	Level 3	Induction Terminal Air Units	y		
23-33 41 13 11	Level 4	Constant Volume Air Induction Terminal Air Units	y		
23-33 41 13 11 11	Level 5	Single Duct Constant Volume Air Induction Terminal Air Units	y		
23-33 41 13 11 13	Level 5	Dual Duct Constant Volume Air Induction Terminal Air Units	y		
23-33 41 13 13	Level 4	Variable Air Volume Induction Terminal Air Units	y		
23-33 41 13 13 11	Level 5	Single Duct Variable Air Volume Induction Terminal Air Units	y		
23-33 41 13 13 13	Level 5	Dual Duct Variable Air Volume Induction Terminal Air Units	y		
23-33 41 15	Level 3	HVAC Mixing Boxes	y		
23-33 41 17	Level 3	Terminal Air Units	y		
23-33 41 17 11	Level 4	Constant Volume Air Terminal Units	y		
23-33 41 17 13	Level 4	Variable Air Volume Terminal Units	y		
23-33 41 17 13 11	Level 5	Dual Duct Variable Air Volume Terminal Units	y		
23-33 41 17 13 13	Level 5	Single Duct Variable Air Volume Terminal Units	y		
23-33 41 19	Level 3	Exhaust Terminals	y		
23-33 43 00	Level 2	HVAC Condenser Units	y		
23-33 43 11	Level 3	Air Cooled Condenser Units	y		
23-33 43 11	Level 3	Air Cooled Condenser Units	y		
23-33 43 11 11	Level 4	Indoor Air Cooled Condenser Units	y		
23-33 43 11 13	Level 4	Outdoor Air Cooled Condenser Units	y		
23-33 43 13	Level 3	Evaporative Condenser Units	y		
23-33 43 15	Level 3	Refrigeration Condenser Units	y		
23-33 43 15 11	Level 4	Air Cooled Refrigeration Condenser Units	y		
23-33 43 15 13	Level 4	Water Cooled Refrigeration Condenser Units	y		
23-33 43 17	Level 3	Water Cooled Condenser Units	y		
23-33 43 17 11	Level 4	Indoor Water Cooled Condenser Units	y		
23-33 45 00	Level 2	HVAC Coolers	y		
23-33 45 11	Level 3	HVAC Dry Coolers	y		
23-33 45 13	Level 3	HVAC Evaporative Coolers	y		
23-33 47 00	Level 2	Air Dryers	y		
23-33 47 11	Level 3	Refrigerated Air Dryers	y		
23-33 47 13	Level 3	Regenerative Desiccant Air Dryers	y		
23-33 51 00	Level 2	HVAC Specialized Equipment	y		
23-33 51 11	Level 3	Refrigerant Monitors	y		
23-33 51 13	Level 3	Refrigerant Purge Units	y		
23-33 51 15	Level 3	Ultraviolet Disinfection Lighting	y		
23-33 53 00	Level 2	Solar Water Heating Equipment	y		
23-33 53 11	Level 3	Solar Water Heating Packaged Units	y		
23-33 53 13	Level 3	Solar Water Heating Collector Components	y		
23-33 53 13 11	Level 4	Solar Water Heating Absorber Plates	y		
23-33 53 13 13	Level 4	Solar Water Heating Absorber Tubing	y		
23-33 53 13 15	Level 4	Solar Water Heating Coatings and Surface Treatment	y		
23-33 53 13 17	Level 4	Solar Water Heating Collector Insulation	y		
23-33 53 13 19	Level 4	Solar Water Heating Glazing	y		
23-33 53 13 21	Level 4	Solar Water Heating Housing and Framing	y		
23-33 53 13 23	Level 4	Solar Water Heating Reflectors	y		
23-33 53 15	Level 3	Solar Water Heating Collector Units	y		
23-33 53 15 11	Level 4	Solar Water Heating Flat Plate Collectors	y		

23-33 53 15 13	Level 4	Solar Water Heating Concentrating Collectors	y		
23-33 53 15 15	Level 4	Solar Water Heating Vacuum Tube Collectors	y		
23-33 55 00	Level 2	Energy HVAC Recovery Equipment	y		
23-35 11 00	Level 2	Electrical Generators	y		
23-35 11 11	Level 3	Single Unit Electrical Generators	y		
23-35 11 11 11	Level 4	Engine Electrical Generators	y		
23-35 11 11 13	Level 4	Motor Electrical Generators	y		
23-35 11 12	Level 3	Single Unit Electrical Generator Engines	y		
23-35 11 12 11	Level 4	Electrical Generation Diesel Engines	y		
23-35 11 12 13	Level 4	Electrical Generation Gas Engines	y		
23-35 11 12 15	Level 4	Electrical Generation Natural Gas Engines	y		
23-35 11 12 15 11	Level 5	Electrical Generation Natural Gas Turbines	y		
23-35 11 12 17	Level 4	Electrical Generation Steam Turbines	y		
23-35 11 13	Level 3	Motor Generator Sets	y		
23-35 11 13 11	Level 4	Alternating Current Frequency Converters	y		
23-35 11 13 13	Level 4	Alternating Current Generator Sets	y		
23-35 11 13 15	Level 4	Direct Current Generator Sets	y		
23-35 11 13 17	Level 4	Multiple Frequency Electrical Generator Sets	y		
23-35 11 13 19	Level 4	Multiple Voltage Electrical Generator Sets	y		
23-35 11 15	Level 3	Engine Generator Sets	y		
23-35 11 15 11	Level 4	Diesel Generator Sets	y		
23-35 11 15 13	Level 4	Gas Generator Sets	y		
23-35 11 15 15	Level 4	Natural Gas Generator Sets	y		
23-35 11 15 17	Level 4	Steam Turbine Generator Sets	y		
23-35 11 15 19	Level 4	Thermal Generator Sets	y		
23-35 11 15 21	Level 4	Hydro Turbine Generator Sets	y		
23-35 11 15 23	Level 4	Wind Generator Sets	y		
23-35 11 17	Level 3	Photovoltaic Generators	y		
23-35 11 17 11	Level 4	Photoelectric Cell	y		
23-35 11 17 12	Level 4	Photoelectric Panel	y		
23-35 11 17 13	Level 4	Photovoltaic Array	y		
23-35 11 17 15	Level 4	Photovoltaic Collectors	y		
23-35 13 00	Level 2	Transformers	y		
23-35 13 11	Level 3	Current Transformers	y		
23-35 13 13	Level 3	Instrument Transformers	y		
23-35 13 13 11	Level 4	Current Instrument Transformers	y		
23-35 13 13 13	Level 4	Pulse Instrument Transformers	y		
23-35 13 13 15	Level 4	Voltage Instrument Transformers	y		
23-35 13 15	Level 3	Electrical Network Transformers	y		
23-35 13 15 11	Level 4	Electrical Network Isolation Transformers	y		
23-35 13 15 11 11	Level 5	Electrical Network Dry Isolation Transformers	y		
23-35 13 15 11 13	Level 5	Electrical Network Oil Filled Isolation Transformers	y		
23-35 13 15 13	Level 4	Electrical Network Step Down Transformers	y		
23-35 13 15 13 11	Level 5	Electrical Network Dry Step Down Transformers	y		
23-35 13 15 13 13	Level 5	Electrical Network Oil Filled Step Down Transformers	y		
23-35 13 15 15	Level 4	Electrical Network Step Up Transformers	y		
23-35 13 15 15 11	Level 5	Electrical Network Dry Step Up Transformers	y		
23-35 13 15 15 13	Level 5	Electrical Network Oil Filled Step Up Transformers	y		
23-35 13 17	Level 3	Power Transformers	y		
23-35 13 17 11	Level 4	Power Harmonic Mitigation Transformers	y		
23-35 13 17 11 11	Level 5	Power Dry Harmonic Mitigation Transformers	y		
23-35 13 17 11 13	Level 5	Power Oil Filled Harmonic Mitigation Transformers	y		
23-35 13 17 13	Level 4	Power Isolation Transformers	y		
23-35 13 17 13 11	Level 5	Power Dry Isolation Transformers	y		
23-35 13 17 13 13	Level 5	Power Oil Filled Isolation Transformers	y		
23-35 13 17 15	Level 4	Power Step Down Transformers	y		

23-35 13 17 15 11	Level 5	Power Dry Step Down Transformers	y		
23-35 13 17 15 13	Level 5	Power Oil Filled Step Down Transformers	y		
23-35 13 17 17	Level 4	Power Step Up Transformers	y		
23-35 13 17 17 11	Level 5	Power Dry Step Up Transformers	y		
23-35 13 17 17 13	Level 5	Power Oil Filled Step Up Transformers	y		
23-35 13 19	Level 3	Transformer Accessories	y		
23-35 13 19 11	Level 4	Transformer Commutators	y		
23-35 13 19 13	Level 4	Transformer Ballasts	y		
23-35 15 00	Level 2	Electric Motors	y		
23-35 15 11	Level 3	Alternating Current (AC) Motors	y		
23-35 15 11 11	Level 4	Single Phase AC Motors	y		
23-35 15 11 11 11	Level 5	Multi Speed Single Phase AC Motors	y		
23-35 15 11 11 13	Level 5	Single Speed Single Phase AC Motors	y		
23-35 15 11 11 15	Level 5	Synchronous Single Phase AC Motors	y		
23-35 15 11 13	Level 4	Three Phase AC Motors	y		
23-35 15 11 13 11	Level 5	Multi Speed Three Phase AC Motors	y		
23-35 15 11 13 13	Level 5	Single Speed Three Phase AC Motors	y		
23-35 15 11 13 15	Level 5	Synchronous Three Phase AC Motors	y		
23-35 15 13	Level 3	Direct Current (DC) Motors	y		
23-35 15 13 11	Level 4	Brushless DC Motors	y		
23-35 15 13 13	Level 4	Compound Wound DC Motors	y		
23-35 15 13 15	Level 4	Coreless DC Motors	y		
23-35 15 13 17	Level 4	Limited Angle Torque DC Motors	y		
23-35 15 13 19	Level 4	Linear DC Motors	y		
23-35 15 13 21	Level 4	Permanent Magnetic DC Motors	y		
23-35 15 13 23	Level 4	Series Wound DC Motors	y		
23-35 15 13 25	Level 4	Shunt Wound DC Motors	y		
23-35 15 13 27	Level 4	Step DC Motors	y		
23-35 15 15	Level 3	DC Servo Motors	y		
23-35 15 17	Level 3	Dynamotors	y		
23-35 15 19	Level 3	Hydraulic Driven Motors	y		
23-35 15 21	Level 3	Pneumatic Driven Motors	y		
23-35 15 23	Level 3	Steam Driven Motors	y		
23-35 17 00	Level 2	Variable Speed Drives	y		
23-35 17 11	Level 3	Direct Current Electronic Speed Controller Drives	y		
23-35 17 13	Level 3	Slip Controlled Drives	y		
23-35 17 15	Level 3	Variable Frequency Drives	y		
23-35 17 15 11	Level 4	Pulse Width Variable Frequency Drives	y		
23-35 17 15 13	Level 4	Current Source Input Variable Frequency Drives	y		
23-35 17 15 15	Level 4	Variable Voltage Input Variable Frequency Drives	y		
23-35 19 00	Level 2	Batteries	y		
23-35 19 13	Level 3	Non Rechargeable Batteries	y		
23-35 19 15	Level 3	Rechargeable Batteries	y		
23-35 19 15 11	Level 4	Alkaline Batteries	y		
23-35 19 15 13	Level 4	Lead Acid Batteries	y		
23-35 19 15 15	Level 4	Lithium Batteries	y		
23-35 19 15 17	Level 4	Manganese Batteries	y		
23-35 19 15 19	Level 4	Mercuric Oxide Batteries	y		
23-35 19 15 21	Level 4	Nickel Cadmium Batteries	y		
23-35 19 15 23	Level 4	Nickel Hydrogen Batteries	y		
23-35 19 15 25	Level 4	Nickel Iron Batteries	y		
23-35 19 15 27	Level 4	Nickel Metal Hydride Batteries	y		
23-35 19 15 29	Level 4	Nickel Sodium Chloride Batteries	y		
23-35 19 15 31	Level 4	Silver Oxide Batteries	y		
23-35 21 00	Level 2	Battery Chargers	y		
23-35 23 00	Level 2	Power Conditioning Equipment	y		

23-35 23 11	Level 3	Harmonic Control Devices	y		
23-35 23 11 11	Level 4	Electric Interference Suppressor Filters	y		
23-35 23 11 13	Level 4	Harmonic Filters	y		
23-35 23 13	Level 3	Power Converters	y		
23-35 23 13 11	Level 4	Rotary Converters	y		
23-35 23 15	Level 3	Static Power Converters	y		
23-35 23 15 11	Level 4	Static Rectifiers	y		
23-35 23 15 13	Level 4	Ondulators	y		
23-35 23 15 15	Level 4	Combined Converter Sets	y		
23-35 23 15 17	Level 4	Direct Current (DC) Drive Controllers	y		
23-35 23 15 19	Level 4	Slip Controllers	y		
23-35 23 15 21	Level 4	Static Frequency Converters	y		
23-35 23 15 23	Level 4	Static Uninterruptible Power Supplies	y		
23-35 23 15 25	Level 4	Variable Frequency Controllers	y		
23-35 23 15 27	Level 4	Frequency Changers	y		
23-35 23 15 29	Level 4	Rotary Uninterruptible Power Units	y		
23-35 23 17	Level 3	Power Inverters	y		
23-35 23 17 11	Level 4	Commutator Inverters	y		
23-35 23 17 13	Level 4	Solid State Inverters	y		
23-35 23 19	Level 4	Powerfactor Correction Devices	y		
23-35 23 19 11	Level 4	Capacitive and Inductive Power Correction Devices	y		
23-35 23 19 13	Level 4	Capacitive Power Correction Devices	y		
23-35 23 19 15	Level 4	Inductive Power Correction Devices	y		
23-35 23 19 17	Level 4	Capacitors	y		
23-35 23 19 19	Level 4	Power Factor Controls (Cosines Phi)	y		
23-35 23 21	Level 3	Uninterrupted Power Supply (UPS) Units	y		
23-35 23 21 11	Level 4	Uninterruptible Power Supply Component Systems	y		
23-35 23 21 13	Level 4	Uninterruptible Power Supply Packaged Units	y		
23-35 25 00	Level 2	Electrical Instrumentation and Controls	y		
23-35 25 11	Level 3	Electrical Meters	y		
23-35 25 11 11	Level 4	Power Meters	y		
23-35 25 11 13	Level 4	Voltage Meters	y		
23-35 25 11 15	Level 4	Resistance Meters	y		
23-35 25 11 17	Level 4	Frequency Meters	y		
23-35 25 11 19	Level 4	Multi Meters	y		
23-35 25 11 21	Level 4	Current Meters	y		
23-35 25 11 23	Level 4	Amp Hour Meters	y		
23-35 25 11 25	Level 4	Power Factor Meters	y		
23-35 25 11 27	Level 4	Kilowatt Hour Meters	y		
23-35 25 11 27 11	Level 5	Electromechanical Remote Kilowatt Hour Meters	y		
23-35 25 11 27 13	Level 5	Electromechancial Kilowatt Hour Meters	y		
23-35 25 11 27 15	Level 5	Solid State Remote Kilowatt Hour Meters	y		
23-35 25 11 27 17	Level 5	Solid State Kilowatt Hour Meters	y		
23-35 25 11 29	Level 4	Multiple Tariff Meters	y		
23-35 25 13	Level 3	Electrical Energy Recording Devices	y		
23-35 25 13 11	Level 4	Watt Hour Recorders	y		
23-35 25 15	Level 3	Electrical Network Protection Modules	y		
23-35 25 17	Level 3	Electrical Power Protection Modules	y		
23-35 25 19	Level 3	Motor Starters	y		
23-35 25 21	Level 3	Programmable Logic Controllers	y		
23-35 25 23	Level 3	Electrical Control Panels	y		
23-35 25 25	Level 3	Electrical Line Supervisor Sets	y		
23-35 29 00	Level 2	Circuit Breakers	y		
23-35 29 11	Level 3	Air Circuit Breakers	y		
23-35 29 11 11	Level 4	Network Distribution Air Circuit Breakers	y		
23-35 29 11 13	Level 4	Power Distribution Air Circuit Breakers	y		

23-35 29 13	Level 3	Gas Circuit Breakers	y		
23-35 29 13 11	Level 4	Network Distribution Gas Circuit Breakers	y		
23-35 29 13 13	Level 4	Power Distribution Gas Circuit Breakers	y		
23-35 29 15	Level 3	Ground Fault Circuit Breakers	y		
23-35 29 17	Level 3	Molded Case Circuit Breakers	y		
23-35 29 17 11	Level 4	Shunt Molded Case Circuit Breakers	y		
23-35 29 19	Level 3	Oil Circuit Breakers	y		
23-35 29 19 11	Level 4	Network Distribution Oil Circuit Breakers	y		
23-35 29 19 13	Level 4	Power Distribution Oil Circuit Breakers	y		
23-35 29 21	Level 3	Vacuum Circuit Breakers	y		
23-35 29 21 11	Level 4	Network Distribution Vacuum Circuit Breakers	y		
23-35 29 21 13	Level 4	Power Distribution Vacuum Circuit Breakers	y		
23-35 29 23	Level 3	Ground Fault Circuit Interrupters	y		
23-35 29 25	Level 3	Network Protectors	y		
23-35 29 27	Level 3	Electrical Disconnects	y		
23-35 29 27 11	Level 4	Air Disconnects	y		
23-35 29 27 13	Level 3	Vacuum Disconnects	y		
23-35 29 27 15	Level 3	Gas Disconnects	y		
23-35 29 29	Level 3	Fuses	y		
23-35 29 29 11	Level 4	Fuse Panels	y		
23-35 29 29 13	Level 3	Fuse Holders	y		
23-35 31 00	Level 2	Electrical Power Distribution Devices	y		
23-35 31 11	Level 3	Power Supply Devices	y		
23-35 31 13	Level 3	Distribution Panel Boards	y		
23-35 31 15	Level 3	Electrical Distribution Control Panels	y		
23-35 31 17	Level 3	Electrical Panel Boards	y		
23-35 31 19	Level 3	Electrical Panel Meter Sockets	y		
23-35 31 21	Level 3	Load Centers	y		
23-35 31 23	Level 3	Motor Control Centers	y		
23-35 31 25	Level 3	Power Control and Monitoring Assemblies	y		
23-35 31 27	Level 3	Power Distribution Units	y		
23-35 31 27 11	Level 4	Multiple Section Power Distribution Units	y		
23-35 31 27 13	Level 4	Stand Alone Power Distribution Units	y		
23-35 31 29	Level 3	Switchboards	y		
23-35 31 29 11	Level 4	Distribution Switchboards	y		
23-35 31 29 13	Level 4	Paralleling Switchboards	y		
23-35 31 31	Level 3	Switchgear	y		
23-35 31 31 11	Level 4	Distribution Switchgear	y		
23-35 31 31 11 11	Level 5	Electronic Controlled Distribution Switchgear	y		
23-35 31 31 11 13	Level 5	Mechanically Controlled Distribution Switchgear	y		
23-35 31 31 11 15	Level 5	Remote Controlled Distribution Switchgear	y		
23-35 31 31 11 17	Level 5	Time Controlled Distribution Switchgear	y		
23-35 31 31 13	Level 4	Paralleling Switchgear	y		
23-35 31 31 13 11	Level 5	Electronic Controlled Paralleling Switchgear	y		
23-35 31 31 13 13	Level 5	Mechanically Controlled Paralleling Switchgear	y		
23-35 31 31 13 15	Level 5	Remote Controlled Paralleling Switchgear	y		
23-35 31 31 13 17	Level 5	Time Controlled Paralleling Switchgear	y		
23-35 31 33	Level 3	Electrical Busbars	y		
23-35 31 33 11	Level 4	Aluminum Electrical Busbars	y		
23-35 31 33 13	Level 4	Copper Electrical Busbars	y		
23-35 31 35	Level 3	Electrical Feeders	y		
23-35 35 00	Level 2	Electrical Contactors	y		
23-35 37 00	Level 2	Electrical Switches	y		
23-35 37 11	Level 3	Automatic Transfer Switches	y		
23-35 37 11 11	Level 4	Normal Power Seeking Automatic Transfer Switches	y		
23-35 37 11 13	Level 4	Power Seeking Automatic Transfer Switches	y		

23-35 37 13	Level 3	Manual Transfer Switches	y		
23-35 37 15	Level 3	Barrel Switches	y		
23-35 37 15 11	Level 4	Barrel Key Switches	y		
23-35 37 17	Level 3	Dimmer Control Switches	y		
23-35 37 17 11	Level 4	Lighting Dimmer Rheostats	y		
23-35 37 17 12	Level 4	Ganged Lighting Dimmers	y		
23-35 37 17 13	Level 4	Dimmers	y		
23-35 37 19	Level 3	Disconnect Switches	y		
23-35 37 19 11	Level 4	Fused Disconnect Switches	y		
23-35 37 19 13	Level 4	Non Fused Disconnect Switches	y		
23-35 37 21	Level 3	Drum Switches	y		
23-35 37 23	Level 3	Flow Switches	y		
23-35 37 25	Level 3	Key Lock Switches	y		
23-35 37 27	Level 3	Limit Switches	y		
23-35 37 27 11	Level 4	Level Switches	y		
23-35 37 27 13	Level 4	Reed Switches	y		
23-35 37 29	Level 3	Modular Wiring System Switches	y		
23-35 37 31	Level 3	Photocell Switches	y		
23-35 37 33	Level 3	Pressure Switches	y		
23-35 37 33 11	Level 4	Differential Pressure Switches	y		
23-35 37 35	Level 3	Rocker Switches	y		
23-35 37 35 11	Level 4	Mercury Switches	y		
23-35 37 37	Level 3	Time Switches	y		
23-35 37 39	Level 3	Foot Switches	y		
23-35 37 41	Level 3	Joysticks	n		
23-35 37 43	Level 3	Programmable Logic Control Switches	y		
23-35 37 45	Level 3	Proximity Switches	y		
23-35 37 47	Level 3	Pull Chain Switches	y		
23-35 37 49	Level 3	Push Button Switches	y		
23-35 37 51	Level 3	Radio Frequency Switches	y		
23-35 37 53	Level 3	Rotary Switches	y		
23-35 37 55	Level 3	Slide Switches	y		
23-35 37 57	Level 3	Snap Switches	y		
23-35 37 59	Level 3	Speed Switches	y		
23-35 37 61	Level 3	Tamper Switches	y		
23-35 37 63	Level 3	Temperature Switches	y		
23-35 37 65	Level 3	Vacuum Switches	y		
23-35 39 00	Level 2	Electric Power Protection Devices	y		
23-35 39 11	Level 3	Electrical Grounding Device	y		
23-35 39 13	Level 3	Earth Connection Electrodes	y		
23-35 39 15	Level 3	Lightning Protection	y		
23-35 39 15 11	Level 4	Lightning Arresters	y		
23-35 39 15 13	Level 4	Lightning Rods	y		
23-35 39 17	Level 3	Surge Protection Devices	y		
23-35 41 00	Level 2	Electrical Isolation Equipment	y		
23-35 41 11	Level 3	Electronic Chokes	y		
23-35 41 13	Level 3	Signal Converters	y		
23-35 43 00	Level 2	Electrical Relays	y		
23-35 43 11	Level 3	Auxiliary Protective Relays	y		
23-35 43 13	Level 3	Control Relays	y		
23-35 43 15	Level 3	Current Differential Relays	y		
23-35 43 15 11	Level 4	Current Differential Solid State Relays	y		
23-35 43 17	Level 3	General Purpose Relays	y		
23-35 43 19	Level 3	Ground Fault Relays	y		
23-35 43 19 11	Level 4	Ground Fault Solid State Relays	y		
23-35 43 21	Level 3	Load Shedding Relays	y		

23-35 43 23	Level 3	Lockout Relays	y		
23-35 43 23 11	Level 4	Automatic Reset Lockout Relays	y		
23-35 43 23 13	Level 4	Manual Reset Lockout Relays	y		
23-35 43 25	Level 3	Mercury Relays	y		
23-35 43 27	Level 3	Over Current Relays	y		
23-35 43 27 11	Level 4	Overcurrent Directional, Induction Disc Relays	y		
23-35 43 27 13	Level 4	Over Current Induction Disc Relays	y		
23-35 43 27 15	Level 4	Over Current Thermal Relays	y		
23-35 43 27 17	Level 4	Over Current Solid State Relays	y		
23-35 43 29	Level 3	Overload Relays	y		
23-35 43 29 11	Level 4	Overload Solid State Relays	y		
23-35 43 31	Level 3	Phase Failure Relays	y		
23-35 43 31 11	Level 4	Phase Failure Solid State Relays	y		
23-35 43 33	Level 3	Power Relays	y		
23-35 43 35	Level 3	Time Relays	y		
23-35 43 35 11	Level 4	Reverse Current Time Relays	y		
23-35 43 35 11 11	Level 5	Reverse Current Solid State Time Relays	y		
23-35 43 35 13	Level 4	Reverse Power Time Relays	y		
23-35 43 35 13 11	Level 5	Reverse Power Solid State Time Relays	y		
23-35 43 35 15	Level 4	Power Factor Time Relays	y		
23-35 43 35 15 11	Level 5	Power Factor Solid State Time Relays	y		
23-35 43 37	Level 3	Voltage Relays	y		
23-35 43 37 11	Level 4	Under Voltage Relays	y		
23-35 43 37 11 11	Level 5	Under Voltage Solid State Relays	y		
23-35 43 37 13	Level 4	Over Voltage Relays	y		
23-35 43 37 13 11	Level 5	Over Voltage Solid State Relays	y		
23-35 43 37 15	Level 4	Over Under Voltage Relays	y		
23-35 43 37 15 11	Level 5	Over Under Voltage Solid State Relays	y		
23-35 47 13	Level 3	Emergency Lighting	y		
23-35 47 13 11	Level 4	Hard Wired Emergency Lighting	y		
23-35 47 13 13	Level 4	Emergency Lighting With Battery Backup	y		
23-35 47 13 15	Level 4	Passive Emergency Lighting Strips	y		
23-35 47 13 17	Level 4	Emergency Lighting Strobe	y		
23-35 47 15	Level 3	Exit Illuminated Signs	y		
23-35 47 15 11	Level 4	Battery Backup Exit Illuminated Signs	y		
23-35 47 15 13	Level 4	Hard Wired Backup Exit Illuminated Signs	y		
23-35 47 15 15	Level 4	Self Illuminated Exit Illuminated Signs	y		
23-37 15 17	Level 3	Projection Equipment	y		
23-37 15 17 11	Level 4	Projection Screens	y		
23-37 15 17 13	Level 4	Projection Screen Stands	y		
23-37 15 19	Level 3	Video Projectors	y		
23-39 31 00	Level 2	Packaged Waste Water Treatment	y		
23-39 31 11	Level 3	Packaged Stations	y		
23-39 31 11 11	Level 4	Packaged Pumping Stations	y		
23-39 31 11 13	Level 4	Packaged Lift Stations	y		
23-39 31 13	Level 3	Packaged Sewage Treatment Plants	y		
23-39 33 00	Level 2	Water and Waste Water Preliminary Treatment Equipment	y		
23-39 33 11	Level 3	Screening Equipment	y		
23-39 33 11 11	Level 4	Climber-type Bar Screens	y		
23-39 33 11 13	Level 4	Chain-and-Rage Bar Screens	y		
23-39 33 11 15	Level 4	Flexible Rake Bar Screens	y		
23-39 33 11 17	Level 4	Catenary Bar Screens	y		
23-39 33 11 19	Level 4	Continuous Belt Screens	y		
23-39 33 11 21	Level 4	Cylindrical Bar Screens	y		
23-39 33 11 23	Level 4	Step Screens	y		
23-39 33 11 25	Level 4	Rotary Drum Screens	y		

23-39 33 11 27	Level 4	Spiral Screens	y		
23-39 33 11 29	Level 4	Band Screens	y		
23-39 33 11 31	Level 4	Disc Screens	y		
23-39 33 11 33	Level 4	Traveling Screens	y		
23-39 33 11 35	Level 4	Perforated Plate Screens	y		
23-39 33 11 37	Level 4	Wedge Wire Screens	y		
23-39 33 11 39	Level 4	Element Screens	y		
23-39 33 11 41	Level 4	Trash Raking Equipment	y		
23-39 33 11 43	Level 4	Screenings Washing and Compacting Equipment	y		
23-39 33 11 45	Level 4	Vacuum Screenings Conveying Equipment	y		
23-39 33 11 47	Level 4	Screenings Storage Containers	y		
23-39 33 11 49	Level 4	Septage Receiving Equipment	y		
23-39 33 13	Level 3	Grit Removal and Handling Equipment	y		
23-39 33 13 11	Level 4	Chain-and-Bucket Grit Removal Equipment	y		
23-39 33 13 13	Level 4	Chain-and-Flight Grit Removal Equipment	y		
23-39 33 13 15	Level 4	Vortex Grit Removal Equipment	y		
23-39 33 13 17	Level 4	Cyclone Degritters	y		
23-39 33 13 19	Level 4	Aerated Grit Removal Equipment	y		
23-39 33 13 21	Level 4	Inline Baffled Grit Removal Equipment	y		
23-39 33 13 23	Level 4	Traveling Bridge Grit Removal Equipment	y		
23-39 33 13 25	Level 4	Grit Classifying and Washing Equipment	y		
23-39 33 13 27	Level 4	Grit Storage Containers	y		
23-39 33 15	Level 3	Grinding and Shredding Equipment	y		
23-39 33 15 11	Level 4	Macerators	y		
23-39 33 15 13	Level 4	Comminutors	y		
23-39 33 15 15	Level 4	Inline Grinders	y		
23-39 33 15 17	Level 4	Open-Channel Grinders	y		
23-39 33 15 19	Level 4	Modular Grinding-Screening-Compacting Equipment	y		
23-39 33 17	Level 3	Oil and Grease Separation and Removal Equipment	y		
23-39 33 17 11	Level 4	Coalescing Oil-Water Separators	y		
23-39 33 17 13	Level 4	API Oil-Water Separators	y		
23-39 33 17 15	Level 4	Grease Traps	y		
23-39 33 17 17	Level 4	Dissolved Air Flotation Grease and Oil Separation Equipment	y		
23-39 33 17 19	Level 4	Helical Scum Skimming and Removal Equipment	y		
23-39 33 17 21	Level 4	Tipping Trough Scum Skimming and Removal Equipment	y		
23-39 33 17 23	Level 4	Chain and Flight Scum Collection and Removal Equipment	y		
23-39 33 17 25	Level 4	Floating Scum Skimming and Removal Equipment	y		
23-39 35 00	Level 2	Water and Wastewater Chemical Feed Equipment	y		
23-39 35 11	Level 3	Gas Chemical Feed Equipment	y		
23-39 35 11 11	Level 4	Chlorine Gas Feed Equipment	y		
23-39 35 11 13	Level 4	Sulfur Dioxide Gas Feed Equipment	y		
23-39 35 11 15	Level 4	Ammonia Gas Feed Equipment	y		
23-39 35 11 17	Level 4	Gas Storage, Weighing, and Leak Detection Equipment	y		
23-39 35 11 19	Level 4	Chlorine Dioxide Reactors	y		
23-39 35 11 21	Level 4	Carbon Dioxide Gas Feed Equipment	y		
23-39 35 11 23	Level 4	Ozone Generating and Feed Equipment	y		
23-39 35 11 25	Level 4	Liquid Oxygen Storage and Feed Equipment	y		
23-39 35 11 27	Level 4	Cleaning Requirements for Oxygen Service	y		
23-39 35 11 29	Level 4	Gas Chemical Feed Accessories and Safety Equipment	y		
23-39 35 13	Level 3	Liquid Chemical Feed Equipment	y		
23-39 35 13 11	Level 4	Sodium Hypochlorite Generating Equipment	y		
23-39 35 13 13	Level 4	Liquid Chemical Weighing Equipment	y		
23-39 35 13 15	Level 4	Polymer Blending and Feed Equipment	y		
23-39 35 13 17	Level 4	Diaphragm-type Metering Pumps	y		
23-39 35 13 19	Level 4	Peristaltic Metering Pumps	y		
23-39 35 13 21	Level 4	Progressing Cavity Metering Pumps	y		

23-39 35 13 23	Level 4	Lobe Metering Pumps	y		
23-39 35 13 25	Level 4	Drum Pumps	y		
23-39 35 13 27	Level 4	Liquid Chemical Transfer Pumps	y		
23-39 35 13 29	Level 4	Liquid Chemical Diffusers	y		
23-39 35 13 31	Level 4	Liquid Chemical Feed Accessories and Safety Equipment	y		
23-39 35 15	Level 3	Dry Chemical Feed Equipment	y		
23-39 35 15 11	Level 4	Storage Silos	y		
23-39 35 15 13	Level 4	Dry Chemical Weighing Equipment	y		
23-39 35 15 15	Level 4	Volumetric Feed Equipment	y		
23-39 35 15 17	Level 4	Gravimetric Feed Equipment	y		
23-39 35 15 19	Level 4	Lime Slaking Equipment	y		
23-39 35 15 21	Level 4	Chemical Tablet Feeding Equipment	y		
23-39 35 15 23	Level 4	Dry Chemical Feed Accessories and Safety Equipment	y		
23-39 37 00	Level 2	Water and Wastewater Clarification and Mixing Equipment	y		
23-39 37 11	Level 3	Mixing Equipment	y		
23-39 37 11 11	Level 4	Rapid Mixers	y		
23-39 37 11 13	Level 4	Inline Blender-type Rapid Mixers	y		
23-39 37 11 15	Level 4	Induction-type Rapid Mixing Equipment	y		
23-39 37 11 17	Level 4	Inline Static Mixers	y		
23-39 37 11 19	Level 4	Mixing Equipment	y		
23-39 37 11 21	Level 4	Submersible Mixers	y		
23-39 37 11 23	Level 4	Floating Mechanical Mixers	y		
23-39 37 11 25	Level 4	Paddle Mixers	y		
23-39 37 11 27	Level 4	Pin Mixers	y		
23-39 37 11 29	Level 4	Vertical Reel Flocculation Equipment	y		
23-39 37 11 31	Level 4	Horizontal Reel Flocculation Equipment	y		
23-39 37 11 33	Level 4	Vertical Turbine Flocculation Equipment	y		
23-39 37 11 35	Level 4	Walking-beam Flocculation Equipment	y		
23-39 37 11 37	Level 4	Horizontal Oscillating Flocculation Equipment	y		
23-39 37 11 39	Level 4	Top-entering Tank Mixers	y		
23-39 37 11 41	Level 4	Side-entry Tank Mixers	y		
23-39 37 11 43	Level 4	Portable Tank Mixers	y		
23-39 37 13	Level 3	Clarifier Equipment	y		
23-39 37 13 11	Level 4	Chain-and-Flight Clarifier Equipment	y		
23-39 37 13 13	Level 4	Traveling Bridge Clarifier Equipment	y		
23-39 37 13 15	Level 4	Differential Head Clarifier Equipment	y		
23-39 37 13 17	Level 4	Oscillating Scraper-type Clarifier Equipment	y		
23-39 37 13 19	Level 4	Circular Clarifier Equipment	y		
23-39 37 13 21	Level 4	Solids Contact Clarifier Equipment	y		
23-39 37 13 23	Level 4	Flocculating Clarifier, Pulsating Sludge Blanket Type	y		
23-39 37 13 25	Level 4	Dissolved Air Flotation Equipment for Water Treatment	y		
23-39 37 13 27	Level 4	Ballasted High-rate Clarifier Equipment	y		
23-39 37 13 29	Level 4	High rate Clarification/Thickening Equipment	y		
23-39 37 13 31	Level 4	Tube Settlers	y		
23-39 37 13 33	Level 4	Lined Plate Settlers	y		
23-39 37 15	Level 3	Sediment Removal Equipment	y		
23-39 37 15 11	Level 4	Tipping Sediment Flushing Tanks	y		
23-39 37 15 13	Level 4	Flushing Gates	y		
23-39 37 15 15	Level 4	Water Cannon	y		
23-39 39 00	Level 2	Water and Wastewater Secondary Treatment Equipment	y		
23-39 39 11	Level 3	Air and Gas Diffusion Equipment	y		
23-39 39 11 11	Level 4	Fixed Mechanical Aerators	y		
23-39 39 11 13	Level 4	Floating Mechanical Aerators	y		
23-39 39 11 15	Level 4	Submersible Aspirating Aerator Equipment	y		
23-39 39 11 17	Level 4	Jet Aeration Equipment	y		
23-39 39 11 19	Level 4	Coarse Bubble Diffusers	y		

23-39 39 11 21	Level 4	Swing-type Channel Aeration Equipment	y		
23-39 39 11 23	Level 4	Shear Box Diffusers	y		
23-39 39 11 25	Level 4	Flexible Membrane Tube Diffusers	y		
23-39 39 11 27	Level 4	Flexible Membrane Disc Diffusers	y		
23-39 39 11 29	Level 4	Ceramic Disc Fine Bubble Diffusers	y		
23-39 39 11 31	Level 4	Floating Membrane Diffusers	y		
23-39 39 11 33	Level 4	Membrane Diffusers	y		
23-39 39 11 35	Level 4	Cascading Aerators	y		
23-39 39 11 37	Level 4	Pure-oxygen Generating Equipment	y		
23-39 39 13	Level 3	Biological Treatment Systems	y		
23-39 39 13 11	Level 4	Rotating Biological Contactors	y		
23-39 39 13 13	Level 4	Trickling Filter Rotary Distributor Equipment	y		
23-39 39 13 15	Level 4	Trickling Filter Media	y		
23-39 39 13 17	Level 4	Bio-towers	y		
23-39 39 13 19	Level 4	Moving-bed Biological Reactors	y		
23-39 39 13 21	Level 4	Integrated Fixed-film Activated Sludge Equipment	y		
23-39 39 13 23	Level 4	Intermittent Sand Filters for Wastewater Treatment	y		
23-39 39 13 25	Level 4	Deep-bed Denitrification Filters	y		
23-39 39 13 27	Level 4	Biologically Activated Filters	y		
23-39 39 13 29	Level 4	Membrane Biological Reactors	y		
23-39 39 13 31	Level 4	Sequencing Batch Reactors	y		
23-39 39 13 33	Level 4	Oxidation Ditch Equipment	y		
23-39 39 13 35	Level 4	Vertical Loop Reactors	y		
23-39 41 00	Level 2	Water and Wastewater Advanced Treatment Equipment	y		
23-39 41 11	Level 3	Filtration Equipment	y		
23-39 41 11 11	Level 4	Filter Media	y		
23-39 41 11 13	Level 4	Filter Surface Wash Agitators	y		
23-39 41 11 15	Level 4	Filter Air Scour Equipment	y		
23-39 41 11 17	Level 4	Wash Water Troughs	y		
23-39 41 11 19	Level 4	Pressure Filters	y		
23-39 41 11 21	Level 4	Gravity Filters	y		
23-39 41 11 23	Level 4	High-rate Sand Filters	y		
23-39 41 11 25	Level 4	Traveling Bridge Filters	y		
23-39 41 11 27	Level 4	Microfiltration and Ultrafiltration Membrane Equipment	y		
23-39 41 11 29	Level 4	Disc Cloth Filters	y		
23-39 41 11 31	Level 4	Rotary Drum Cloth Filters	y		
23-39 41 11 33	Level 4	Automatic Backwash Cloth Filter Equipment	y		
23-39 41 11 35	Level 4	Cartridge Filters	y		
23-39 41 11 37	Level 4	Bag Filters	y		
23-39 41 11 39	Level 4	Automatic Straining Equipment	y		
23-39 41 13	Level 3	Demineralization Equipment	y		
23-39 41 13 11	Level 4	Ion-exchange Vessel Media	y		
23-39 41 13 13	Level 4	Electrodialysis Reversal Equipment	y		
23-39 41 13 15	Level 4	Reverse Osmosis and Nanofiltration Membrane Equipment	y		
23-39 41 13 17	Level 4	Multiple-effect Distillation Equipment	y		
23-39 41 13 19	Level 4	Desalination Mechanical Vapor Compression Equipment	y		
23-39 41 13 21	Level 4	Desalination Thermal Vapor Compression Equipment	y		
23-39 41 13 23	Level 4	Desalination Multi-stage Flash Equipment	y		
23-39 41 13 25	Level 4	Desalination Falling Film Evaporators	y		
23-39 41 13 27	Level 4	Desalination Rising Film Evaporators	y		
23-39 41 13 29	Level 4	Desalination Forced-circulation Crystallizing Equipment	y		
23-39 41 13 31	Level 4	Desalination Spray Dry Evaporation Equipment	y		
23-39 41 13 33	Level 4	Demineralization Energy Recovery Equipment	y		
23-39 41 15	Level 3	Ultraviolet Equipment	n		
23-39 41 15 11	Level 4	Closed-vessel Low-pressure/Low-intensity Ultraviolet Treatment Equipment	n		
23-39 41 15 13	Level 4	Closed-vessel Low-pressure/High-intensity Ultraviolet Treatment Equipment	n		

23-39 41 15 15	Level 4	Closed-vessel Medium-pressure Ultraviolet Treatment Equipment	n		
23-39 41 15 17	Level 4	Open-channel Low-pressure/Low-intensity Ultraviolet Treatment Equipment	n		
23-39 41 15 19	Level 4	Open-channel Low-pressure/High-intensity Ultraviolet Treatment Equipment	n		
23-39 41 15 21	Level 4	Open-channel Medium-pressure Ultraviolet Treatment Equipment	n		
23-39 43 00	Level 2	Water and Wastewater Residuals Handling and Treatment	y		
23-39 43 11	Level 3	Residuals Thickening Equipment	y		
23-39 43 11 11	Level 4	Circular Gravity Thickeners	y		
23-39 43 11 13	Level 4	Gravity Belt Thickeners	y		
23-39 43 11 15	Level 4	Dissolved Air Flotation Thickening Equipment	y		
23-39 43 11 17	Level 4	Rotary Drum Thickening Equipment	y		
23-39 43 11 19	Level 4	Centrifuge Thickening Equipment	y		
23-39 43 11 21	Level 4	Disc Thickeners	y		
23-39 43 11 23	Level 4	Thickening Screw Press	y		
23-39 43 11 25	Level 4	Scum Concentrator Equipment	y		
23-39 43 13	Level 3	Residuals Stabilization	y		
23-39 43 13 11	Level 4	Digester Covers and Appurtenances	y		
23-39 43 13 11 11	Level 5	Fixed Covers	y		
23-39 43 13 11 13	Level 5	Floating Covers	y		
23-39 43 13 11 15	Level 5	Gasholder Covers	y		
23-39 43 13 13	Level 4	Radial Beam Fixed Digester Covers	y		
23-39 43 13 15	Level 4	Dual Deck Truss-type Fixed Digester Covers	y		
23-39 43 13 17	Level 4	Radial Beam Floating Digester Covers	y		
23-39 43 13 19	Level 4	Dual Deck Truss-type Floating Digester Covers	y		
23-39 43 13 21	Level 4	Radial Beam Floating Gas-holding Digester Covers	y		
23-39 43 13 23	Level 4	Dual Deck Truss-type Floating Gas-holding Digester Covers	y		
23-39 43 13 25	Level 4	Digester Appurtenances	y		
23-39 43 13 27	Level 4	Aerobic Digester Aeration Equipment	y		
23-39 43 13 29	Level 4	Autothermal Thermophilic Aerobic Digestion Equipment	y		
23-39 43 13 31	Level 4	Egg-shaped Digesters	y		
23-39 43 13 33	Level 4	Confined Gas Mixing System	y		
23-39 43 13 35	Level 4	Digester Heating Equipment	y		
23-39 43 13 37	Level 4	Residuals Pasteurization Equipment	y		
23-39 43 15	Level 3	Residuals Dewatering Equipment	y		
23-39 43 15 11	Level 4	Vacuum Filters	y		
23-39 43 15 13	Level 4	Belt Filter Presses	y		
23-39 43 15 15	Level 4	Plate-and-Frame Filter Presses	y		
23-39 43 15 17	Level 4	Rotary Presses	y		
23-39 43 15 19	Level 4	Screw Presses	y		
23-39 43 15 21	Level 4	Dewatering Centrifuges	y		
23-39 43 15 23	Level 4	Belt Dryers	y		
23-39 43 15 25	Level 4	Direct-heat Residuals Drying Equipment	y		
23-39 43 15 27	Level 4	Indirect-heat Residuals Drying Equipment	y		
23-39 43 17	Level 3	Thermal Treatment of Residuals	y		
23-39 43 17 11	Level 4	Multiple-hearth Sludge Incinerators	y		
23-39 43 17 13	Level 4	Fluidized-bed Sludge Incinerators	y		
23-39 43 17 15	Level 4	Ash Handling Equipment	y		
23-39 43 17 17	Level 4	Recuperative Air Preheating Equipment	y		
23-39 43 17 19	Level 4	Regenerative Thermal Oxidizers	y		
23-39 43 17 21	Level 4	Waste Heat Recovery Boilers	y		
23-39 43 17 23	Level 4	Waste Heat Recovery Heat Exchangers	y		
23-39 43 17 25	Level 4	Thermal Oxidation Equipment	y		
23-39 45 00	Level 2	Septic System Equipment	y		
23-39 45 11	Level 3	Liquid Waste Treatment	y		
23-39 45 11 11	Level 4	Liquid Waste Decanter	y		
23-39 45 11 13	Level 4	Bacterial Filter Tanks	y		
23-39 45 11 15	Level 4	Liquid Waste Decanters	y		

23-39 45 11 17	Level 4	Liquid Waste Separators	y		
23-39 45 11 19	Level 4	Liquid Waste Pond and Reservoir Products	y		
23-39 45 11 19 11	Level 5	Liquid Waste Pond Covers	y		
23-39 45 11 19 13	Level 5	Liquid Waste Pond Liners	y		
23-39 45 11 21	Level 4	Additives for Treatment of Liquid Waste	y		
23-39 45 11 21 11	Level 5	Additives for Waste Water and Sewage Treatment	y		
23-39 45 11 21 13	Level 5	Additives for Residue Treatment	y		
23-39 45 13	Level 3	Liquid Waste Monitoring and Control	y		
23-39 45 13 11	Level 4	Detectors of Water Pollution	y		
23-39 45 15	Level 3	Solid Waste Disposal Plant Products	y		
23-39 45 15 11	Level 4	Chutes and Collectors	y		
23-39 45 15 13	Level 4	Pneumatic Waste Equipment	y		
23-39 45 15 15	Level 4	Incineration Plant	y		
23-39 45 15 15 11	Level 5	Packaged Incinerators	y		
23-39 45 15 17	Level 4	Crusher Plant	y		
23-39 45 15 17 11	Level 5	Waste Compactors and Destructors	y		
23-39 45 15 19	Level 4	Baling Plant	y		
23-39 45 15 21	Level 4	Pulping Machines	y		
23-39 45 17	Level 3	Solid Waste Handling Products	y		
23-39 45 19	Level 3	Solid Waste Impelling Equipment	y		
23-39 45 21	Level 3	Solid Waste Treatment Equipment	y		
23-39 45 21 11	Level 4	Solid Waste Compactors, Destructors, and Balers	y		
23-39 45 21 13	Level 4	Solid Waste Crushers	y		
23-39 45 21 15	Level 4	Solid Waste Pulping Machines	y		
23-39 45 21 17	Level 4	Solid Waste Shredding Machines	y		
23-39 45 21 19	Level 4	Incinerators	y		
23-39 45 21 19 11	Level 5	Solid Waste Incinerators	y		
23-39 45 21 19 13	Level 5	Packaged Incinerators	y		
23-39 45 23	Level 3	Solid Waste Monitoring and Control Equipment	y		
23-39 45 23 11	Level 4	Solid Waste Metal Detectors	y		
23-39 45 23 13	Level 4	Solid Waste Detectors for Other Solids	y		
23-39 45 25	Level 3	Solid Waste Collection and Removal Products	y		
23-39 45 25 11	Level 4	Complete Solid Waste Removal Systems	y		
23-39 45 25 13	Level 4	Solid Waste Bins	y		
23-39 45 25 15	Level 4	Gravity Chute Solid Waste Systems	y		
23-39 45 25 17	Level 4	Refuse Disposal Chutes	y		
23-39 45 25 17 11	Level 5	Refuse Hoppers	y		
23-39 45 25 17 13	Level 5	Refuse Chute Doors	y		
23-39 45 25 17 15	Level 5	Refuse Chute Decontamination Units	y		
23-39 45 27	Level 3	Solid Waste Handling Systems	y		
23-39 45 27 11	Level 4	Refuse Compactors	y		
23-39 45 27 13	Level 4	Refuse Containers	y		
23-39 45 27 15	Level 4	Dust Collectors	y		
23-39 45 27 17	Level 4	Utility Poles	y		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Automatic External Defibrilator	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1029	GENERIC	23-25 21 13 19 11 19	10 43 13	2104	AED00365	29300001	DEFIBRILLATOR, AUTOMATIC EXTERNAL (2ND FLR)															
5		1029	GENERIC	23-25 21 13 19 11 19	10 43 13	2104	AED00366	29300002	DEFIBRILLATOR, AUTOMATIC EXTERNAL (4TH FLR)															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	A FraMe lifts	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)		Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	WEIGHT CAP	BAR LENGTH	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1029	LIFTEQUIP	23-23 13 00	05 50 13	2104	AFM00016	29300003	A FRAME/2000LBS (HALL BY RM-170E)																	
5		1029	LIFTEQUIP	23-23 13 00	05 50 13	2104	AFM00017	29300004	A FRAME/2000LBS (HALL BY RM-204)																	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1	Air Handeler Unit	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)														Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SUPFANVOL	FANSPEED	RETFAN VOL	FANSPEED	DRIVE	COIL TYPE	COOLTYPE	HEATTYPE	FIL#1 (PreFilter Type)	SIZE	FIL#2 (PreFilter Type)	SIZE (INCH)	INBRDBRG	OUTBDBRG	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01031	29300005	AIR HANDLER/UNIT (AHU-1 H1RF)																													
5		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01032	29300006	AIR HANDLER/UNIT (AHU-2 LAB)																													
6		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01033	29300007	AIR HANDLER/UNIT (AHU-3 LAB)																													
7		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01034	29300008	AIR HANDLER/UNIT (AHU-4A LAB)																													
8		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01035	29300009	AIR HANDLER/UNIT (AHU-4B LAB)																													
9		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01036	29300010	AIR HANDLER/UNIT (AHU-5 OFC)																													
10		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01037	29300011	AIR HANDLER/UNIT (AHU-6 OFC)																													
11		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01038	29300012	AIR HANDLER/UNIT (AHU-7 OFC)																													
12		1003	AHFAN	23-33 25 00	23 00 00	2104	AHU01039	29300013	AIR HANDLER/UNIT (MAU-1)																													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	ALArms	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	SYSVOLT	SYSAMP	FRQNCY	PHASES	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1029	GENERIC	23-27 11 21 11	23 22 13.00 41	2104	ALA00015	29300014	ALARM/CONDENSATE HIGH WATER LEVEL																				
5		1029	GENERIC	23-27 11 21 11	23 22 13.00 41	2104	ALA00016	29300015	ALARM/FAILURE (CONDENSATE PUMP [redacted])																				
6		1029	GENERIC	23-27 11 21 11	23 22 13.00 41	2104	ALA00017	29300016	ALARM/FAILURE (CONDENSATE PUMP [redacted])																				
7		1029	GENERIC	23-27 11 21 11	23 22 13.00 41	2104	ALA00018	29300017	ALARM/LOW WATER LEVEL (CLEAN STM GEN)																				
8		1029	GENERIC	23-27 11 21 11	23 22 13.00 41	2104	ALA00019	29300018	ALARM/LOW STM PRESS (CLEAN STM GEN)																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	BATtery banks	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	QTY	#CELLS	VOLTDC	AMPDC	AMPHRS	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00041	29300019	BATTERY BANK UPS [redacted]																				
5		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00042	29300020	BATTERY BANK UPS [redacted]																				
6		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00043	29300021	BATTERY BANK UPS [redacted]																				
7		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00044	29300022	BATTERY BANK UPS [redacted]																				
8		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00045	29300023	BATTERY BANK UPS [redacted]																				
9		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00046	29300024	BATTERY BANK UPS [redacted]																				
10		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00047	29300025	BATTERY BANK UPS [redacted]																				
11		1016	BATTERIES	23-35 19 15	26 28 01.00 10	2104	BAT00048	29300026	BATTERY BANK UPS [redacted]																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	Back Flow Preventer	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)						Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	NOMSIZE	BODYMTRL	RLFSETPR	MAX WRK PRES	TEMP RANGE	AWWA CL	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1046	VALVE	23-27 31 11	33 11 00	2104	BFP00284	29300027	BACK FLOW PREVENTER (CITY WATER MAKEUP TO CLG TWR)																					
5		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00285	29300028	BACK FLOW PREVENTER (CITY WATER MAKEUP TO LABS HW&CW)																					
6		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00286	29300029	BACK FLOW PREVENTER (CITY WATER MAKEUP TO LABS HW&CW)																					
7		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00287	29300030	BACK FLOW PREVENTER (CITY WATER MAKEUP TO CLEAN STM GEN)																					
8		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00288	29300031	BACK FLOW PREVENTER (CITY WATER MAKEUP TO DOM HW)																					
9		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00289	29300032	BACK FLOW PREVENTER (CITY WATER MAKEUP TO DOM BOOSTER PMP)																					
10		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00290	29300033	BACK FLOW PREVENTER (CITY WATER MAKEUP TO CHILLER PENTHOUSE)																					
11		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00291	29300034	BACK FLOW PREVENTER (CITY WATER MAKEUP TO CHILLERS)																					
12		1046	VALVE	23-27 31 11	33 11 00	2104	BFP00292	29300035	BACK FLOW PREVENTER (CITY WATER SUPPLY FIRE SUPPRESSION SYS)																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	BreaKeR	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	master spec ID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	master spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	VOLTAC	VOLTDC	AMPSAC	PHASES	OPMECH	INTERUPT	FRAMENO	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1008	BREAKER	23-35 29 00	26 24 16.00 40	2104	BKR02199	29300036	BREAKER/480-277V/2000A/AIR																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	BoiLeR	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attrubute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	HTRTYPE	ELMNQTY	MAXBTURT	WORKPRESS	RLFVLMFG	RLFVLMOD	RLFVLSIZ	RLFSTNG	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1031	HEATER	23-333 11 00	23 22 26.00.20	2104	BLR00016	29300037	BOILER/CLEAN STEAM GENERATOR																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	battery CHarGer	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)							Documents							
2	COBie Schema Table.Field	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	VOLTAC	VOLTDC	AMPSAC	AMPSDC	PHASES	HZ	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00058	29300038	BATTERY CHARGER BATT BANK UPS [redacted]																						
5		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00059	29300039	(BATTERY CHARGER BATT BANK UPS [redacted]																						
6		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00060	29300040	BATTERY CHARGER BATT BANK UPS [redacted]																						
7		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00061	29300041	BATTERY CHARGER BATT BANK UPS [redacted]																						
8		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00062	29300042	BATTERY CHARGER BATT BANK UPS [redacted]																						
9		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00063	29300043	BATTERY CHARGER BATT BANK UPS [redacted]																						
10		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00064	29300044	BATTERY CHARGER BATT BANK UPS [redacted])																						
11		1016	BATTERIES	23-25 21 00	26 28 01.00 10	2104	CHG00065	29300045	BATTERY CHARGER BATT BANK UPS [redacted]																						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1	CHiller	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)														Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	COOLBTU	HEATBTU	RFRIGTYP	RFRIGLBS	HP	COILTYPE	COMPTYPE	COMPMFG	DSCHPRES	SUCTPRES	VOLTAC	LRA	AMPSAC	RFRIGOZS	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1009	COOL	23-33 21 13	23 64 10	2104	CHL00571	29300046	CHILLER UNIT [redacted]																													
5		1009	COOL	23-33 21 13	23 64 10	2104	CHL00572	29300047	CHILLER UNIT [redacted]																													
6		1009	COOL	23-33 21 13	23 64 10	2104	CHL00573	29300048	CHILLER UNIT [redacted]																													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	CooLing Tower	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)							Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	CELLQTY	SUMPCAP	SUMP HTR	AIRFLOW	WTRFLOW	FANSPEED	CAP/TON	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1009	COOWTRSYS	23-33 23 11	23 65 00	2104	CLT00063	29300049	COOLING TOWER/FORCED DRAFT (CT-1)																						
5		1009	COOWTRSYS	23-33 23 11	23 65 00	2104	CLT00064	29300050	COOLING TOWER/FORCED DRAFT (CT-2)																						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	Control PaneL	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)										Documents							
2	COBie Schema Table.Key Column	type.classstructure ID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	CLASS	TYPE	VOLTRATE	AMPRATE	SECVLTAC	SECVLTDC	SECAMPAC	SECAMPDC	PHASES	VOLTRATE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1016	ELECTEQUIP	23-35 31 15	26 24 16.00 40	2104	CPL00258	29300051	CONTROL PANEL (equipment served)																									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	ConTroLler	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	AMPSAC	AMPSDC	VOLTAC	VOLTDC	OUTRANGE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00085	29300052	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
5		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00086	29300053	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
6		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00087	29300054	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
7		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00088	29300055	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
8		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00089	29300056	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
9		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00090	29300057	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
10		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00091	29300058	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
11		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00092	29300059	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				
12		1021	ELECTRONIC	23-27 13 13 11	23 09 23.13 20	2104	CTL00093	29300060	CONTROLLER/DDC/AIR HANDLER//UNIT [redacted]																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	smoke DETector	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)				Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SMKDTYPE	HTDETYPE	VOLTDC	DCTDTYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00106	29300061	SMOKE DETECTOR/DUCT [redacted]																			
5		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00107	29300062	SMOKE DETECTOR/DUCT [redacted]																			
6		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00108	29300063	SMOKE DETECTOR/DUCT [redacted]																			
7		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00109	29300064	SMOKE DETECTOR/DUCT [redacted]																			
8		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00110	29300065	SMOKE DETECTOR/DUCT [redacted]																			
9		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00111	29300066	SMOKE DETECTOR/DUCT [redacted]																			
10		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00112	29300067	SMOKE DETECTOR/DUCT [redacted]																			
11		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00113	29300068	SMOKE DETECTOR/DUCT [redacted]																			
12		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00114	29300069	SMOKE DETECTOR/DUCT [redacted]																			
13		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00115	29300070	SMOKE DETECTOR/DUCT [redacted]																			
14		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00116	29300071	SMOKE DETECTOR/DUCT [redacted]																			
15		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00117	29300072	SMOKE DETECTOR/DUCT [redacted]																			
16		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00118	29300073	SMOKE DETECTOR/DUCT [redacted]																			
17		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00119	29300074	SMOKE DETECTOR/DUCT [redacted]																			
18		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00120	29300075	SMOKE DETECTOR/DUCT [redacted]																			
19		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00121	29300076	SMOKE DETECTOR/DUCT [redacted]																			
20		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00122	29300077	SMOKE DETECTOR/DUCT [redacted]																			
21		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00123	29300078	SMOKE DETECTOR/DUCT [redacted]																			
22		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00124	29300079	SMOKE DETECTOR/DUCT [redacted]																			
23		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00125	29300080	SMOKE DETECTOR/DUCT [redacted]																			
24		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00126	29300081	SMOKE DETECTOR/DUCT [redacted]																			
25		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00127	29300082	SMOKE DETECTOR/DUCT [redacted]																			
26		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00128	29300083	SMOKE DETECTOR/DUCT [redacted]																			
27		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00129	29300084	SMOKE DETECTOR/DUCT [redacted]																			
28		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00130	29300085	SMOKE DETECTOR/DUCT [redacted]																			
29		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00131	29300086	SMOKE DETECTOR/DUCT [redacted]																			
30		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00132	29300087	SMOKE DETECTOR/DUCT [redacted]																			
31		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00133	29300088	SMOKE DETECTOR/DUCT [redacted]																			
32		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00134	29300089	SMOKE DETECTOR/DUCT [redacted]																			
33		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00135	29300090	SMOKE DETECTOR/DUCT [redacted]																			
34		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00136	29300091	SMOKE DETECTOR/DUCT [redacted]																			
35		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00137	29300092	SMOKE DETECTOR/DUCT [redacted]																			
36		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00138	29300093	SMOKE DETECTOR/DUCT [redacted]																			
37		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00139	29300094	SMOKE DETECTOR/DUCT [redacted]																			
38		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00140	29300095	SMOKE DETECTOR/DUCT [redacted]																			
39		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00141	29300096	SMOKE DETECTOR/DUCT [redacted]																			
40		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00142	29300097	SMOKE DETECTOR/DUCT [redacted]																			
41		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00143	29300098	SMOKE DETECTOR/DUCT [redacted]																			
42		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00144	29300099	SMOKE DETECTOR/DUCT [redacted]																			
43		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00145	29300100	SMOKE DETECTOR/DUCT [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
44		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00146	29300101	SMOKE DETECTOR/DUCT [redacted]																			
45		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00147	29300102	SMOKE DETECTOR/DUCT [redacted]																			
46		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00148	29300103	SMOKE DETECTOR/DUCT [redacted]																			
47		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00149	29300104	SMOKE DETECTOR/DUCT [redacted]																			
48		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00150	29300105	SMOKE DETECTOR/DUCT [redacted]																			
49		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00151	29300106	SMOKE DETECTOR/DUCT [redacted]																			
50		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00152	29300107	SMOKE DETECTOR/DUCT [redacted]																			
51		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00153	29300108	SMOKE DETECTOR/DUCT [redacted]																			
52		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00154	29300109	SMOKE DETECTOR/DUCT [redacted]																			
53		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00155	29300110	SMOKE DETECTOR/DUCT [redacted]																			
54		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00156	29300111	SMOKE DETECTOR/DUCT [redacted]																			
55		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00157	29300112	SMOKE DETECTOR/DUCT [redacted]																			
56		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00158	29300113	SMOKE DETECTOR/DUCT [redacted]																			
57		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00159	29300114	SMOKE DETECTOR/DUCT [redacted]																			
58		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00160	29300115	SMOKE DETECTOR/DUCT [redacted]																			
59		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00161	29300116	SMOKE DETECTOR/DUCT [redacted]																			
60		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00162	29300117	SMOKE DETECTOR/DUCT [redacted]																			
61		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00163	29300118	SMOKE DETECTOR/DUCT [redacted]																			
62		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00164	29300119	SMOKE DETECTOR/DUCT [redacted]																			
63		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00165	29300120	SMOKE DETECTOR/DUCT [redacted]																			
64		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00166	29300121	SMOKE DETECTOR/DUCT [redacted]																			
65		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00167	29300122	SMOKE DETECTOR/DUCT [redacted]																			
66		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00168	29300123	SMOKE DETECTOR/DUCT [redacted]																			
67		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00169	29300124	SMOKE DETECTOR/DUCT [redacted]																			
68		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00170	29300125	SMOKE DETECTOR/DUCT [redacted]																			
69		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00171	29300126	SMOKE DETECTOR/DUCT [redacted]																			
70		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00172	29300127	SMOKE DETECTOR/DUCT [redacted]																			
71		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00173	29300128	SMOKE DETECTOR/DUCT [redacted]																			
72		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00174	29300129	SMOKE DETECTOR/DUCT [redacted]																			
73		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00175	29300130	SMOKE DETECTOR/DUCT [redacted]																			
74		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00176	29300131	SMOKE DETECTOR/DUCT [redacted]																			
75		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00177	29300132	SMOKE DETECTOR/DUCT [redacted]																			
76		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00178	29300133	SMOKE DETECTOR/DUCT [redacted]																			
77		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00179	29300134	SMOKE DETECTOR/DUCT [redacted]																			
78		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00180	29300135	SMOKE DETECTOR/DUCT [redacted]																			
79		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00181	29300136	SMOKE DETECTOR/DUCT [redacted]																			
80		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00182	29300137	SMOKE DETECTOR/DUCT [redacted]																			
81		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00183	29300138	SMOKE DETECTOR/DUCT [redacted]																			
82		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00184	29300139	SMOKE DETECTOR/DUCT [redacted]																			
83		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00185	29300140	SMOKE DETECTOR/DUCT [redacted]																			
84		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00186	29300141	SMOKE DETECTOR/DUCT [redacted]																			
85		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00187	29300142	SMOKE DETECTOR/DUCT [redacted]																			
86		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00188	29300143	SMOKE DETECTOR/DUCT [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
87		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00189	29300144	SMOKE DETECTOR/DUCT [redacted]																			
88		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00190	29300145	SMOKE DETECTOR/DUCT [redacted]																			
89		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00191	29300146	SMOKE DETECTOR/DUCT [redacted]																			
90		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00192	29300147	SMOKE DETECTOR/DUCT [redacted]																			
91		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00193	29300148	SMOKE DETECTOR/DUCT [redacted]																			
92		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00194	29300149	SMOKE DETECTOR/DUCT [redacted]																			
93		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00195	29300150	SMOKE DETECTOR/DUCT [redacted]																			
94		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00196	29300151	SMOKE DETECTOR/DUCT [redacted]																			
95		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00197	29300152	SMOKE DETECTOR/DUCT [redacted]																			
96		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00198	29300153	SMOKE DETECTOR/DUCT [redacted]																			
97		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00199	29300154	SMOKE DETECTOR/DUCT [redacted]																			
98		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00200	29300155	SMOKE DETECTOR/DUCT [redacted]																			
99		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00201	29300156	SMOKE DETECTOR/DUCT [redacted]																			
100		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00202	29300157	SMOKE DETECTOR/DUCT [redacted]																			
101		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00203	29300158	SMOKE DETECTOR/DUCT [redacted]																			
102		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00204	29300159	SMOKE DETECTOR/DUCT [redacted]																			
103		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00205	29300160	SMOKE DETECTOR/DUCT [redacted]																			
104		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00206	29300161	SMOKE DETECTOR/DUCT [redacted]																			
105		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00207	29300162	SMOKE DETECTOR/DUCT [redacted]																			
106		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00208	29300163	SMOKE DETECTOR/DUCT [redacted]																			
107		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00209	29300164	SMOKE DETECTOR/DUCT [redacted]																			
108		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00210	29300165	SMOKE DETECTOR/DUCT [redacted]																			
109		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00211	29300166	SMOKE DETECTOR/DUCT [redacted]																			
110		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00212	29300167	SMOKE DETECTOR/DUCT [redacted]																			
111		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00213	29300168	SMOKE DETECTOR/DUCT [redacted]																			
112		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00214	29300169	SMOKE DETECTOR/DUCT [redacted]																			
113		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00215	29300170	SMOKE DETECTOR/DUCT [redacted]																			
114		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00216	29300171	SMOKE DETECTOR/DUCT [redacted]																			
115		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00217	29300172	SMOKE DETECTOR/DUCT [redacted]																			
116		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00218	29300173	SMOKE DETECTOR/DUCT [redacted]																			
117		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00219	29300174	SMOKE DETECTOR/DUCT [redacted]																			
118		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00220	29300175	SMOKE DETECTOR/DUCT [redacted]																			
119		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00221	29300176	SMOKE DETECTOR/DUCT [redacted]																			
120		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00222	29300177	SMOKE DETECTOR/DUCT [redacted]																			
121		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00223	29300178	SMOKE DETECTOR/DUCT [redacted]																			
122		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00224	29300179	SMOKE DETECTOR/DUCT [redacted]																			
123		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00225	29300180	SMOKE DETECTOR/DUCT [redacted]																			
124		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00226	29300181	SMOKE DETECTOR/DUCT [redacted]																			
125		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00227	29300182	SMOKE DETECTOR/DUCT [redacted]																			
126		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00228	29300183	SMOKE DETECTOR/DUCT [redacted]																			
127		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00229	29300184	SMOKE DETECTOR/DUCT [redacted]																			
128		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00230	29300185	SMOKE DETECTOR/DUCT [redacted]																			
129		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00231	29300186	SMOKE DETECTOR/DUCT [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
130		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00232	29300187	SMOKE DETECTOR/DUCT [redacted]																			
131		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00233	29300188	SMOKE DETECTOR/DUCT [redacted]																			
132		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00234	29300189	SMOKE DETECTOR/DUCT [redacted]																			
133		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00235	29300190	SMOKE DETECTOR/DUCT [redacted]																			
134		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00236	29300191	SMOKE DETECTOR/DUCT [redacted]																			
135		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00237	29300192	SMOKE DETECTOR/DUCT [redacted]																			
136		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00238	29300193	SMOKE DETECTOR/DUCT [redacted]																			
137		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00239	29300194	SMOKE DETECTOR/DUCT [redacted]																			
138		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00240	29300195	SMOKE DETECTOR/DUCT [redacted]																			
139		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00241	29300196	SMOKE DETECTOR/DUCT [redacted]																			
140		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00242	29300197	SMOKE DETECTOR/DUCT [redacted]																			
141		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00243	29300198	SMOKE DETECTOR/DUCT [redacted]																			
142		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00244	2930199	SMOKE DETECTOR/DUCT [redacted]																			
143		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00245	29300200	SMOKE DETECTOR/DUCT [redacted]																			
144		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00246	29300201	SMOKE DETECTOR/DUCT [redacted]																			
145		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00247	29300202	SMOKE DETECTOR/DUCT [redacted]																			
146		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00248	29300203	SMOKE DETECTOR/DUCT [redacted]																			
147		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00249	29300204	SMOKE DETECTOR/DUCT [redacted]																			
148		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00250	29300205	SMOKE DETECTOR/DUCT [redacted]																			
149		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00251	29300206	SMOKE DETECTOR/DUCT [redacted]																			
150		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00252	29300207	SMOKE DETECTOR/DUCT [redacted]																			
151		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00253	29300208	SMOKE DETECTOR/DUCT [redacted]																			
152		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00254	29300209	SMOKE DETECTOR/DUCT [redacted]																			
153		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00255	29300210	SMOKE DETECTOR/DUCT [redacted]																			
154		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00256	29300211	SMOKE DETECTOR/DUCT [redacted]																			
155		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00257	29300212	SMOKE DETECTOR/DUCT [redacted]																			
156		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00258	29300213	SMOKE DETECTOR/DUCT [redacted]																			
157		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00259	29300214	SMOKE DETECTOR/DUCT [redacted]																			
158		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00260	29300215	SMOKE DETECTOR/DUCT [redacted]																			
159		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00261	29300216	SMOKE DETECTOR/DUCT [redacted]																			
160		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00262	29300217	SMOKE DETECTOR/DUCT [redacted]																			
161		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00263	29300218	SMOKE DETECTOR/DUCT [redacted]																			
162		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00264	29300219	SMOKE DETECTOR/DUCT [redacted]																			
163		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00265	29300220	SMOKE DETECTOR/DUCT [redacted]																			
164		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00266	29300221	SMOKE DETECTOR/DUCT [redacted]																			
165		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00267	29300222	SMOKE DETECTOR/DUCT [redacted]																			
166		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00268	29300223	SMOKE DETECTOR/DUCT [redacted]																			
167		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00269	29300224	SMOKE DETECTOR/DUCT [redacted]																			
168		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00270	29300225	SMOKE DETECTOR/DUCT [redacted]																			
169		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00271	29300226	SMOKE DETECTOR/DUCT [redacted]																			
170		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00272	29300227	SMOKE DETECTOR/DUCT [redacted]																			
171		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00273	29300228	SMOKE DETECTOR/DUCT [redacted]																			
172		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00274	29300239	SMOKE DETECTOR/DUCT [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
173		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00275	29300230	SMOKE DETECTOR/DUCT [redacted]																			
174		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00276	29300231	SMOKE DETECTOR/DUCT [redacted]																			
175		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00277	29300232	SMOKE DETECTOR/DUCT [redacted]																			
176		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00278	29300233	SMOKE DETECTOR/DUCT [redacted]																			
177		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00279	29300234	SMOKE DETECTOR/DUCT [redacted]																			
178		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00280	29300235	SMOKE DETECTOR/DUCT [redacted]																			
179		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00281	29300236	SMOKE DETECTOR/DUCT [redacted]																			
180		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00282	29300237	SMOKE DETECTOR/DUCT [redacted]																			
181		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00283	29300238	SMOKE DETECTOR/DUCT (MAU-1)																			
182		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00284	29300239	SMOKE DETECTOR/DUCT (AHU-4A SUPPLY)																			
183		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00285	29300240	SMOKE DETECTOR/DUCT (AHU-4A RETURN)																			
184		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00286	29300241	SMOKE DETECTOR/DUCT (AHU-4B SUPPLY)																			
185		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00287	29300242	SMOKE DETECTOR/DUCT (AHU-4B RETURN)																			
186		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00288	29300243	SMOKE DETECTOR/DUCT (HV-1)																			
187		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00289	29300244	SMOKE DETECTOR/DUCT (AHU-5 SUPPLY)																			
188		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00290	29300245	SMOKE DETECTOR/DUCT (AHU-5 RETURN)																			
189		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00291	29300246	SMOKE DETECTOR/DUCT (AHU-7 SUPPLY)																			
190		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00292	29300247	SMOKE DETECTOR/DUCT (AHU-7 RETURN)																			
191		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00293	29300248	SMOKE DETECTOR/DUCT (AHU-6 SUPPLY)																			
192		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00294	29300249	SMOKE DETECTOR/DUCT (AHU-6 RETURN)																			
193		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00295	29300250	SMOKE DETECTOR/DUCT (EAV-1)																			
194		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00296	29300251	SMOKE DETECTOR/DUCT (AHU-3 SUPPLY)																			
195		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00297	29300252	SMOKE DETECTOR/DUCT (AHU-3 RETURN)																			
196		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00298	29300253	SMOKE DETECTOR/DUCT (EAV-2)																			
197		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00299	29300254	SMOKE DETECTOR/DUCT (AHU-2 SUPPLY)																			
198		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00300	29300255	SMOKE DETECTOR/DUCT (AHU-2 RETURN)																			
199		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00301	29300256	SMOKE DETECTOR/DUCT (AHU-1 SUPPLY)																			
200		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00302	29300257	SMOKE DETECTOR/DUCT (AHU-1 RETURN)																			
201		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00303	29300258	SMOKE DETECTOR/DUCT (ELEVATOR #1 HOISTWAY)																			
202		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00304	29300259	SMOKE DETECTOR/DUCT (ELEVATOR #2 HOISTWAY)																			
203		1025	FIRESYSTEM	23-29 31 13	28 31 76	2104	DET00305	29300260	SMOKE DETECTOR/DUCT (ELEVATOR #3 HOISTWAY)																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	DOE/fs Fire & ADA	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)										Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	MTRMFG	HP	VOLTS	GRBXMFG	GRLUBTYP	GRLUBQTY	DRVTYPE	DIMENSION	SPEED	TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00641	29300261	DOOR/POWER ASSIST [redacted]																									
5		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00642	29300262	DOOR/POWER ASSIST [redacted]																									
6		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00643	29300263	DOOR/POWER ASSIST [redacted]																									
7		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00644	29300264	DOOR/POWER ASSIST [redacted]																									
8		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00645	29300265	DOOR/POWER ASSIST [redacted]																									
9		1013	DOOR	23-17 11 13 25	08 33 23	2104	DOR00646	29300266	DOOR/POWER ASSIST [redacted]																									
10		1013	DOOR	23-17 21 15 11 13	08 34 19.10 20	2104	DOR00647	29300267	DOOR/FIRE/ACCORDIAN [redacted]																									
11		1013	DOOR	23-17 21 15 11 13	08 34 19.10 20	2104	DOR00648	29300268	DOOR/FIRE/ACCORDIAN [redacted]																									
12		1013	DOOR	23-17 21 15 11 13	08 34 19.10 20	2104	DOR00649	29300269	DOOR/FIRE/ACCORDIAN [redacted]																									
13		1013	DOOR	23-17 21 15 11 13	08 34 19.10 20	2104	DOR00650	29300270	DOOR/FIRE/ACCORDIAN [redacted]																									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	DamPeR	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)				Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	master spec ID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	master spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SMOKE	FIRE	VOLTAC	VOLTDC	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00065	29300271	DAMPER/SMOKE [redacted]																			
5		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00066	29300272	DAMPER/SMOKE [redacted]																			
6		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00067	29300273	DAMPER/SMOKE [redacted]																			
7		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00068	29300274	DAMPER/SMOKE [redacted]																			
8		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00069	29300275	DAMPER/SMOKE [redacted]																			
9		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00070	29300276	DAMPER/SMOKE [redacted]																			
10		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00071	29300277	DAMPER/SMOKE [redacted]																			
11		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00072	29300278	DAMPER/SMOKE [redacted]																			
12		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00073	29300279	DAMPER/SMOKE [redacted]																			
13		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00074	29300280	DAMPER/SMOKE [redacted]																			
14		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00075	29300281	DAMPER/SMOKE [redacted]																			
15		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00076	29300282	DAMPER/SMOKE [redacted]																			
16		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00077	29300283	DAMPER/SMOKE [redacted]																			
17		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00078	29300284	DAMPER/SMOKE [redacted]																			
18		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00079	29300285	DAMPER/SMOKE [redacted]																			
19		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00080	29300286	DAMPER/SMOKE [redacted]																			
20		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00081	29300287	DAMPER/SMOKE [redacted]																			
21		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00082	29300288	DAMPER/SMOKE [redacted]																			
22		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00083	29300289	DAMPER/SMOKE [redacted]																			
23		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00084	29300290	DAMPER/SMOKE [redacted]																			
24		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00085	29300291	DAMPER/SMOKE [redacted]																			
25		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00086	29300292	DAMPER/SMOKE [redacted]																			
26		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00087	29300293	DAMPER/SMOKE [redacted]																			
27		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00088	29300294	DAMPER/SMOKE [redacted]																			
28		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00089	29300295	DAMPER/SMOKE [redacted]																			
29		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00090	29300296	DAMPER/SMOKE [redacted]																			
30		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00091	29300297	DAMPER/SMOKE [redacted]																			
31		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00092	29300298	DAMPER/SMOKE [redacted]																			
32		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00093	29300299	DAMPER/SMOKE [redacted]																			
33		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00094	29300300	DAMPER/SMOKE [redacted]																			
34		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00095	29300301	DAMPER/SMOKE [redacted]																			
35		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00096	29300302	DAMPER/SMOKE [redacted]																			
36		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00097	29300303	DAMPER/SMOKE [redacted]																			
37		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00098	29300304	DAMPER/SMOKE [redacted]																			
38		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00099	29300305	DAMPER/SMOKE [redacted]																			
39		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00100	29300306	DAMPER/SMOKE [redacted]																			
40		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00101	29300307	DAMPER/SMOKE [redacted]																			
41		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00102	29300308	DAMPER/SMOKE [redacted]																			
42		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00103	29300309	DAMPER/SMOKE [redacted]																			
43		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00104	29300310	DAMPER/SMOKE [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
44		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00105	29300311	DAMPER/SMOKE [redacted]																			
45		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00106	29300312	DAMPER/SMOKE [redacted]																			
46		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00107	29300313	DAMPER/SMOKE [redacted]																			
47		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00108	29300314	DAMPER/SMOKE [redacted]																			
48		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00109	29300315	DAMPER/SMOKE [redacted]																			
49		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00110	29300316	DAMPER/SMOKE [redacted]																			
50		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00111	29300317	DAMPER/SMOKE [redacted]																			
51		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00112	29300318	DAMPER/SMOKE [redacted]																			
52		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00113	29300319	DAMPER/SMOKE [redacted]																			
53		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00114	29300320	DAMPER/SMOKE [redacted]																			
54		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00115	29300321	DAMPER/SMOKE [redacted]																			
55		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00116	29300322	DAMPER/SMOKE [redacted]																			
56		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00117	29300323	DAMPER/SMOKE [redacted]																			
57		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00118	29300324	DAMPER/SMOKE [redacted]																			
58		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00119	29300325	DAMPER/SMOKE [redacted]																			
59		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00120	29300326	DAMPER/SMOKE [redacted]																			
60		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00121	29300327	DAMPER/SMOKE [redacted]																			
61		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00122	29300328	DAMPER/SMOKE [redacted]																			
62		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00123	29300329	DAMPER/SMOK [redacted]																			
63		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00124	29300330	DAMPER/SMOKE [redacted]																			
64		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00125	29300331	DAMPER/SMOKE [redacted]																			
65		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00126	29300332	DAMPER/SMOKE [redacted]																			
66		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00127	29300333	DAMPER/SMOKE [redacted]																			
67		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00128	29300334	DAMPER/SMOKE [redacted]																			
68		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00129	29300335	DAMPER/SMOKE [redacted]																			
69		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00130	29300336	DAMPER/SMOKE [redacted]																			
70		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00131	29300337	DAMPER/SMOKE [redacted]																			
71		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00132	29300338	DAMPER/SMOKE [redacted]																			
72		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00133	29300339	DAMPER/SMOKE [redacted]																			
73		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00134	29300340	DAMPER/SMOKE [redacted]																			
74		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00135	29300341	DAMPER/SMOKE [redacted]																			
75		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00136	29300342	DAMPER/SMOKE [redacted]																			
76		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00137	29300343	DAMPER/SMOKE [redacted]																			
77		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00138	29300344	DAMPER/SMOKE [redacted]																			
78		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00139	29300345	DAMPER/SMOKE [redacted]																			
79		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00140	29300346	DAMPER/SMOKE [redacted]																			
80		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00141	29300347	DAMPER/SMOKE [redacted]																			
81		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00142	29300348	DAMPER/SMOKE [redacted]																			
82		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00143	29300349	DAMPER/SMOKE [redacted]																			
83		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00144	29300350	DAMPER/SMOKE [redacted]																			
84		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00145	29300351	DAMPER/SMOKE [redacted]																			
85		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00146	29300352	DAMPER/SMOKE [redacted]																			
86		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00147	29300353	DAMPER/SMOKE [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
87		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00148	29300354	DAMPER/SMOKE [redacted]																			
88		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00149	29300355	DAMPER/SMOKE [redacted]																			
89		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00150	29300356	DAMPER/SMOKE [redacted]																			
90		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00151	29300357	DAMPER/SMOKE [redacted]																			
91		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00152	29300358	DAMPER/SMOKE [redacted]																			
92		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00153	29300359	DAMPER/SMOKE [redacted]																			
93		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00154	29300360	DAMPER/SMOKE [redacted]																			
94		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00155	29300361	DAMPER/SMOKE [redacted]																			
95		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00156	29300362	DAMPER/SMOKE [redacted]																			
96		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00157	29300363	DAMPER/SMOKE [redacted]																			
97	**Assets**	1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00158	29300364	DAMPER/SMOKE [redacted]																			
98		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00159	29300365	DAMPER/SMOKE [redacted]																			
99		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00160	29300366	DAMPER/SMOKE [redacted]																			
100		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00161	29300367	DAMPER/SMOKE [redacted]																			
101		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00162	29300368	DAMPER/SMOKE [redacted]																			
102		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00163	29300369	DAMPER/SMOKE [redacted]																			
103		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00164	29300370	DAMPER/SMOKE [redacted]																			
104		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00165	29300371	DAMPER/SMOKE [redacted]																			
105		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00166	29300372	DAMPER/SMOKE [redacted]																			
106		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00167	29300373	DAMPER/SMOKE [redacted]																			
107		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00168	29300374	DAMPER/SMOKE [redacted]																			
108		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00169	29300375	DAMPER/SMOKE [redacted]																			
109		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00170	29300376	DAMPER/SMOKE [redacted]																			
110		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00171	29300377	DAMPER/SMOKE [redacted]																			
111		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00172	29300378	DAMPER/SMOKE [redacted]																			
112		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00173	29300379	DAMPER/SMOKE [redacted]																			
113		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00174	29300380	DAMPER/SMOKE [redacted]																			
114		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00175	29300381	DAMPER/SMOKE [redacted]																			
115		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00176	29300382	DAMPER/SMOKE [redacted]																			
116		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00177	29300383	DAMPER/SMOKE [redacted]																			
117		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00178	29300384	DAMPER/SMOKE [redacted]																			
118		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00179	29300385	DAMPER/SMOKE [redacted]																			
119		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00180	29300386	DAMPER/SMOKE [redacted]																			
120		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00181	29300387	DAMPER/SMOKE [redacted]																			
121		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00182	29300388	DAMPER/SMOKE [redacted]																			
122		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00183	29300389	DAMPER/SMOKE [redacted]																			
123		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00184	29300390	DAMPER/SMOKE [redacted]																			
124		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00185	29300391	DAMPER/SMOKE [redacted]																			
125		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00186	29300392	DAMPER/SMOKE [redacted]																			
126		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00187	29300393	DAMPER/SMOKE [redacted]																			
127		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00188	29300394	DAMPER/SMOKE [redacted]																			
128		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00189	29300395	DAMPER/SMOKE [redacted]																			
129		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00190	29300396	DAMPER/SMOKE [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
130		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00191	29300397	DAMPER/SMOKE [redacted]																			
131		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00192	29300398	DAMPER/SMOKE [redacted]																			
132		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00193	29300399	DAMPER/SMOKE [redacted]																			
133		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00194	29300400	DAMPER/SMOKE [redacted]																			
134		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00195	29300401	DAMPER/SMOKE [redacted]																			
135		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00196	29300402	DAMPER/SMOKE [redacted]																			
136		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00197	29300403	DAMPER/SMOKE [redacted]																			
137		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00198	29300404	DAMPER/SMOKE [redacted]																			
138		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00199	29300405	DAMPER/SMOKE [redacted]																			
139		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00200	29300406	DAMPER/SMOKE [redacted]																			
140		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00201	29300407	DAMPER/SMOKE [redacted]																			
141		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00202	29300408	DAMPER/SMOKE [redacted]																			
142		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00203	29300409	DAMPER/SMOKE [redacted]																			
143		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00204	29300410	DAMPER/SMOKE [redacted]																			
144		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00205	29300411	DAMPER/SMOKE [redacted]																			
145		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00206	29300412	DAMPER/SMOKE [redacted]																			
146		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00207	29300413	DAMPER/SMOKE [redacted]																			
147		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00208	29300414	DAMPER/SMOKE [redacted]																			
148		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00209	29300415	DAMPER/SMOKE [redacted]																			
149		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00210	29300416	DAMPER/SMOKE [redacted]																			
150		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00211	29300417	DAMPER/SMOKE [redacted]																			
151		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00212	29300418	DAMPER/SMOKE [redacted]																			
152		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00213	29300419	DAMPER/SMOKE [redacted]																			
153		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00214	29300420	DAMPER/SMOKE [redacted]																			
154		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00215	29300421	DAMPER/SMOKE [redacted]																			
155		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00216	29300422	DAMPER/SMOKE [redacted]																			
156		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00217	29300423	DAMPER/SMOKE [redacted]																			
157		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00218	29300424	DAMPER/SMOKE [redacted]																			
158		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00219	29300425	DAMPER/SMOKE [redacted]																			
159		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00220	29300426	DAMPER/SMOKE [redacted]																			
160		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00221	29300427	DAMPER/SMOKE [redacted]																			
161		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00222	29300428	DAMPER/SMOKE [redacted]																			
162		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00223	29300429	DAMPER/SMOKE [redacted]																			
163		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00224	29300430	DAMPER/SMOKE [redacted]																			
164		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00225	29300431	DAMPER/SMOKE [redacted]																			
165		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00226	29300432	DAMPER/SMOKE [redacted]																			
166		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00227	29300433	DAMPER/SMOKE [redacted]																			
167		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00228	29300434	DAMPER/SMOKE [redacted]																			
168		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00229	29300435	DAMPER/SMOKE [redacted]																			
169		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00230	29300436	DAMPER/SMOKE [redacted]																			
170		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00231	29300437	DAMPER/SMOKE [redacted]																			
171		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00232	29300438	DAMPER/SMOKE [redacted]																			
172		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00233	29300449	DAMPER/SMOKE [redacted]																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
173		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00234	29300440	DAMPER/SMOKE [redacted]																			
174		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00235	29300441	DAMPER/SMOKE [redacted]																			
175		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00236	29300442	DAMPER/SMOKE [redacted]																			
176		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00237	29300443	DAMPER/SMOKE [redacted]																			
177		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00238	29300444	DAMPER/SMOKE [redacted]																			
178		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00239	29300445	DAMPER/SMOKE [redacted]																			
179		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00240	29300446	DAMPER/SMOKE [redacted]																			
180		1025	FIRESYSTEM	23-33 29 25 13	07 84 00	2104	DPR00241	29300447	DAMPER/SMOKE [redacted]																			
181		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00242	29300448	DAMPER/SMOKE (AHU-4B)																			
182		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00243	29300449	DAMPER/SMOKE (EAV-1)																			
183		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00244	29300450	DAMPER/SMOKE (AHU-3)																			
184		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00245	29300451	DAMPER/SMOKE (AHU-2)																			
185		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00246	29300452	DAMPER/SMOKE (ELEVATOR #1 HOISTWAY)																			
186		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00247	29300453	DAMPER/SMOKE (ELEVATOR #2 HOISTWAY)																			
187		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00248	29300454	DAMPER/SMOKE (ELEVATOR #3 HOISTWAY)																			
188		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00249	29301659	DAMPER/AUTOMATIC (ES-1 EXHAUST STACK)																			
189		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00250	29301660	DAMPER/AUTOMATIC (ES-2 EXHAUST STACK)																			
190		1025	FIRESYSTEM	23-33 29 23 13	07 84 00	2104	DPR00251	29301661	DAMPER/AUTOMATIC (ES-3 EXHAUST STACK)																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	Emergency LighTing	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)						Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	VOLTAC	VOLTDC	TYPE	BATTTYPE	BATTMFG	QUANTITY	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08046	10144457	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
5		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08047	10144458	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
6		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08048	10144459	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
7		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08049	10144460	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
8		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08050	10144461	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
9		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08051	10144462	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
10		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08052	10144463	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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12		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08054	10144465	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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41		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08083	10144494	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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44		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08086	10144497	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
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53		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08095	10145006	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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56		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08098	10145009	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
57		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08099	10145010	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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59		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08101	10145012	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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62		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08104	10145015	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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66		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08108	10145019	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
67		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08109	10145020	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
68		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08110	10145021	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
69		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08111	10145022	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
70		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08112	10145023	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
71		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08113	10145024	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
72		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08114	10145025	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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74		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08116	10145027	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
75	**Assets**	1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08117	10145028	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
76		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08118	10145029	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
77		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08119	10145030	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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79		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08121	10145032	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
80		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08122	10145033	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
81		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08123	10145034	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
82		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08124	10145035	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
83		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08125	10145036	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
84		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08126	10145037	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
85		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08127	10145038	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
86		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08128	10145039	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
87		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08129	10145040	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
88		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08130	10145041	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
89		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08131	10145042	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
90		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08132	10145043	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
91		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08133	10145044	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
92		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08134	10145045	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
93		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08135	10145046	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
94		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08136	10145047	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
95		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08137	10145048	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
96		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08138	10145049	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
97		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08139	10145050	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
98		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08140	10145051	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
99		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08141	10145052	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
100		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08142	10145053	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
101		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08143	10145054	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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103		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08145	10145056	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
104		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08146	10145057	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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106		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08148	10145059	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
107		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08149	10145060	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
108		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08150	10145061	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
109		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08151	10145062	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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111		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08153	10145064	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
112		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08154	10145065	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
113		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08155	10145066	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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122		1035	LIGHTING	23-35 47 15 13	26 53 00.00 40	2104	ELT08164	10145075	LIGHT/EXIT/SELF DIAGONOSTIC [redacted]																					
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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
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135		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08177	10145088	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
136		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08178	10145089	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
137		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08179	10145090	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
138		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08180	10145091	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
139		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08181	10145092	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
140		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08182	10145093	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
141		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08183	10145094	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
142		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08184	10145095	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
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144		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08186	10145097	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
145		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08187	10145098	LIGHT/EMERGENCY/W/BATTERY [redacted]																					
146		1035	LIGHTING	23-35 47 13 13	26 53 00.00 40	2104	ELT08188	10145099	LIGHT/EMERGENCY/W/BATTERY [redacted]																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	ELeVator	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)											Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	WGHTCAP	VOLTAC	AMPSAC	PHASES	FRQNCY	WORKPRES	LUBETYPE	LUBEQTY	RLFSTNG	SPEED	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1022	ELEVATOR	23-23 11 11 11 13	14 21 00.00 20	2104	ELV00059	29300456	ELEVATOR/TRACTION/PERSONNEL (E1A LOBBY)																										
5		1022	ELEVATOR	23-23 11 11 11 13	14 21 00.00 20	2104	ELV00060	29300457	ELEVATOR/TRACTION/PERSONNEL (E1B LOBBY)																										
6		1022	ELEVATOR	23-23 11 11 11 17	41 21 13	2104	ELV00061	29300458	ELEVATOR/TRACTION/PERSONNEL (E1C SERVICE)																										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	EMErgency shower	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00239	29300459	EMERGENCY SHOWER/EYE WASH (b) (5)															
5		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00240	29300460	EMERGENCY SHOWER/EYE WASH (b) (5)															
6		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00241	29300461	EMERGENCY SHOWER/EYE WASH (b) (5)															
7		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00242	29300462	EMERGENCY SHOWER/EYE WASH (b) (5)															
8		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00243	29300463	EMERGENCY SHOWER/EYE WASH (b) (5)															
9		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00244	29300464	EMERGENCY SHOWER/EYE WASH (b) (5)															
10		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00245	29300465	EMERGENCY SHOWER/EYE WASH (b) (5)															
11		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00246	29300466	EMERGENCY SHOWER/EYE WASH (b) (5)															
12		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00247	29300467	EMERGENCY SHOWER/EYE WASH (b) (5)															
13		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00248	29300468	EMERGENCY SHOWER/EYE WASH (b) (5)															
14		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00249	29300469	EMERGENCY SHOWER/EYE WASH (b) (5)															
15		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00250	29300470	EMERGENCY SHOWER/EYE WASH (b) (5)															
16		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00251	29300471	EMERGENCY SHOWER/EYE WASH (b) (5)															
17		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00252	29300472	EMERGENCY SHOWER/EYE WASH (b) (5)															
18		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00253	29300473	EMERGENCY SHOWER/EYE WASH (b) (5)															
19		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00254	29300474	EMERGENCY SHOWER/EYE WASH (b) (5)															
20		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00255	29300475	EMERGENCY SHOWER/EYE WASH (b) (5)															
21		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00256	29300476	EMERGENCY SHOWER/EYE WASH (b) (5)															
22		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00257	29300477	EMERGENCY SHOWER/EYE WASH (b) (5)															
23		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00258	29300478	EMERGENCY SHOWER/EYE WASH (b) (5)															
24		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00259	29300479	EMERGENCY SHOWER/EYE WASH (b) (5)															
25		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00260	29300480	EMERGENCY SHOWER/EYE WASH (b) (5)															
26		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00261	29300481	EMERGENCY SHOWER/EYE WASH (b) (5)															
27		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00262	29300482	EMERGENCY SHOWER/EYE WASH (b) (5)															
28		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00263	29300483	EMERGENCY SHOWER/EYE WASH (b) (5)															
29		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00264	29300484	EMERGENCY SHOWER/EYE WASH (b) (5)															
30		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00265	29300485	EMERGENCY SHOWER/EYE WASH (b) (5)															
31		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00266	29300486	EMERGENCY SHOWER/EYE WASH (b) (5)															
32		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00267	29300487	EMERGENCY SHOWER/EYE WASH (b) (5)															
33		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00268	29300488	EMERGENCY SHOWER/EYE WASH (b) (5)															
34		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00269	29300489	EMERGENCY SHOWER/EYE WASH (b) (5)															
35		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00270	29300490	EMERGENCY SHOWER/EYE WASH (b) (5)															
36		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00271	29300491	EMERGENCY SHOWER/EYE WASH (b) (5)															
37		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00272	29300492	EMERGENCY SHOWER/EYE WASH (b) (5)															
38		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00273	29300493	EMERGENCY SHOWER/EYE WASH (b) (5)															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
39		1029	GENERIC	23-29 37 13 15	12 30 90	2104	EME00274	29300494	EMERGENCY SHOWER/EYE WASH [redacted]															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	FAN	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)											Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	FANVOLUM	FANSPEED	DRIVE	BELT#	OUTBDBRG	INBRDBRG	MOTOR HP	VOLT	FILTERS	SIZE	RPM	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01344	29300495	FAN/SUPPLY AIR (SF-1 AHU-1 H1RF #1)																										
5		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01345	29300496	FAN/SUPPLY AIR (SF-1AHU-1 H1RF #2)																										
6		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01346	29300497	FAN/SUPPLY AIR (SF-1AHU-1 H1RF #3)																										
7		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01347	29300498	FAN/SUPPLY AIR (SF-1AHU-1 H1RF #4)																										
8		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01348	29300499	FAN/SUPPLY AIR (SF-2 AHU-2 LAB #1)																										
9		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01349	29300500	FAN/SUPPLY AIR (SF-2 AHU-2 LAB #2)																										
10		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01350	29300501	FAN/SUPPLY AIR (SF-3 AHU-3 LAB #1)																										
11		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01351	29300502	FAN/SUPPLY AIR (SF-3 AHU-3 LAB #2)																										
12		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01352	29300503	FAN/SUPPLY AIR (SF-4 AHU-4A LAB #1)																										
13		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01353	29300504	FAN/SUPPLY AIR (SF-4 AHU-4A LAB #2)																										
14		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01354	29300505	FAN/SUPPLY AIR (SF-4 AHU-4A LAB #3)																										
15		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01355	29300506	FAN/SUPPLY AIR (SF-4 AHU-4A LAB #4)																										
16		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01356	29300507	FAN/SUPPLY AIR (SF-5 AHU4B LAB #1)																										
17		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01357	29300508	FAN/SUPPLY AIR (SF-5 AHU-4B LAB #2)																										
18		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01358	29300509	FAN/SUPPLY AIR (SF-5 AHU-4B LAB #3)																										
19		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01359	29300510	FAN/SUPPLY AIR (SF-5 AHU-4B LAB #4)																										
20		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01360	29300511	FAN/SUPPLY AIR (SF-6 AHU-5 OFC #1)																										
21		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01361	29300512	FAN/SUPPLY AIR (SF-6 AHU-5 OFC #2)																										
22		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01362	29300513	FAN/SUPPLY AIR (SF-6 AHU-5 OFC #3)																										
23		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01363	29300514	FAN/SUPPLY AIR (SF-6 AHU-5 OFC #4)																										
24		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01364	29300515	FAN/SUPPLY AIR (SF-7 AHU-6 OFC #1)																										
25		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01365	29300516	FAN/SUPPLY AIR (SF-7 AHU-6 OFC #2)																										
26		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01366	29300517	FAN/SUPPLY AIR (SF-7 AHU-6 OFC #3)																										
27		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01367	29300518	FAN/SUPPLY AIR (SF-7 AHU-6 OFC #4)																										
28		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01368	29300519	FAN/SUPPLY AIR (SF-8 AHU-7 TOWER #1)																										
29		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01369	29300520	FAN/SUPPLY AIR (SF-8 AHU-7 TOWER #2)																										
30		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01370	29300521	FAN/SUPPLY AIR (SF-9 MAU-1 #1)																										
31		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01371	29300522	FAN/SUPPLY AIR (SF-9 MAU-1 #2)																										
32		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01372	29300523	FAN/SUPPLY AIR (RF-1 AHU-1 H1RF #1)																										
33		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01373	29300524	FAN/SUPPLY AIR (RF-1 AHU-1 H1RF #2)																										
34		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01374	29300525	FAN/SUPPLY AIR (RF-1 AHU-1 H1RF #3)																										
35		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01375	29300526	FAN/SUPPLY AIR (RF-1 AHU-1 H1RF #4)																										
36		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01376	29300527	FAN/SUPPLY AIR (RF-2 AHU-2 LAB #1)																										
37		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01377	29300528	FAN/SUPPLY AIR (RF-2 AHU-2 LAB #2)																										
38		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01378	29300529	FAN/SUPPLY AIR (RF-3 AHU-3 LAB #1)																										
39		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01379	29300530	FAN/SUPPLY AIR (RF-3 AHU-3 LAB #2)																										
40		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01380	29300531	FAN/SUPPLY AIR (RF-4 AHU-4A LABI#1)																										
41		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01381	29300532	FAN/SUPPLY AIR (RF-4 AHU-4A LABI#2)																										
42		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01382	29300533	FAN/SUPPLY AIR (RF-4 AHU-4A LABI#3)																										
43		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01383	29300534	FAN/SUPPLY AIR (RF-4 AHU-4A LABI#4)																										
44		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01384	29300535	FAN/SUPPLY AIR (RF-5 AHU-4B LAB #1)																										
45		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01385	29300536	FAN/SUPPLY AIR (RF-5 AHU-4B LAB #2)																										
46		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01386	29300537	FAN/SUPPLY AIR (RF-5 AHU-4B LAB #3)																										
47		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01387	29300538	FAN/SUPPLY AIR (RF-5 AHU-4B LAB #4)																										
48		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01388	29300539	FAN/SUPPLY AIR (RF-6 AHU-5 OFC #1)																										
49		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01389	29300540	FAN/SUPPLY AIR (RF-6 AHU-5 OFC #2)																										
50		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01390	29300541	FAN/SUPPLY AIR (RF-6 AHU-5 OFC #3)																										
51		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01391	29300542	FAN/SUPPLY AIR (RF-6 AHU-5 OFC #4)																										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
52		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01392	29300543	FAN/SUPPLY AIR (RF-7 AHU-5 OFC #1)																										
53		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01393	29300544	FAN/SUPPLY AIR (RF-7 AHU-5 OFC #2)																										
54		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01394	29300545	FAN/SUPPLY AIR (RF-7 AHU-5 OFC #3)																										
55		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01395	29300546	FAN/SUPPLY AIR (RF-7 AHU-5 OFC #4)																										
56		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01396	29300547	FAN/SUPPLY AIR (RF-8 AHU-7 TOWER #1)																										
57		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01397	29300548	FAN/SUPPLY AIR (RF-8 AHU-7 TOWER #2)																										
58		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01398	29300549	FAN/SUPPLY AIR (SF-11 PAINT SPRAY BOOTH 1st Flr)																										
59		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01399	29300550	FAN/SUPPLY AIR (SF-12 PAINT SPRAY BOOTH 1st Flr)																										
60		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01400	29300551	FAN/SUPPLY AIR (SF-13 PAINT SPRAY BOOTH PENTHOUSE)																										
61		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01401	29300552	FAN/SUPPLY AIR (SF-14 LOADING DOCK)																										
62		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01402	29300553	FAN/SUPPLY AIR (EF-1A FUME EXHUAST)																										
63		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01403	29300554	FAN/SUPPLY AIR (EF-1B FUME EXHUAST)																										
64		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01404	29300555	FAN/SUPPLY AIR (EF-2A FLAME)																										
65	**Assets**	1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01405	29300556	FAN/SUPPLY AIR (EF-2B FLAME)																										
66		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01406	29300557	FAN/SUPPLY AIR (EF-2C FLAME)																										
67		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01407	29300558	FAN/SUPPLY AIR (EF-2D FLAME)																										
68		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01408	29300559	FAN/SUPPLY AIR (EF-2DFLAME)																										
69		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01409	29300560	FAN/SUPPLY AIR (EF-2E FLAME)																										
70		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01410	29300561	FAN/SUPPLY AIR (EF-3 GENERAL)																										
71		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01411	29300562	FAN/SUPPLY AIR (EF-4 GENERAL)																										
72		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01412	29300563	FAN/SUPPLY AIR (EF-5 GENERAL)																										
73		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01413	29300564	FAN/SUPPLY AIR (EF-6 REF)																										
74		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01414	29300565	FAN/EXHAUST AIR (EF-7 MECH SHOP)																										
75		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01415	29300566	FAN/EXHAUST AIR (EF-8A HIRF)																										
76		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01416	29300567	FAN/EXHAUST AIR (EF-8B HIRF)																										
77		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01417	29300568	FAN/EXHAUST AIR (EF-8C HIRF)																										
78		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01418	29300569	FAN/EXHAUST AIR (EF-9 ELEC SHOP)																										
79		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01419	29300570	FAN/EXHAUST AIR (EF-10 VC)																										
80		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01420	29300571	FAN/EXHAUST AIR (EF-11 GENERAL)																										
81		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01421	29300572	FAN/EXHAUST AIR (EF-12 GENERAL)																										
82		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01422	29300573	FAN/EXHAUST AIR (EF-13 FLORINE)																										
83		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01423	29300574	FAN/EXHAUST AIR (EF-14A VCC)																										
84		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01424	29300575	FAN/EXHAUST AIR (EF-14B VCC)																										
85		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01425	29300576	FAN/EXHAUST AIR (EF-14C VCC)																										
86		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01426	29300577	FAN/EXHAUST AIR (EF-14D VCC)																										
87		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01427	29300578	FAN/EXHAUST AIR (EF-14E VCC)																										
88		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01428	29300579	FAN/EXHAUST AIR (EF-14F VCC)																										
89		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01429	29300580	FAN/EXHAUST AIR (EF-14G VCC)																										
90		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01430	29300581	FAN/EXHAUST AIR (EF-14H VCC)																										
91		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01431	29300582	FAN/EXHAUST AIR (EF-14I VCC)																										
92		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01432	29300583	FAN/EXHAUST AIR (EF-14J VCC)																										
93		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01433	29300584	FAN/EXHAUST AIR (EF-14K VCC)																										
94		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01434	29300585	FAN/EXHAUST AIR (EF-14L VCC)																										
95		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01435	29300586	FAN/EXHAUST AIR (EF-14M VCC)																										
96		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01436	29300587	FAN/EXHAUST AIR (EF-14N VCC)																										
97		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01437	29300588	FAN/EXHAUST AIR (EF-14O VCC)																										
98		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01438	29300589	FAN/EXHAUST AIR (EF-14P VCC)																										
99		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01439	29300590	FAN/EXHAUST AIR (EF-9 SHOP OVEN)																										
100		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01440	29300591	FAN/EXHAUST AIR (EF-10 CHEM STORAGE/ VC)																										
101		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01441	29300592	FAN/EXHAUST AIR (EF-11 GENERAL LAB)																										
102		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01442	29300593	FAN/EXHAUST AIR (EF-12 GENERAL LAB)																										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
103		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01443	29300594	FAN/EXHAUST AIR (EF-13 FLUORINE)																										
104		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01444	29300595	FAN/EXHAUST AIR (EF-14A VCC)																										
105		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01445	29300596	FAN/EXHAUST AIR (EF-14B VCC)																										
106		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01446	29300597	FAN/EXHAUST AIR (EF-14C VCC)																										
107		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01447	29300598	FAN/EXHAUST AIR (EF-14DVCC)																										
108		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01448	29300599	FAN/EXHAUST AIR (EF-14E VCC)																										
109		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01449	29300600	FAN/EXHAUST AIR (EF-14F VCC)																										
110		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01450	29300601	FAN/EXHAUST AIR (EF-14G VCC)																										
111		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01451	29300602	FAN/EXHAUST AIR (EF-14H VCC)																										
112		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01452	29300603	FAN/EXHAUST AIR (EF-14I VCC)																										
113		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01453	29300604	FAN/EXHAUST AIR (EF-14J VCC)																										
114		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01454	29300605	FAN/EXHAUST AIR (EF-14K VCC)																										
115		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01455	29300606	FAN/EXHAUST AIR (EF-14L VCC)																										
116		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01456	29300607	FAN/EXHAUST AIR (EF-14M VCC)																										
117		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01457	29300608	FAN/EXHAUST AIR (EF-14N VCC)																										
118		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01458	29300609	FAN/EXHAUST AIR (EF-14O VCC)																										
119		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01459	29300610	FAN/EXHAUST AIR (EF-14P VCC)																										
120		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01460	29300611	FAN/EXHAUST AIR (EF-15 LOADING DOCK)																										
121		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01461	29300612	FAN/EXHAUST AIR (EF-16 CLEAN ROOM)																										
122		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01462	29300613	FAN/SUPPLY AIR (AIR CURTIAN ACT-1)																										
123		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01463	29300614	FAN/SUPPLY AIR (AIR CURTIAN ACT-2I)																										
124		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01464	29300615	FAN/EXHAUST AIR (ES-1 EXHAUST STACK)																										
125		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01465	29300616	FAN/EXHAUST AIR (ES-2 EXHAUST STACK)																										
126		1003	AHFAHU	23-33 31 19	23 00 00	2104	FAN01466	29300617	FAN/EXHAUST AIR (ES-3 EXHAUST STACK)																										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	Fan Coil Unit	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications							Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	FANVOLUM	FANSPEED	COILTYPE	RFRIGTYP	HEATTYPE	FLT1TYPE	FLT2TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00494	29300618	FAN COIL UNIT (FCU-1 FIRST FLOOR)																						
5		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00495	29300619	FAN COIL UNIT (FCU-2 THIRD FLOOR)																						
6		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00496	29300620	FAN COIL UNIT (FCU-3 PENTHOUSE)																						
7		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00497	29300621	FAN COIL UNIT (FCU-4 FIRST FLOOR)																						
8		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00498	29300622	FAN COIL UNIT (FCU-5 THIRD FLOOR)																						
9		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00499	29300623	FAN COIL UNIT (FCU-6 PENTHOUSE)																						
10		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00500	29300624	FAN COIL UNIT (FCU-7 FIRST FLOOR)																						
11		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00501	29300625	FAN COIL UNIT (FCU-8 SECOND FLOOR)																						
12		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00502	29300626	FAN COIL UNIT (FCU-9 THIRD FLOOR)																						
13		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00503	29300627	FAN COIL UNIT (FCU-10 FOURTH FLOOR)																						
14		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00504	29300628	FAN COIL UNIT (FCU-11 FIRST FLOOR)																						
15		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00505	29300629	FAN COIL UNIT (FCU-12 FIRST FLOOR)																						
16		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00506	29300630	FAN COIL UNIT (FCU-13 PENTHOUSE ROOF)																						
17		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00507	29300631	FAN COIL UNIT (FCU14 FIRST FLOOR)																						
18		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00508	29300632	FAN COIL UNIT (FCU-15 FIRST FLOOR)																						
19		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00509	29300633	FAN COIL UNIT (FCU-16 SECOND FLOOR)																						
20		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00510	29300634	FAN COIL UNIT (FCU-17 PENTHOUSE)																						
21		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00511	29300635	FAN COIL UNIT (FCU-18 PENTHOUSE)																						
22		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00512	29300636	FAN COIL UNIT (FCU-19 PENTHOUSE)																						
23		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00513	29300637	FAN COIL UNIT (FCU-20 PENTHOUSE)																						
24		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00514	29300638	FAN COIL UNIT (FCU-21 PENTHOUSE)																						
25		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00514	29301657	FAN COIL UNIT (FCU-22 PENTHOUSE)																						
26		1004	AHFFCU	23-33 33 11	23 82 00.00 20	2104	FCU00514	29301658	FAN COIL UNIT (FCU-23 PENTHOUSE)																						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Fire Department Conection	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)			Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	ANSICLNO	TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1025	FIRESYSTEM	23-29 25 15 19	12 12 00	2104	FDC00082	29300639	FIRE DEPARTMENT CONNECTION (NE SIDE)																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Fire Detection System	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)			Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	master spec ID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	master spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	ZONEQTY	VOLTDC	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-29 31 13 11	28 31 76	2104	FDS01304	29300640	FIRE DETECTION SYSTEM (H1A)																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	FIL ter	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)											Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	MEDIUM	FLOWCAP	FLOWGPM	PRESRATE	FLTRSIZE	ELMNTYPE	ELMNPTNO	MESHSCRN	OUTLTSIZ	MICRONSZ	INLETSIZ	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01207	29300641	FILTER/AIR (AHU-1-H1RF)																										
5		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01208	29300642	FILTER/AIR (AHU-2-LAB)																										
6		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01209	29300643	FILTER/AIR (AHU-3-LAB)																										
7		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01210	29300644	FILTER/AIR (AHU-4A-LAB)																										
8		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01211	29300645	FILTER/AIR (AHU-5-OFC)																										
9		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01212	29300646	FILTER/AIR (AHU-6-OFC)																										
10		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01213	29300647	FILTER/AIR (AHU-7-OFC)																										
11		1024	FILTER	23-27 57 27 11	23 00 00	2104	FIL01214	29300648	FILTER/AIR (AHU-MAU-1)																										
12		1024	FILTER	23-27 55 11 11	23 00 00	2104	FIL01215	29300649	FILTER/WATER/SIDE STREAM (SST-1)																										
13		1024	FILTER	23-27 55 11 11	23 00 00	2104	FIL01216	29300650	FILTER/WATER/SIDE STREAM (SST-2)																										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	FLow Meter	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)						Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	INPUT RANGE	SYS PRESS	ALRM SET PT.	SCALE FCTR	CYCLE TIME	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1031	METER	23-27 11 15 21	33 11 00	2104	FLM00238	29300651	FLOW METER/WATER (CITY WATER SUPPLY #1)																					
5		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00239	29300652	FLOW METER/WATER (CITY WATER SUPPLY #2)																					
6		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00240	29300653	FLOW METER/WATER (CITY WATER SUPPLY CLG TOWERS)																					
7		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00241	29300654	FLOW METER/WATER (FM-1 CHILL WATER [redacted])																					
8		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00242	29300655	FLOW METER/STEAM (FM-2 STEAM [redacted])																					
9		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00243	29300656	FLOW METER/WATER (FM-3 HEATING HOT WATER [redacted])																					
10		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00244	29300657	FLOW METER/WATER (FM-4 CHILL WATER [redacted])																					
11		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00245	29300658	FLOW METER/STEAM (FM-5 STEAM [redacted])																					
12		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00246	29300659	FLOW METER/STEAM (FM-6 STEAM [redacted])																					
13		1031	METER	23-27 11 15 21	33 11 00	2104	FLM00247	29300660	FLOW METER/WATER (FM-7 CLG TWR DRAIN 1ST FLR ROOF)																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Fall Protection Equipment	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1029	GENERIC	23-27 71 21	07 22 00	2104	FPE00496	29300661	FALL PROTECTION EQUIPMENT (STANCHION TIE OFF #)															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Fire Suppression System	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	CHKVLSIZ	WTRPRESS	FLOSWMFG	FLSWMODN	TMPSWMFG	TMSMODNO	TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-29 25 11 11	21 13 00.00 40	2104	FSS00322	29300662	FIRE SUPPRESSION SYSTEM/TOTAL PAC 3 WET SYS																							
5		1026	FIRESYSTEM	23-29 25 11 11	21 13 00.00 40	2104	FSS00323	29300663	FIRE SUPPRESSION SYSTEM/TOTAL PAC 3 WET SYS																							
6		1026	FIRESYSTEM	23-29 25 11 11	21 13 00.00 40	2104	FSS00324	29300664	FIRE SUPPRESSION SYSTEM/TOTAL PAC 3 WET SYS																							
7		1026	FIRESYSTEM	23-29 25 11 11	21 13 00.00 40	2104	FSS00325	29300665	FIRE SUPPRESSION SYSTEM/TOTAL PAC 3 DRY SYS																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	GAuGe	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	RANGE/PSI	RANGE/TEMP	VACUUM	TYPE	ENTRY/B,R	BLOWOUT	MAT'L	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	GAUGE	23-27 11 13 17	23 03 00.00 20	2104	GAG04251	29300666	DIAL PRESSURE GAUGE (STM SUP CLEAN STM GEN)																							
5		1026	GAUGE	23-27 11 13 17	23 03 00.00 20	2104	GAG04252	29300667	DIAL PRESSURE GAUGE (MAIN STEAM SUPPLY)																							
6		1026	GAUGE	23-27 11 13 17	23 03 00.00 20	2104	GAG04253	29300668	DIAL PRESSURE GAUGE (MAIN STEAM SUPPLY HX-1A)																							
7		1026	GAUGE	23-27 11 13 17	23 03 00.00 20	2104	GAG04254	29300669	DIAL PRESSURE GAUGE (MAIN STEAM SUPPLY HX-1B)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Heat EXchanger	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	TYPE	TUBMEDM	TUBMAXPR	SHELMEDM	SHLMAXPR	FLOWRATE	SHELMAXTM	TUBMAXTM	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00470	29300670	HEAT EXCHANGER (HRV-1 MACH)																								
5		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00471	29300671	HEAT EXCHANGER (HRV-2 AHU-4A LAB)																								
6		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00472	29300672	HEAT EXCHANGER (HRV-3 AHU-4B LAB)																								
7		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00473	29300673	HEAT EXCHANGER/ENERGY RECOVERY (ERV-1 PENTHOUSE)																								
8		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00474	29300674	HEAT EXCHANGER/ENERGY RECOVERY (ERV-2 PENTHOUSE)																								
9		1032	HEATEX	23-27 23 00	23 57 10.00 10	2104	HEX00475	29300675	HEAT EXCHANGER/CONVERTOR/STEAM (HX-1A BASEMENT)																								
10		1032	HEATEX	23-27 23 00	23 57 10.00 10	2104	HEX00476	29300676	HEAT EXCHANGER/CONVERTOR/STEAM (HX-1B BASEMENT)																								
11		1032	HEATEX	23-27 23 11	23 72 00	2104	HEX00477	29300677	HEAT EXCHANGER/ENERGY RECOVERY VENTILATOR (ERV-1 FIXED MEMBRANE)																								
12		1032	HEATEX	23-27 23 11	23 72 00	2104	HEX00478	29300678	HEAT EXCHANGER/ENERGY RECOVERY VENTILATOR (RV-2 FIXED MEMBRANE)																								
13		1032	HEATEX	23-27 23 11	23 72 00	2104	HEX00479	29300679	HEAT EXCHANGER/ENERGY RECOVERY WHEEL (MAU-1)																								
14		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00480	29300680	HEAT EXCHANGER/ENTHALPY WHEEL (EW-1 AHU-1)																								
15		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00481	29300681	HEAT EXCHANGER/ENTHALPY WHEEL (EW-2 AHU-2)																								
16		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00482	29300682	HEAT EXCHANGER/ENTHALPY WHEEL (EW-3 AHU-3)																								
17		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00483	29300683	HEAT EXCHANGER/ENTHALPY WHEEL (EW-4A AHU-4A)																								
18		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00484	29300684	HEAT EXCHANGER/ENTHALPY WHEEL (EW-4B AHU-4B)																								
19		1032	HEATEX	23-27 23 00	23 72 00	2104	HEX00485	29300685	HEAT EXCHANGER/ENTHALPY WHEEL (EW-5 MAU-1)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	Hazardous GAs leak detection	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)						Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	CLASS	TYPE	VOLTAC	Watts	INRANGE	OUTSIGNL	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1028	GASMOMITOR	23-27 11 27 11	23 64 10	2104	HGA 00141	29300686	HAZARDOUS GAS LEAK DETECTION (REFRIGERANT CHILLER RM)																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1	HeaTeR	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)												Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	HTRVOLT	AMP	KW	MAXBTURT	WORKPRES	CAPACITY	RLFVLMFG	RLFVLMOD	RLFVLSIZ	RLFSTNG	HTRTYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00430	29300687	HEATER/HYDRONIC/REHEAT (HC-1 SPRA[redacted]																											
5		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00431	29300688	HEATER/HYDRONIC/REHEAT (HC-2 SPRA[redacted]																											
6		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00432	29300689	HEATER/HYDRONIC/REHEAT (HC-3 SPRA[redacted]																											
7		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00433	29300690	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-03)																											
8		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00434	29300691	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-03)																											
9		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00435	29300692	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-04)																											
10		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00436	29300693	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-05)																											
11		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00437	29300694	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-06)																											
12		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00438	29300695	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-07)																											
13		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00439	29300696	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-08)																											
14		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00440	29300697	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-10)																											
15		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00441	29300698	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-13)																											
16		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00442	29300699	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-14)																											
17		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00443	29300700	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-15)																											
18		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00444	29300701	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-16)																											
19		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00445	29300702	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-17)																											
20		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00446	29300703	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-18)																											
21		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00447	29300704	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-21)																											
22		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00448	29300705	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-22)																											
23		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00449	29300706	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-23)																											
24		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00450	29300707	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-25)																											
25		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00451	29300708	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-07-01)																											
26		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00452	29300709	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-07-02)																											
27		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00453	29300710	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-07-03)																											
28		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00454	29300711	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-07-04)																											
29		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00455	29300712	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-27)																											
30		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00456	29300713	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-28)																											
31		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00457	29300714	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-29)																											
32		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00458	29300715	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-30)																											
33		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00459	29300716	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-31)																											
34		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00460	29300717	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-32)																											
35		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00461	29300718	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-33)																											
36		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00462	29300719	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-34)																											
37		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00463	29300720	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-35)																											
38		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00464	29300721	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-36)																											
39		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00465	29300722	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-38)																											
40		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00466	29300723	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-39)																											
41		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00467	29300724	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-40)																											
42		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00468	29300725	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-41)																											
43		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00469	29300726	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-42)																											
44		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00470	29300727	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-05-45)																											
45		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00471	29300728	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-07-05)																											
46		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00472	29300729	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-07-06)																											
47		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00473	29300730	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-07-07)																											
48		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00474	29300731	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-07-08)																											
49		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00475	29300732	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-07-09)																											
50		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00476	29300733	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-02)																											
51		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00477	29300734	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-03)																											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
52		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00478	29300735	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-04)																										
53		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00479	29300736	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-05)																											
54		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00480	29300737	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-06)																											
55		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00481	29300738	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-07)																											
56		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00482	29300739	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-08)																											
57		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00483	29300740	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-12)																											
58		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00484	29300741	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-13)																											
59		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00485	29300742	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-14)																											
60		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00486	29300743	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-15)																											
61		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00487	29300744	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-16)																											
62		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00488	29300745	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-17)																											
63		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00489	29300746	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-18)																											
64		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00490	29300747	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-19)																											
65		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00491	29300748	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-20)																											
66		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00492	29300749	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-06-21)																											
67		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00493	29300750	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-07-10)																											
68		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00494	29300751	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-07-11)																											
69		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00495	29300752	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-07-12)																											
70		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00496	29300753	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-07-13)																											
71		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00497	29300754	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-07-14)																											
72		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00498	29300755	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-23)																											
73		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00499	29300756	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-24)																											
74		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00500	29300757	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-25)																											
75		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00501	29300758	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-26)																											
76		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00502	29300759	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-27)																											
77		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00503	29300760	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-28)																											
78		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00504	29300761	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-29)																											
79		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00505	29300762	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-30)																											
80		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00506	29300763	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-31)																											
81		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00507	29300764	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-33)																											
82		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00508	29300765	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-34)																											
83		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00509	29300766	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-35)																											
84		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00510	29300767	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-36)																											
85		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00511	29300768	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-37)																											
86		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00512	29300769	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-38)																											
87	**Assets**	1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00513	29300770	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-41)																											
88		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00514	29300771	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-06-43)																											
89		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00515	29300772	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-07-15)																											
90		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00516	29300773	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-07-16)																											
91		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00517	29300774	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-07-17)																											
92		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00518	29300775	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-07-18)																											
93		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00519	29300776	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-07-19)																											
94		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00520	29300777	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-1H-01)																											
95		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00521	29300778	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-1H-02)																											
96		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00522	29300779	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-1H-03)																											
97		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00523	29300780	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-1H-04)																											
98		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00524	29300781	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-1H-05)																											
99		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00525	29300782	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-01)																											
100		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00526	29300783	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-02)																											
101		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00527	29300784	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-05)																											
102		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00528	29300785	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-06)																											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
103		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00529	29300786	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-07)																										
104		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00530	29300787	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-08)																											
105		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00531	29300788	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-09)																											
106		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00532	29300789	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4A-10)																											
107		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00533	29300790	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-17)																											
108		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00534	29300791	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-18)																											
109		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00535	29300792	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-19)																											
110		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00536	29300793	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-20)																											
111		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00537	29300794	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-21)																											
112		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00538	29300795	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-22)																											
113		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00539	29300796	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-23)																											
114		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00540	29300797	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-24)																											
115		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00541	29300798	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-4A-25)																											
116		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00542	29300799	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-32)																											
117		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00543	29300800	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-33)																											
118		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00544	29300801	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-34)																											
119		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00545	29300802	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-35)																											
120		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00546	29300803	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-36)																											
121		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00547	29300804	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-37)																											
122		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00548	29300805	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-4A-38)																											
123		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00549	29300806	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4B-01)																											
124		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00550	29300807	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4B-02)																											
125		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00551	29300808	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4B-11)																											
126		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00552	29300809	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4B-12)																											
127		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00553	29300810	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4B-17)																											
128		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00554	29300811	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-4B-18)																											
129		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00555	29300812	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-3L-01)																											
130		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00556	29300813	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-3L-02)																											
131		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00557	29300814	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-3L-03)																											
132		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00558	29300815	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-3L-04)																											
133		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00559	29300816	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 1-3L-05)																											
134		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00560	29300817	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-10)																											
135		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00561	29300818	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-11)																											
136		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00562	29300819	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-12)																											
137		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00563	29300820	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-13)																											
138		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00564	29300821	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-14)																											
139		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00565	29300822	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-15)																											
140		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00566	29300823	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-3L-16)																											
141		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00567	29300824	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-3L-22)																											
142		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00568	29300825	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-3L-23)																											
143		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00569	29300826	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-3L-24)																											
144		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00570	29300827	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-3L-27)																											
145		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00571	29300828	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-3L-28)																											
146		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00572	29300829	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-3L-29)																											
147		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00573	29300830	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-3L-30)																											
148		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00574	29300831	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-3L-31)																											
149		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00575	29300832	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-3L-32)																											
150		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00576	29300833	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-01)																											
151		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00577	29300834	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-02)																											
152		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00578	29300835	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-03)																											
153		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00579	29300836	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-04)																											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
154		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00580	29300837	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-05)																										
155		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00581	29300838	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-06)																											
156		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00582	29300839	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 2-2L-07)																											
157		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00583	29300840	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-2L-13)																											
158		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00584	29300841	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-2L-14)																											
159		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00585	29300842	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-2L-15)																											
160		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00586	29300843	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 3-2L-16)																											
161		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00587	29300844	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-21)																											
162		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00588	29300845	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-22)																											
163		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00589	29300846	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-23)																											
164		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00590	29300847	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-24)																											
165		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00591	29300848	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-25)																											
166		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00592	29300849	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-26)																											
167		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00593	29300850	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-27)																											
168		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00594	29300851	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 4-2L-28)																											
169		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00595	29300852	HEATER/HYDRONIC/REHEAT (AIR TERMINAL UNIT 5-2L-34)																											
170		1031	HEATEQ	23-33 15 21	23 57 10.00 10	2104	HTR00596	29300853	HEATER/STEAM (CSG-1 CLEAN STEAM GENERATOR)																											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1	HUMidifier	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)														Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	COOLBTU	HEATBTU	RFRIGTYP	RFRIGLB$	HP	COILTYPE	COMPTYPE	COMPMFG	DSCHPRES	SUCTPRES	VOLTAC	LRA	AMPS&C	RFRIGOZS	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00042	29300854	HUMIDIFIER UNIT/STEAM (H-1 LABS)																													
5		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00043	29300855	HUMIDIFIER UNIT/STEAM (H-2 LABS)																													
6		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00044	29300856	HUMIDIFIER UNIT/STEAM (H-3 LABS)																													
7		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00045	29300857	HUMIDIFIER UNIT/STEAM (H-4) LABS																													
8		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00046	29300858	HUMIDIFIER UNIT/STEAM (H-5 AHU-1)																													
9		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00047	29300859	HUMIDIFIER UNIT/STEAM (H-6 AHU-2)																													
10		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00048	29300860	HUMIDIFIER UNIT/STEAM (H-7 AHU-3)																													
11		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00049	29300861	HUMIDIFIER UNIT/STEAM (H-8 AHU-4A)																													
12		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00050	29300862	HUMIDIFIER UNIT/STEAM (H-9 AHU-4B)																													
13		1009	COOL	23-33 27 15	23 22 26.00 20	2104	HUM00051	29300863	HUMIDIFIER UNIT/STEAM (H-10 MAU-1)																													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	fire HYDrant	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)			Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	ANSICLNO	AWWA#	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-29 25 13	21 12 00	843-10	HYD00086	15400076	HYDRANT/FIRE PROTECTION (NW W.TAYLOR B-2104)																		
5		1026	FIRESYSTEM	23-29 25 13	21 12 00	843-10	HYD00087	15400077	HYDRANT/FIRE PROTECTION (SOUTH ENTRANCE B-2104)																		
6		1026	FIRESYSTEM	23-29 25 13	21 12 00	843-10	HYD00088	15400078	HYDRANT/FIRE PROTECTION (NE CORNER B- 2104)																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	ICE machine	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	COMPTYPE	RFRIGTYP	RFRIGLBS	RFRIGOZS	MTRVLTAC	LRA	COOLBTU	SIZE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1010	COOL	23-21 21 29	12 93 00	2104	ICE00081	29300864	ICE MACHINE (PANTRY 1ST FLR)																							
5		1010	COOL	23-21 21 29	12 93 00	2104	ICE00082	29300865	ICE MACHINE (PANTRY 2ND FLR)																							
6		1010	COOL	23-21 21 29	12 93 00	2104	ICE00083	29300866	ICE MACHINE (PANTRY 3RD FLR)																							
7		1010	COOL	23-21 21 29	12 93 00	2104	ICE00084	29300867	ICE MACHINE (PANTRY 4TH FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	LighTNing arrestor	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)						Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	CLASS	TYPE	KVRATE	PRIVLTAC	STATUS	TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1018	ELECTEQUIP	23-35 39 15	26 41 00.00 40	2104	LTN00063	29300868	LIGHTNING ARRESTOR (ALUMININUM)																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Motor Control Center	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	PRIVLTAC	PRIVLTDC	AMPSAC	PHASES	KVRATE	INTERUPT	TYPE	CUBEQTY	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1017	ELECTEQUIP	23-35 31 23	26 00 00,00 20	2104	MCC00248	29300869	MOTOR CONTROL CENTER# 0																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Motor Starter Assembly	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	PRIVLTAC	PRIVLTDC	AMPSAC	PHASES	KVRATE	STARTSIZ	FRAMENO	CUBEQTY	INTERUPT	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02745	29301654	MOTOR STARTER ASSEMBLY (EF-1)																								
5		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02746	29301655	MOTOR STARTER ASSEMBLY (EF-2)																								
6		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02747	29301656	MOTOR STARTER ASSEMBLY (EF-3)																								
7		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02748	29300870	MOTOR STARTER ASSEMBLY (EF-4)																								
8		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02749	29300871	MOTOR STARTER ASSEMBLY (EF-5)																								
9		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02750	29300872	MOTOR STARTER ASSEMBLY (EF-6)																								
10		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02751	29300873	MOTOR STARTER ASSEMBLY (EF-7)																								
11		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02752	29300874	MOTOR STARTER ASSEMBLY (EF-8)																								
12		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02753	29300875	MOTOR STARTER ASSEMBLY (EF-9)																								
13		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02754	29300876	MOTOR STARTER ASSEMBLY (EF-10)																								
14		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02755	29300877	MOTOR STARTER ASSEMBLY (EF-11)																								
15		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02756	29300878	MOTOR STARTER ASSEMBLY (EF-12)																								
16		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02757	29300879	MOTOR STARTER ASSEMBLY (EF-13)																								
17		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02758	29300880	MOTOR STARTER ASSEMBLY (EF-14)																								
18		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02759	29300881	MOTOR STARTER ASSEMBLY (EF-15)																								
19		1017	ELECTEQUIP	23-35 25 19	26 28 01.00 10	2104	MSA02760	29300882	MOTOR STARTER ASSEMBLY (EF-16)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	MoToR	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SPEED	HRSEPWR	VOLTAC	VOLTDC	AMPSAC	AMPSDC	FRAMENO	DRENDBRG	OPENDBRG	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02813	29300883	MOTOR/FAN SUPPLY AIR (SF-1 AHU-1-HIRF #1)																								
5		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02814	29300884	MOTOR/FAN SUPPLY AIR (SF-1 AHU-1-HIRF #2)																								
6		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02815	29300885	MOTOR/FAN SUPPLY AIR (SF-1 AHU-1-HIRF #3)																								
7		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02816	29300886	MOTOR/FAN SUPPLY AIR (SF-1 AHU-1-HIRF #4)																								
8		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02817	29300887	MOTOR/FAN SUPPLY AIR (SF-2 AHU-2-LAB #1)																								
9		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02818	29300888	MOTOR/FAN SUPPLY AIR (SF-2 AHU-2-LAB #2)																								
10		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02819	29300889	MOTOR/FAN SUPPLY AIR (SF-3 AHU-3-LAB #1)																								
11		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02820	29300890	MOTOR/FAN SUPPLY AIR (SF-3 AHU-3-LAB #2)																								
12		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02821	29300891	MOTOR/FAN SUPPLY AIR (SF-4 AHU-4A-LAB #1)																								
13		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02822	29300892	MOTOR/FAN SUPPLY AIR (SF-4 AHU-4A-LAB #2)																								
14		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02823	29300893	MOTOR/FAN SUPPLY AIR (SF-4 AHU-4A-LAB #3)																								
15		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02824	29300894	MOTOR/FAN SUPPLY AIR (SF-4 AHU-4A-LAB #4)																								
16		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02825	29300895	MOTOR/FAN SUPPLY AIR (SF-5 AHU-4B-LAB #1)																								
17		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02826	29300896	MOTOR/FAN SUPPLY AIR (SF-5 AHU-4B-LAB #2)																								
18		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02827	29300897	MOTOR/FAN SUPPLY AIR (SF-5 AHU-4B-LAB #3)																								
19		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02828	29300898	MOTOR/FAN SUPPLY AIR (SF-5 AHU-4B-LAB #4)																								
20		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02829	29300899	MOTOR/FAN SUPPLY AIR (SF-6 AHU-5-OFC #1)																								
21		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02830	29300900	MOTOR/FAN SUPPLY AIR (SF-6 AHU-5-OFC #2)																								
22		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02831	29300901	MOTOR/FAN SUPPLY AIR (SF-6 AHU-5-OFC #3)																								
23		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02832	29300902	MOTOR/FAN SUPPLY AIR (SF-6 AHU-5-OFC #4)																								
24		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02833	29300903	MOTOR/FAN SUPPLY AIR (SF-7 AHU-6-OFC #1)																								
25		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02834	29300904	MOTOR/FAN SUPPLY AIR (SF-7 AHU-6-OFC #2)																								
26		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02835	29300905	MOTOR/FAN SUPPLY AIR (SF-7 AHU-6-OFC #3)																								
27		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02836	29300906	MOTOR/FAN SUPPLY AIR (SF-7 AHU-6-OFC #4)																								
28		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02837	29300907	MOTOR/FAN SUPPLY AIR (SF-8 AHU-7-TOWER #1)																								
29		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02838	29300908	MOTOR/FAN SUPPLY AIR (SF-8 AHU-7-TOWER #2)																								
30		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02839	29300909	MOTOR/FAN SUPPLY AIR (SF-9-MAU-1 #1)																								
31		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02840	29300910	MOTOR/FAN SUPPLY AIR (SF-9-MAU -1 #2)																								
32		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02841	29300911	MOTOR/FAN RETURN AIR (RF-1 AHU-1-HIRF #1)																								
33		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02842	29300912	MOTOR/FAN RETURN AIR (RF-1 AHU-1-HIRF #2)																								
34		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02843	29300913	MOTOR/FAN RETURN AIR (RF-1 AHU-1-HIRF #3)																								
35		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02844	29300914	MOTOR/FAN RETURN AIR (RF-1 AHU-1-HIRF #4)																								
36		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02845	29300915	MOTOR/FAN RETURN AIR (RF-2 AHU-2-LAB #1)																								
37		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02846	29300916	MOTOR/FAN RETURN AIR (RF-2 AHU-2-LAB #2)																								
38		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02847	29300917	MOTOR/FAN RETURN AIR (RF-3 AHU-3-LAB #1)																								
39		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02848	29300918	MOTOR/FAN RETURN AIR (RF-3 AHU-3-LAB #2)																								
40		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02849	29300919	MOTOR/FAN RETURN AIR (RF-4 AHU4A-LAB #1)																								
41		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02850	29300920	MOTOR/FAN RETURN AIR (RF-4 AHU4A-LAB #2)																								
42		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02851	29300921	MOTOR/FAN RETURN AIR (RF-4 AHU4A-LAB #3)																								
43		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02852	29300922	MOTOR/FAN RETURN AIR (RF-4 AHU4A-LAB #4)																								
44		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02853	29300923	MOTOR/FAN RETURN AIR (RF-5 AHU4B-LAB #1)																								
45		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02854	29300924	MOTOR/FAN RETURN AIR (RF-5 AHU4B-LAB #2)																								
46		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02855	29300925	MOTOR/FAN RETURN AIR (RF-5 AHU4B-LAB #3)																								
47		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02856	29300926	MOTOR/FAN RETURN AIR (RF-5 AHU4B-LAB #4)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
48		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02857	29300927	MOTOR/FAN RETURN AIR (RF-6 AHU-5-OFC #1)																								
49		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02858	29300928	MOTOR/FAN RETURN AIR (RF-6 AHU-5-OFC #2)																								
50		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02859	29300929	MOTOR/FAN RETURN AIR (RF-6 AHU-5-OFC #3)																								
51		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02860	29300930	MOTOR/FAN RETURN AIR (RF-6 AHU-5-OFC #4)																								
52		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02861	29300931	MOTOR/FAN RETURN AIR (RF-7 AHU-6-OFC #1)																								
53		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02862	29300932	MOTOR/FAN RETURN AIR (RF-7 AHU-6-OFC #2)																								
54		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02863	29300933	MOTOR/FAN RETURN AIR (RF-7 AHU-6-OFC #3)																								
55		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02864	29300934	MOTOR/FAN RETURN AIR (RF-7 AHU-6-OFC #4)																								
56		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02865	29300935	MOTOR/FAN RETURN AIR (RF-8 AHU-7-OFC #1)																								
57		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02866	29300936	MOTOR/FAN RETURN AIR (RF-8 AHU-7-OFC #2)																								
58		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02867	29300937	MOTOR/SUPPLY AIR (SF-11 PAINT SPRAY ROOM 1st Flr)																								
59		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02868	29300938	MOTOR/SUPPLY AIR (SF-12 PAINT SPRAY ROOM 1st Flr)																								
60		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02869	29300939	MOTOR/SUPPLY AIR (SF-13 PAINT SPRAY ROOM PENTHOUSE)																								
61		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02870	29300940	MOTOR/SUPPLY AIR (SF-14 LOADING DOCK)																								
62		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02871	29300941	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
63		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02872	29300942	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
64		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02873	29300943	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
65		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02874	29300944	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
66		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02875	29300945	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
67		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02876	29300946	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
68		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02877	29300947	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
69		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02878	29300948	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
70		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02879	29300949	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
71		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02880	29300950	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
72		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02881	29300951	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
73		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02882	29300952	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
74		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02883	29300953	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
75		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02884	29300954	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
76		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02885	29300955	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
77	**Assets**	1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02886	29300956	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
78		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02887	29300957	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
79		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02888	29300958	MOTOR/EXHAUST AIR (EF-1A FUME EXHUAST)																								
80		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02889	29300959	MOTOR/EXHAUST AIR (EF-1B FUME EXHUAST)																								
81		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02890	29300960	MOTOR/EXHAUST AIR (EF-2A FLAME EXHUAST)																								
82		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02891	29300961	MOTOR/EXHAUST AIR (EF-2B FLAME EXHUAST)																								
83		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02892	29300962	MOTOR/EXHAUST AIR (EF-2C FLAME EXHUAST)																								
84		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02893	29300963	MOTOR/EXHAUST AIR (EF-2D FLAME EXHUAST)																								
85		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02894	29300964	MOTOR/EXHAUST AIR (EF-2E FLAME EXHUAST)																								
86		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02895	29300965	MOTOR/EXHAUST AIR (EF-3 GENERAL EXHUAST)																								
87		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02896	29300966	MOTOR/EXHAUST AIR (EF-4 GENERAL EXHUAST)																								
88		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02897	29300967	MOTOR/EXHAUST AIR (EF-5 GENERAL EXHUAST)																								
89		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02898	29300968	MOTOR/EXHAUST AIR (EF-6 CHILLER ROOM)																								
90		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02899	29300969	MOTOR/EXHAUST AIR (EF-7 MECHANICAL SHOPS)																								
91		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02900	29300970	MOTOR/EXHAUST AIR (EF-8A H1RF)																								
92		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02901	29300971	MOTOR/EXHAUST AIR (EF-8B H1RF)																								
93		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02902	29300972	MOTOR/EXHAUST AIR (EF-8C H1RF)																								
94		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02903	29300973	MOTOR/EXHAUST AIR (EF-9 SHOP OVEN)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
95		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02904	29300974	MOTOR/EXHAUST AIR (EF-10 CHEM STORAGE/ VC)																								
96		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02905	29300975	MOTOR/EXHAUST AIR (EF-11 GENERAL LAB)																								
97		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02906	29300976	MOTOR/EXHAUST AIR (EF-12 GENERAL LAB)																								
98		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02907	29300977	MOTOR/EXHAUST AIR (EF-13 FLUORINE)																								
99		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02908	29300978	MOTOR/EXHAUST AIR (EF-14A VCC)																								
100		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02909	29300979	MOTOR/EXHAUST AIR (EF-14B VCC)																								
101		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02910	29300980	MOTOR/EXHAUST AIR (EF-14C VCC)																								
102		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02911	29300981	MOTOR/EXHAUST AIR (EF-14DVCC)																								
103		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02912	29300982	MOTOR/EXHAUST AIR (EF-14E VCC)																								
104		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02913	29300983	MOTOR/EXHAUST AIR (EF-14F VCC)																								
105		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02914	29300984	MOTOR/EXHAUST AIR (EF-14G VCC)																								
106		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02915	29300985	MOTOR/EXHAUST AIR (EF-14H VCC)																								
107		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02916	29300986	MOTOR/EXHAUST AIR (EF-14I VCC)																								
108		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02917	29300987	MOTOR/EXHAUST AIR (EF-14J VCC)																								
109		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02918	29300988	MOTOR/EXHAUST AIR (EF-14K VCC)																								
110		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02919	29300989	MOTOR/EXHAUST AIR (EF-14L VCC)																								
111		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02920	29300990	MOTOR/EXHAUST AIR (EF-14M VCC)																								
112		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02921	29300991	MOTOR/EXHAUST AIR (EF-14N VCC)																								
113		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02922	29300992	MOTOR/EXHAUST AIR (EF-14O VCC)																								
114		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02923	29300993	MOTOR/EXHAUST AIR (EF-14P VCC)																								
115		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02924	29300994	MOTOR/EXHAUST AIR (EF-15 LOADING DOCK)																								
116		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02925	29300995	MOTOR/EXHAUST AIR (EF-16 CLEAN ROOM)																								
117		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02926	29300996	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
118		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02927	29300997	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
119		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02928	29300998	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
120		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02929	29300999	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
121		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02930	29301000	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
122		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02931	29301001	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
123		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02932	29301002	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
124		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02933	29301003	MOTOR/SUPPLY AIR (CLEAN ROOM [redacted]																								
125		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02934	29301004	MOTOR/DRIVE/PUMP (CWP-1)																								
126		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02935	29301005	MOTOR/DRIVE/PUMP (CWP-2)																								
127		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02936	29301006	MOTOR/DRIVE/PUMP (CWP-3)																								
128		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02937	29301007	MOTOR/DRIVE/PUMP (HWP-1)																								
129		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02938	29301008	MOTOR/DRIVE/PUMP (HWP-2)																								
130		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02939	29301009	MOTOR/DRIVE/PUMP (PCHWP-1)																								
131		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02940	29301010	MOTOR/DRIVE/PUMP (PCHWP-2)																								
132		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02941	29301011	MOTOR/DRIVE/PUMP (PCHWP-3)																								
133		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02942	29301012	MOTOR/DRIVE/PUMP (PWP-1)																								
134		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02943	29301013	MOTOR/DRIVE/PUMP (PWP-2)																								
135		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02944	29301014	MOTOR/DRIVE/PUMP (SCHWP-1)																								
136		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02945	29301015	MOTOR/DRIVE/PUMP (SCHWP-2)																								
137		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02946	29301016	MOTOR/DRIVE/PUMP (SCHWP-3)																								
138		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02947	29301017	MOTOR/DRIVE/PUMP (SCHWP-4)																								
139		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02948	29301018	MOTOR/DRIVE/FAN (CT-1)																								
140		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02949	29301019	MOTOR/DRIVE/FAN (CT-2)																								
141		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02950	29301020	MOTOR/DRIVE/FAN (CT-3)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
142		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02951	29301021	MOTOR/DRIVE/PUMP (SST-1)																								
143		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02952	29301022	MOTOR/DRIVE/PUMP (SST-2)																								
144		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02953	29301023	MOTOR/DRIVE/AIR CURTAIN (ACT-1 #1)																								
145		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02954	29301024	MOTOR/DRIVE/AIR CURTAIN (ACT-1 #2)																								
146		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02955	29301025	MOTOR/DRIVE/AIR CURTAIN (ACT-1 #3)																								
147		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02956	29301026	MOTOR/DRIVE/AIR CURTAIN (ACT-2 #1)																								
148		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02957	29301027	MOTOR/DRIVE/AIR CURTAIN (ACT-2 #2)																								
149		1036	MOTOR	23-35 15 11 13	26 60 13,00 40	2104	MTR02958	29301028	MOTOR/DRIVE/AIR CURTAIN (ACT-2 #3)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1	Oxegen Alarm System	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)						Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	CLASS	TYPE	VOLTAC	Watts	INRANGE	OUTSIGNL	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1028	GASMONITOR	23-27 11 27 17 19	10 00 00	2104	OAS00130	29301029	CONTROL PANEL (OXYGEN MONITOR SYS)																					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	Post Indicator Valve	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)				Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	TYPE	TMPSWMFG	TMSMODNO	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-27 31 43	21 12 00	2104	PIV00088	29301030	POST IND VLV-FIRE PROTECTION (NE CORNER B-2104)																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	PuMP	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	Horsepower	PUMPSPD	FLOWGPM	IMPLRDIA	DSCHPRES	BRGSMFG	BRGSMOD	MEDIUM	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1036	PUMP	23-27 17 13	23 64 26	2104	PMP02900	29301031	PUMP/CENTRIFUGAL (CWP-1 CONDENSING WATER)																								
5		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02901	29301032	PUMP/CENTRIFUGAL (CWP-2 CONDENSING WATER)																								
6		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02902	29301033	PUMP/CENTRIFUGAL (CWP-3 CONDENSING WATER)																								
7		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02903	29301034	PUMP/CENTRIFUGAL (HWP-1 HOT WATER)																								
8		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02904	29301035	PUMP/CENTRIFUGAL (HWP-2 HOT WATER)																								
9		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02905	29301036	PUMP/CENTRIFUGAL (PCHWP-1 PREMIMUM CHILL WATER)																								
10		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02906	29301037	PUMP/CENTRIFUGAL (PCHWP-2 PREMIMUM CHILL WATER)																								
11		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02907	29301038	PUMP/CENTRIFUGAL (PCHWP-3 PREMIMUM CHILL WATER)																								
12		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02908	29301039	PUMP/CENTRIFUGAL (SCHWP-1 SECONDARY CHILL WATER)																								
13		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02909	29301040	PUMP/CENTRIFUGAL (SCHWP-2 SECONDARY CHILL WATER)																								
14		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02910	29301041	PUMP/CENTRIFUGAL (SCHWP-3 SECONDARY CHILL WATER)																								
15		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02911	29301042	PUMP/CENTRIFUGAL (SCHWP-4 SECONDARY CHILL WATER)																								
16		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02912	29301043	PUMP/CENTRIFUGAL (SST-1 SIDESTREAM FILTRATION)																								
17		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02913	29301044	PUMP/CENTRIFUGAL (SST-2 SIDESTREAM FILTRATION)																								
18		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02914	29301045	PUMP/CENTRIFUGAL (PWP-1 WATER)																								
19		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02915	29301046	PUMP/CENTRIFUGAL (PWP-2 WATER)																								
20		1036	PUMP	23-27 17 13	23 22 23.0040	2104	PMP02916	29301047	PUMP/STEAM POWERED (PPCP-1 CONDENSATE)																								
21		1036	PUMP	23-27 17 13	23 03 00.00 20	2104	PMP02917	29301048	PUMP/CENTRIFUGAL (PPCP-2 CONDENSATE)																								
22		1036	PUMP	23-27 17 13	23 03 00.00 20	2104	PMP02918	29301049	PUMP/SUBMERISABLE (SP-1 ELEVATOR SUMP)																								
23		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02919	29301050	PUMP/SUBMERISABLE (SP-2 ELEVATOR SUMP)																								
24		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02920	29301051	PUMP/DUPLEX (DBP-1 DOMESTIC CW BOOSTER)																								
25		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02921	29301052	PUMP/DUPLEX (DBP-2 DOMESTIC CW BOOSTER)																								
26		1036	PUMP	23-27 17 13	23 64 26	2104	PMP02922	29301053	PUMP/CENTRIFUGAL (RO-1 RO WATER)																								
27		1036	PUMP	23-27 17 13	23 21 13.00 20	2104	PMP02933	29301054	PUMP/RECIRCULATING (HWC-1 WATER)																								
28		1036	PUMP	23-27 17 13	23 21 13.00 20	2104	PMP02934	29301055	PUMP/RECIRCULATING (HWC-2 WATER)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	PaNeL boards	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)					Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	PHASES	FRQNCY	VOLTRATE	AMPS	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01657	29301056	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
5		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01658	29301057	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
6		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01659	29301058	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
7		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01660	29301059	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
8		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01661	29301060	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
9		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01662	29301061	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
10		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01663	29301062	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
11		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01664	29301063	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
12		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01665	29301064	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
13		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01666	29301065	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
14		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01667	29301066	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
15		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01668	29301067	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
16		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01669	29301068	PANEL/POWER DISTRIBUTION/480/2277V (b) (5)																				
17		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01670	29301069	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
18		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01671	29301070	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
19		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01672	29301071	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
20		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01673	29301072	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
21		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01674	29301073	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
22		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01675	29301074	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
23		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01676	29301075	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
24		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01677	29301076	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
25		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01678	29301077	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
26		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01679	29301078	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
27		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01680	29301079	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
28		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01681	29301080	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
29		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01682	29301081	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
30		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01683	29301082	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
31		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01684	29301083	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
32		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01685	29301084	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
33		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01686	29301085	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
34		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01687	29301086	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
35		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01688	29301087	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
36		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01689	29301088	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
37		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01690	29301089	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
38		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01691	29301090	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
39		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01692	29301091	PANEL/POWER DISTRIBUTION/480/277V (b) (5)																				
40		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01693	29301092	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
41		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01694	29301093	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
42		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01695	29301094	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
43		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01696	29301095	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
44		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01697	29301096	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
45		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01698	29301097	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
46		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01699	29301098	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
47		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01700	29301099	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
48		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01701	29301100	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
49		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01702	29301101	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
50		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01703	29301102	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
51		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01704	29301103	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
52		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01705	29301104	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
53		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01706	29301105	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
54		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01707	29301106	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
55		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01708	29301107	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
56		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01709	29301108	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
57		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01710	29301109	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
58		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01711	29301110	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
59		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01712	29301111	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
60		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01713	29301112	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
61		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01714	29301113	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
62		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01715	29301114	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
63		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01716	29301115	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
64		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01717	29301116	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
65		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01718	29301117	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
66		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01719	29301118	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
67		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01720	29301119	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
68		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01721	29301120	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
69		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01722	29301121	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
70		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01723	29301122	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
71		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01724	29301123	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
72		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01725	29301124	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
73		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01726	29301125	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
74	**Assets**	1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01727	29301126	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
75		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01728	29301127	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
76		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01729	29301128	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
77		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01730	29301129	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
78		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01731	29301130	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
79		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01732	29301131	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
80		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01733	29301132	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
81		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01734	29301133	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
82		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01735	29301134	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
83		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01736	29301135	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
84		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01737	29301136	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
85		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01738	29301137	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
86		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01739	29301138	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
87		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01740	29301139	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
88		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01741	29301140	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
89		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01742	29301141	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
90		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01743	29301142	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
91		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01744	29301143	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
92		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01745	29301144	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
93		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01746	29301145	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
94		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01747	29301146	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
95		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01748	29301147	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
96		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01749	29301148	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
97		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01750	29301149	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
98		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01751	29301150	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
99		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01752	29301151	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
100		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01753	29301152	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
101		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01754	29301153	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
102		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01755	29301154	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
103		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01756	29301155	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
104		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01757	29301156	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
105		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01758	29301157	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
106		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01759	29301158	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
107		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01760	29301159	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
108		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01761	29301160	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
109		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01762	29301161	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
110		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01763	29301162	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
111		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01764	29301163	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
112		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01765	29301164	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
113		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01766	29301165	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
114		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01767	29301166	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
115		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01768	29301167	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
116		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01769	29301168	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
117		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01770	29301169	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
118		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01771	29301170	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
119		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01772	29301171	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
120		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01773	29301172	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
121		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01774	29301173	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
122		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01775	29301174	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
123		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01776	29301175	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
124		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01777	29301176	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
125		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01778	29301177	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
126		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01779	29301178	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
127		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01780	29301179	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
128		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01781	29301180	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
129		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01782	29301181	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
130		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01783	29301182	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
131		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01784	29301183	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				
132		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01785	29301184	PANEL/POWER DISTRIBUTION/120/208V (b) (5)																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
133		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01786	29301185	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
134		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01787	29301186	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
135		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01788	29301187	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
136		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01789	29301188	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
137		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01790	29301189	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
138		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01791	29301190	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
139		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01792	29301191	PANEL/POWER DISTRIBUTION/120/208V (D) (S)																				
140		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01793	29301192	PANEL/POWER DISTRIBUTION/480/277V (BUSDUCT A)																				
141		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01794	29301193	PANEL/POWER DISTRIBUTION/480/208V (BUSDUCT B)																				
142		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01795	29301194	PANEL/POWER DISTRIBUTION/480/277V (BUSDUCT C)																				
143		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01796	29301195	PANEL/POWER DISTRIBUTION/480/277V (BUSDUCT D)																				
144		1016	ELECTEQUIP	23-35 31 17	26 24 16.00 40	2104	PNL01797	29301196	PANEL/POWER DISTRIBUTION/480/277V (BUSDUCT E)																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	Rei.eiF Valve	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)							Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	NOMSIZE	BODYMTRL	DISCMTRL	INPRESS	RLFSETPR	RLFTMPST	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1046	VALVE	23-27 31 49	23 03 00.00 20	2104	RLF03531	29301197	VALVE/RELIEF/GRAVITY (GV-1 PAINT SPRAY RM)																						
5		1046	VALVE	23-27 31 49	23 03 00.00 20	2104	RLF03532	29301198	VALVE/RELIEF/GRAVITY (GV-2 PAINT SPRAY RM)																						
6		1046	VALVE	23-27 31 49 11	23 22 13.00 41	2104	RLF03533	29301199	VALVE/RELIEF/STEAM (HP STM TO LPS FOR HX-1A, HX-1B)																						
7		1046	VALVE	23-27 31 49 11	23 22 13.00 41	2104	RLF03534	29301200	VALVE/RELIEF/STEAM (LP STM FROM PRV-1A, PRV-1B)																						
8		1046	VALVE	23-27 31 49 11	23 22 13.00 41	2104	RLF03535	29301201	VALVE/RELIEF/STEAM (CLEAN STEAM GENERATOR)																						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	STand Pipe	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	SIZE	WTRPRESS	FLOSWMFG	FLSWMODN	ISLVLSIZ	TMPSWMFG	TMSMODNO	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-29 33 11	21 12 00	2104	STP00073	29301202	STANDPIPE/FIRE PROTECTION (STRWAY #2)																							
5		1026	FIRESYSTEM	23-29 33 11	21 12 00	2104	STP00074	29301203	STANDPIPE/FIRE PROTECTION (STRWAY #3)																							
6		1026	FIRESYSTEM	23-29 33 11	21 12 00	2104	STP00075	29301204	STANDPIPE/FIRE PROTECTION (STRWAY #1)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	STeam Trap	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	TYPE	TUBEMEDM	TUBMAXPR	SHELMEDM	SHLMAXPR	FLOWRATE	SHELMAXTM	TUBMAXTM	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01726	29301205	STEAM TRAP (HP STM SUP FT-1 PPCP-1)																								
5		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01727	29301206	STEAM TRAP (HP STM SUP FT-2 PPCP-2)																								
6		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01728	29301207	STEAM TRAP (TP-1 ABCH-1)																								
7		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01729	29301208	STEAM TRAP (TP-2 CSG)																								
8		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01730	29301209	STEAM TRAP (TP-3 PRV-1A & 1B HPS)																								
9		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01731	29301210	STEAM TRAP (TP-4 PRV-2A &2B LPS)																								
10		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01732	29301211	STEAM TRAP (TP-5 HX-1A & 1B)																								
11		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01733	29301212	STEAM TRAP (TP-6 FT-1)																								
12		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01734	29301213	STEAM TRAP (TP-7 H-1,2,3,4,5,6,7,10)																								
13		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01735	29301214	STEAM TRAP (TP-8 H-8& 9)																								
14		1032	VALVE	23-27 37 15 13	23 22 13.35 40	2104	STT01736	29301215	STEAM TRAP (TP-9 MAINS)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	high voltageSWitch	Equipment Record Data Fields NASA Form 481				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)																			Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installdondate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	PRIVLTAC	PRIVLTDC	AMPSAC	PHASES	SECVLTAC	SECVLTDC	SECAMPAC	SECAMPDC	KVRATE	KVARATE	SECTIONS	TOTALWT	INTRDSRS	INTERUPT	CLASS	FRQNCY	FUSERATE	SHRTCKRT	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02415	29301216	SWITCH22KV/480/277V/1500KVA/AIR (#2186)																																		
5		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02416	29301217	SWITCH22KV/480/277V/1500KVA/AIR (#2231)																																		
6		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02417	29301218	SWITCH22KV (SF6 SWTGR 2N1-L-1 #2182)																																		
7		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02418	29301219	SWITCH22KV (SF6 SWTGR 2N1-L-1A #2183)																																		
8		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02419	29301220	SWITCH22KV (SF6 SWTGR 2N1-L-1B #2184)																																		
9		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02420	29301221	SWITCH22KV (SF6 SWTGR SPARE #2185)																																		
10		1018	ELECTEQUIP	23-35 31 11	26 28 21.00 40	2104	SWI02421	29301222	SWITCH/AUTOMATIC TRANSFER/480V/225A (#1 ATS-1)																																		
11		1018	ELECTEQUIP	23-35 31 11	26 28 21.00 40	2104	SWI02422	29301223	SWITCH/AUTOMATIC TRANSFER/480V/225A (#2 ATS-2)																																		
12		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02423	29301224	SWITCH/MANUAL TRANSFER/480V/200A (#1 MTS-1)																																		
13		1018	ELECTEQUIP	23-35 31 11	26 00 00.00 20	2104	SWI02424	29301225	SWITCH/MANUAL TRANSFER/480V/200A (#2 MTS-2)																																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	power distribution SWITch	Equipment Record Data Fields NASA Form 481				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)																			Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.rcsmtag	component.barcode	component.larcid	component.name	type.artidentifier	Component.artidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	PRIVLTAC	PRIVLTDC	AMPSAC	PHASES	SECVLTAC	SECVLTDC	SECAMPAC	SECAMPDC	KVRATE	KVARATE	SECTIONS	TOTALWT	INTRDSRS	INTERUPT	CLASS	FRQNCY	FUSERATE	SHRTCKRT	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01493	29301226	SWITCH480/277V (SWITCHBOARD SWB"A")																																		
5		1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01494	29301227	SWITCH480/277V (SWITCHBOARD SWB"B")																																		
6		1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01495	29301228	SWITCH480/277V (SWITCHBOARD SWB"C")																																		
7		1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01496	29301229	SWITCH480V/225A (AUTOMATIC TRANSFER #1)																																		
8		1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01497	29301230	SWITCH480V/400A (AUTOMATIC TRANSFER #2)																																		
9		1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01498	29301231	SWITCH480V/200A (MANUAL TRANSFER MTS #1)																																		
10		1018	ELEPDIST	23-35 31 29	26 00 00.00 20	2104	SWT01499	29301232	SWITCH480V/200A (MANUAL TRANSFER MTS #2)																																		
11		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01500	29301233	SWITCH FLOW (FSS, SECT A STRWY 3 1ST FLR)																																		
12		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01501	29301234	SWITCH FLOW (FSS, SECT A STRWY 3 2ND FLR)																																		
13		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01502	29301235	SWITCH FLOW (FSS, SECT A STRWY 3 3RD FLR)																																		
14		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01503	29301236	SWITCH FLOW (FSS, SECT A STRWY 3 4TH FLR)																																		
15		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01504	29301237	SWITCH FLOW (FSS, SECT A STRWY 3 PNTHSE)																																		
16		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01505	29301238	SWITCH FLOW (FSS, SECT B STRWY 3 1ST FLR																																		
17		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01506	29301239	SWITCH FLOW (FSS, SECT B STRWY 3 2ND FLR																																		
18		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01507	29301240	SWITCH FLOW (FSS, SECT A STRWY 2 1ST FLR)																																		
19		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01508	29301241	SWITCH FLOW (FSS, SECT A STRWY 2 2ND FLR)																																		
20		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01509	29301242	SWITCH FLOW (FSS, SECT A STRWY 2 3RD FLR)																																		
21		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01510	29301243	SWITCH FLOW (FSS, SECT A STRWY 2 4TH FLR)																																		
22		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01511	29301244	SWITCH FLOW (FSS, SECT A STRWY 2 PNTHSE)																																		
23		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01512	29301245	SWITCH FLOW (FSS, SECT B STRWY 2 1ST FLR)																																		
24		1018	ELEPDIST	23-29 20 15 13	21 13 00.00 40	2104	SWT01513	29301246	SWITCH FLOW (FSS, SECT B STRWY 2 2ND FLR)																																		
25		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01514	29301247	SWITCH TAMPER (FSS, SECT A STRWY 3 1ST FLR)																																		
26		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01515	29301248	SWITCH TAMPER (FSS, SECT A STRWY 3 2ND FLR)																																		
27		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01516	29301249	SWITCH TAMPER (FSS, SECT A STRWY 3 3RD FLR)																																		
28		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01517	29301250	SWITCH TAMPER (FSS, SECT A STRWY 3 4TH FLR)																																		
29		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01518	29301251	SWITCH TAMPER (FSS, SECT A STRWY 3 PNTHSE)																																		
30		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01519	29301252	SWITCH TAMPER (FSS, SECT B STRWY 3 1ST FLR																																		
31		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01520	29301253	SWITCH TAMPER (FSS, SECT B STRWY 3 2ND FLR																																		
32		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01521	29301254	SWITCH TAMPER (FSS, SECT A STRWY 2 1ST FLR)																																		
33		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01522	29301255	SWITCH TAMPER (FSS, SECT A STRWY 2 2ND FLR)																																		
34		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01523	29301256	SWITCH TAMPER (FSS, SECT A STRWY 2 3RD FLR)																																		
35		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01524	29301257	SWITCH TAMPER (FSS, SECT A STRWY 2 4TH FLR)																																		
36		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01525	29301258	SWITCH TAMPER (FSS, SECT A STRWY 2 PNTHSE)																																		
37		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01526	29301259	SWITCH TAMPER (FSS, SECT B STRWY 2 1ST FLR																																		
38		1018	ELEPDIST	23-29 20 15 15	21 13 00.00 40	2104	SWT01527	29301260	SWITCH TAMPER (FSS, SECT B STRWY 2 2ND FLR																																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	TaNK	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	NATLBRD	SIZE	TANKNO	WORKPRES	CAPACITY	QUANTITY	MAXWKPR	MAXWKTM	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1042	TANK	23-27 29 19	23 64 26	2104	TNK00394	29301261	TANK/ EXPANSION (ET-1)																							
5		1042	TANK	23-27 29 19	23 64 26	2104	TNK00395	29301262	TANK/ EXPANSION (ET-2)																							
6		1042	TANK	23-27 29 19	23 64 26	2104	TNK00396	29301263	TANK/ EXPANSION (ET-3)																							
7		1042	TANK	23-27 29 19	23 64 26	2104	TNK00397	29301264	TANK/ EXPANSION (ET-4)																							
8		1042	TANK	23-27 29 19	23 64 26	2104	TNK00398	29301265	TANK/ EXPANSION (ET-5)																							
9		1042	TANK	23-27 29 19	23 64 26	2104	TNK00399	29301266	TANK/ AIR SEPARATOR (AS-1 CHILL WATER)																							
10		1042	TANK	23-27 29 19 13 11	43 02 00.00 41	2104	TNK00400	29301267	TANK/DEWAR (LIQUID NITROGEN)																							
11		1042	TANK	23-27 29 19	23 64 26	2104	TNK00401	29301268	TANK/CHEMICAL FEED (CHILL WATER SYSTEM)																							
12		1042	TANK	23-27 29 19	23 64 26	2104	TNK00402	29301269	TANK/FLASH (FT-1 PUMP RM)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Unit HeaTer	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	HTRTYPE	HTRVOLT	HTRAMP	MAXBTURT	WORKPRES	MTRMFG	MTRMODNO	CFM	PHASES	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1031	HEATEQ	23-33 15 00	23 82 00.00 20	2104	UHT00725	29301270	UNIT HEATER/ELECTRIC (CUH-1)																								
5		1031	HEATEQ	23-33 15 00	23 82 00.00 20	2104	UHT00726	29301271	UNIT HEATER/ELECTRIC (CUH-2)																								
6		1031	HEATEQ	23-33 15 00	23 82 00.00 20	2104	UHT00727	29301272	UNIT HEATER/ELECTRIC (CUH-3)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
1	Uninterruptable Power Supply	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)															Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	PRIVLTAC	PRIVLTDC	AMPSAC	AMPSDC	SECVLTAC	SECVLTDC	SECAMPAC	SECAMPDC	KVRATE	KVARATE	PHASES	WATTS	OHMS	TYPE	AIR FLTR	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00059	29301273	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
5		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00060	29301274	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
6		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00061	29301275	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
7		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00062	29301276	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
8		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00063	29301277	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
9		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00064	29301278	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
10		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00065	29301279	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														
11		1019	ELECTEQUIP	23-35 23 21 11	26 35 23 01.00 10	2104	UPS00066	29301280	UNINTERRUPTABLE POWER SUPPLY (T&M [redacted])																														

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Vairiable Air Box	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)								Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	FANVOLUM	FANSPEED	HEATTYPE	COILTYPE	FLT1TYPE	FLT2TYPE	HEATVOLT	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00441	29301281	VARIABLE AIR BOX/SINGLE DUCT (1-05-01 1st FLR)																							
5		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00442	29301282	VARIABLE AIR BOX/SINGLE DUCT (1-05-02A 1st FLR)																							
6		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00443	29301283	VARIABLE AIR BOX/SINGLE DUCT (1-05-02B 1st FLR)																							
7		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00444	29301284	VARIABLE AIR BOX/SINGLE DUCT (1-05-03 1st FLR)																							
8		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00445	29301285	VARIABLE AIR BOX/SINGLE DUCT (1-05-04 1st FLR)																							
9		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00446	29301286	VARIABLE AIR BOX/SINGLE DUCT (1-05-05 1st FLR)																							
10		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00447	29301287	VARIABLE AIR BOX/SINGLE DUCT (1-05-06 1st FLR)																							
11		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00448	29301288	VARIABLE AIR BOX/SINGLE DUCT (1-05-07 1st FLR)																							
12		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00449	29301289	VARIABLE AIR BOX/SINGLE DUCT (1-05-08 1st FLR)																							
13		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00450	29301290	VARIABLE AIR BOX/SINGLE DUCT (1-05-09 1st FLR)																							
14		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00451	29301291	VARIABLE AIR BOX/SINGLE DUCT (1-05-10 1st FLR)																							
15		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00452	29301292	VARIABLE AIR BOX/SINGLE DUCT (1-05-11 1st FLR)																							
16		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00453	29301293	VARIABLE AIR BOX/SINGLE DUCT (1-05-12 1st FLR)																							
17		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00454	29301294	VARIABLE AIR BOX/SINGLE DUCT (1-05-13 1st FLR)																							
18		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00455	29301295	VARIABLE AIR BOX/SINGLE DUCT (1-05-14 1st FLR)																							
19		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00456	29301296	VARIABLE AIR BOX/SINGLE DUCT (1-05-15 1st FLR)																							
20		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00457	29301297	VARIABLE AIR BOX/SINGLE DUCT (1-05-16 1st FLR)																							
21		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00458	29301298	VARIABLE AIR BOX/SINGLE DUCT (1-05-17 1st FLR)																							
22		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00459	29301299	VARIABLE AIR BOX/SINGLE DUCT (1-05-18 1st FLR)																							
23		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00460	29301300	VARIABLE AIR BOX/SINGLE DUCT (1-05-19 1st FLR)																							
24		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00461	29301301	VARIABLE AIR BOX/SINGLE DUCT (1-05-20 1st FLR)																							
25		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00462	29301302	VARIABLE AIR BOX/SINGLE DUCT (1-05-21 1st FLR)																							
26		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00463	29301303	VARIABLE AIR BOX/SINGLE DUCT (1-05-22 1st FLR)																							
27		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00464	29301304	VARIABLE AIR BOX/SINGLE DUCT (1-05-23 1st FLR)																							
28		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00465	29301305	VARIABLE AIR BOX/SINGLE DUCT (1-05-24a 1st FLR)																							
29		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00466	29301306	VARIABLE AIR BOX/SINGLE DUCT (1-05-24b 1st FLR)																							
30		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00467	29301307	VARIABLE AIR BOX/SINGLE DUCT (1-05-25 1st FLR)																							
31		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00468	29301308	VARIABLE AIR BOX/SINGLE DUCT (1-07-01 1st FLR)																							
32		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00469	29301309	VARIABLE AIR BOX/SINGLE DUCT (1-07-02 1st FLR)																							
33		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00470	29301310	VARIABLE AIR BOX/SINGLE DUCT (1-07-03 1st FLR)																							
34		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00471	29301311	VARIABLE AIR BOX/SINGLE DUCT (1-07-04 1st FLR)																							
35		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00472	29301312	VARIABLE AIR BOX/SINGLE DUCT (2-05-26 2nd FLR)																							
36		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00473	29301313	VARIABLE AIR BOX/SINGLE DUCT (2-05-27 2nd FLR)																							
37		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00474	29301314	VARIABLE AIR BOX/SINGLE DUCT (2-05-28 2nd FLR)																							
38		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00475	29301315	VARIABLE AIR BOX/SINGLE DUCT (2-05-29 2nd FLR)																							
39		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00476	29301316	VARIABLE AIR BOX/SINGLE DUCT (2-05-30 2nd FLR)																							
40		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00477	29301317	VARIABLE AIR BOX/SINGLE DUCT (2-05-31 2nd FLR)																							
41		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00478	29301318	VARIABLE AIR BOX/SINGLE DUCT (2-05-32 2nd FLR)																							
42		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00479	29301319	VARIABLE AIR BOX/SINGLE DUCT (2-05-33 2nd FLR)																							
43		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00480	29301320	VARIABLE AIR BOX/SINGLE DUCT (2-05-34A 2nd FLR)																							
44		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00481	29301321	VARIABLE AIR BOX/SINGLE DUCT (2-05-34B 2nd FLR)																							
45		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00482	29301322	VARIABLE AIR BOX/SINGLE DUCT (2-05-35 2nd FLR)																							
46		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00483	29301323	VARIABLE AIR BOX/SINGLE DUCT (2-05-36 2nd FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
47		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00484	29301324	VARIABLE AIR BOX/SINGLE DUCT (2-05-37 2nd FLR)																							
48		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00485	29301325	VARIABLE AIR BOX/SINGLE DUCT (2-05-38 2nd FLR)																							
49		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00486	29301326	VARIABLE AIR BOX/SINGLE DUCT (2-05-39 2nd FLR)																							
50		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00487	29301327	VARIABLE AIR BOX/SINGLE DUCT (2-05-40 2nd FLR)																							
51		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00488	29301328	VARIABLE AIR BOX/SINGLE DUCT (2-05-41 2nd FLR)																							
52		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00489	29301329	VARIABLE AIR BOX/SINGLE DUCT (2-05-42 2nd FLR)																							
53		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00490	29301330	VARIABLE AIR BOX/SINGLE DUCT (2-05-43 2nd FLR)																							
54		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00491	29301331	VARIABLE AIR BOX/SINGLE DUCT (2-05-44 2nd FLR)																							
55		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00492	29301332	VARIABLE AIR BOX/SINGLE DUCT (2-05-45 2nd FLR)																							
56		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00493	29301333	VARIABLE AIR BOX/SINGLE DUCT (2-05-46A 2nd FLR)																							
57		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00494	29301334	VARIABLE AIR BOX/SINGLE DUCT (2-05-46B 2nd FLR)																							
58		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00495	29301335	VARIABLE AIR BOX/SINGLE DUCT (2-07-05 2nd FLR)																							
59		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00496	29301336	VARIABLE AIR BOX/SINGLE DUCT (2-07-06 2nd FLR)																							
60		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00497	29301337	VARIABLE AIR BOX/SINGLE DUCT (2-07-07 2nd FLR)																							
61		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00498	29301338	VARIABLE AIR BOX/SINGLE DUCT (2-07-08 2nd FLR)																							
62		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00499	29301339	VARIABLE AIR BOX/SINGLE DUCT (2-07-09 2nd FLR)																							
63		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00500	29301340	VARIABLE AIR BOX/SINGLE DUCT (3-06-01 3rd FLR)																							
64		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00501	29301341	VARIABLE AIR BOX/SINGLE DUCT (3-06-02 3rd FLR)																							
65		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00502	29301342	VARIABLE AIR BOX/SINGLE DUCT (3-06-03 3rd FLR)																							
66		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00503	29301343	VARIABLE AIR BOX/SINGLE DUCT (3-06-04 3rd FLR)																							
67		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00504	29301344	VARIABLE AIR BOX/SINGLE DUCT (3-06-05 3rd FLR)																							
68		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00505	29301345	VARIABLE AIR BOX/SINGLE DUCT (3-06-06 3rd FLR)																							
69		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00506	29301346	VARIABLE AIR BOX/SINGLE DUCT (3-06-07 3rd FLR)																							
70		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00507	29301347	VARIABLE AIR BOX/SINGLE DUCT (3-06-08 3rd FLR)																							
71		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00508	29301348	VARIABLE AIR BOX/SINGLE DUCT (3-06-09A 3rd FLR)																							
72		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00509	29301349	VARIABLE AIR BOX/SINGLE DUCT (3-06-09B 3rd FLR)																							
73		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00510	29301350	VARIABLE AIR BOX/SINGLE DUCT (3-06-10 3rd FLR)																							
74		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00511	29301351	VARIABLE AIR BOX/SINGLE DUCT (3-06-11 3rd FLR)																							
75		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00512	29301352	VARIABLE AIR BOX/SINGLE DUCT (3-06-12 3rd FLR)																							
76		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00513	29301353	VARIABLE AIR BOX/SINGLE DUCT (3-06-13 3rd FLR)																							
77		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00514	29301354	VARIABLE AIR BOX/SINGLE DUCT (3-06-14 3rd FLR)																							
78		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00515	29301355	VARIABLE AIR BOX/SINGLE DUCT (3-06-15 3rd FLR)																							
79		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00516	29301356	VARIABLE AIR BOX/SINGLE DUCT (3-06-16 3rd FLR)																							
80		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00517	29301357	VARIABLE AIR BOX/SINGLE DUCT (3-06-17 3rd FLR)																							
81		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00518	29301358	VARIABLE AIR BOX/SINGLE DUCT (3-06-18 3rd FLR)																							
82		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00519	29301359	VARIABLE AIR BOX/SINGLE DUCT (3-06-19A 3rd FLR)																							
83		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00520	29301360	VARIABLE AIR BOX/SINGLE DUCT (3-06-19B 3rd FLR)																							
84		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00521	29301361	VARIABLE AIR BOX/SINGLE DUCT (3-06-20 3rd FLR)																							
85		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00522	29301362	VARIABLE AIR BOX/SINGLE DUCT (3-06-21A 3rd FLR)																							
86		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00523	29301363	VARIABLE AIR BOX/SINGLE DUCT (3-06-21B 3rd FLR)																							
87		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00524	29301364	VARIABLE AIR BOX/SINGLE DUCT (3-07-10 3rd FLR)																							
88		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00525	29301365	VARIABLE AIR BOX/SINGLE DUCT (3-07-11 3rd FLR)																							
89		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00526	29301366	VARIABLE AIR BOX/SINGLE DUCT (3-07-12 3rd FLR)																							
90		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00527	29301367	VARIABLE AIR BOX/SINGLE DUCT (3-07-13 3rd FLR)																							
91		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00528	29301368	VARIABLE AIR BOX/SINGLE DUCT (3-07-14 3rd FLR)																							
92		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00529	29301369	VARIABLE AIR BOX/SINGLE DUCT (4-06-21 4th FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
93		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00530	29301370	VARIABLE AIR BOX/SINGLE DUCT (4-06-22 4th FLR)																							
94		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00531	29301371	VARIABLE AIR BOX/SINGLE DUCT (4-06-23 4th FLR)																							
95		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00532	29301372	VARIABLE AIR BOX/SINGLE DUCT (4-06-24 4th FLR)																							
96		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00533	29301373	VARIABLE AIR BOX/SINGLE DUCT (4-06-25 4th FLR)																							
97		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00534	29301374	VARIABLE AIR BOX/SINGLE DUCT (4-06-26 4th FLR)																							
98		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00535	29301375	VARIABLE AIR BOX/SINGLE DUCT (4-06-27 4th FLR)																							
99		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00536	29301376	VARIABLE AIR BOX/SINGLE DUCT (4-06-28 4th FLR)																							
100		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00537	29301377	VARIABLE AIR BOX/SINGLE DUCT (4-06-29 4th FLR)																							
101		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00538	29301378	VARIABLE AIR BOX/SINGLE DUCT (4-06-30A 4th FLR)																							
102		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00539	29301379	VARIABLE AIR BOX/SINGLE DUCT (4-06-30B 4th FLR)																							
103		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00540	29301380	VARIABLE AIR BOX/SINGLE DUCT (4-06-31 4th FLR)																							
104		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00541	29301381	VARIABLE AIR BOX/SINGLE DUCT (4-06-32 4th FLR)																							
105		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00542	29301382	VARIABLE AIR BOX/SINGLE DUCT (4-06-33 4th FLR)																							
106		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00543	29301383	VARIABLE AIR BOX/SINGLE DUCT (4-06-34 4th FLR)																							
107		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00544	29301384	VARIABLE AIR BOX/SINGLE DUCT (4-06-35 4th FLR)																							
108		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00545	29301385	VARIABLE AIR BOX/SINGLE DUCT (4-06-36 4th FLR)																							
109		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00546	29301386	VARIABLE AIR BOX/SINGLE DUCT (4-06-37 4th FLR)																							
110		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00547	29301387	VARIABLE AIR BOX/SINGLE DUCT (4-06-38 4th FLR)																							
111		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00548	29301388	VARIABLE AIR BOX/SINGLE DUCT (4-06-39 4th FLR)																							
112		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00549	29301389	VARIABLE AIR BOX/SINGLE DUCT (4-06-40A 4th FLR)																							
113		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00550	29301390	VARIABLE AIR BOX/SINGLE DUCT (4-06-40B 4th FLR)																							
114		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00551	29301391	VARIABLE AIR BOX/SINGLE DUCT (4-06-41 4th FLR)																							
115		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00552	29301392	VARIABLE AIR BOX/SINGLE DUCT (4-06-42A 4th FLR)																							
116		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00553	29301393	VARIABLE AIR BOX/SINGLE DUCT (4-06-42B 4th FLR)																							
117		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00554	29301394	VARIABLE AIR BOX/SINGLE DUCT (4-07-15 3rd FLR)																							
118		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00555	29301395	VARIABLE AIR BOX/SINGLE DUCT (4-07-16 3rd FLR)																							
119		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00556	29301396	VARIABLE AIR BOX/SINGLE DUCT (4-07-17 3rd FLR)																							
120		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00557	29301397	VARIABLE AIR BOX/SINGLE DUCT (4-07-18 3rd FLR)																							
121		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00558	29301398	VARIABLE AIR BOX/SINGLE DUCT (4-07-19 3rd FLR)																							
122		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00559	29301399	VARIABLE AIR BOX/SINGLE DUCT (5-06-43 5th FLR)																							
123		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00560	29301400	VARIABLE AIR BOX/SINGLE DUCT (1-1H-01 1st FLR)																							
124		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00561	29301401	VARIABLE AIR BOX/SINGLE DUCT (1-1H-02 1st FLR)																							
125		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00562	29301402	VARIABLE AIR BOX/SINGLE DUCT (1-1H-03 1st FLR)																							
126		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00563	29301403	VARIABLE AIR BOX/SINGLE DUCT (1-1H-04 1st FLR)																							
127		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00564	29301404	VARIABLE AIR BOX/SINGLE DUCT (1-1H-05 1st FLR)																							
128		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00565	29301405	VARIABLE AIR BOX/SINGLE DUCT (1-1H-06 1st FLR)																							
129		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00566	29301406	VARIABLE AIR BOX/SINGLE DUCT (1-1H-07 1st FLR)																							
130		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00567	29301407	VARIABLE AIR BOX/SINGLE DUCT (1-1H-08 1st FLR)																							
131		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00568	29301408	VARIABLE AIR BOX/SINGLE DUCT (1-1H-9 1st FLR)																							
132		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00569	29301409	VARIABLE AIR BOX/SINGLE DUCT (1-3L-01 1st FLR)																							
133		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00570	29301410	VARIABLE AIR BOX/SINGLE DUCT (1-3L-02 1st FLR)																							
134		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00571	29301411	VARIABLE AIR BOX/SINGLE DUCT (1-3L-03 1st FLR)																							
135		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00572	29301412	VARIABLE AIR BOX/SINGLE DUCT (1-3L-04 1st FLR)																							
136		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00573	29301413	VARIABLE AIR BOX/SINGLE DUCT (1-3L-05 1st FLR)																							
137		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00574	29301414	VARIABLE AIR BOX/SINGLE DUCT (1-3L-06 1st FLR)																							
138		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00575	29301415	VARIABLE AIR BOX/SINGLE DUCT (1-3L-07 1st FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
139		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00576	29301416	VARIABLE AIR BOX/SINGLE DUCT (1-3L-08 1st FLR)																							
140		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00577	29301417	VARIABLE AIR BOX/SINGLE DUCT (1-3L-09 1st FLR)																							
141		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00578	29301418	VARIABLE AIR BOX/SINGLE DUCT (1-3L-09A 1st FLR)																							
142		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00579	29301419	VARIABLE AIR BOX/SINGLE DUCT (1-3L-33 1st FLR)																							
143		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00580	29301420	VARIABLE AIR BOX/SINGLE DUCT (1-4A-01 1st FLR)																							
144		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00581	29301421	VARIABLE AIR BOX/SINGLE DUCT (1-4A-02 1st FLR)																							
145		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00582	29301422	VARIABLE AIR BOX/SINGLE DUCT (1-4A-03 1st FLR)																							
146		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00583	29301423	VARIABLE AIR BOX/SINGLE DUCT (1-4A-04 1st FLR)																							
147	**Assets**	1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00584	29301424	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-01 1st FLR)																							
148		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00585	29301425	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-01 1st FLR)																							
149		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00586	29301426	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-02 1st FLR)																							
150		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00587	29301427	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-03 1st FLR)																							
151		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00588	29301428	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-04 1st FLR)																							
152		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00589	29301429	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-05 1st FLR)																							
153		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00590	29301430	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-06 1st FLR)																							
154		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00591	29301431	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-07 1st FLR)																							
155		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00592	29301432	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-08 1st FLR)																							
156		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00593	29301433	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-09 1st FLR)																							
157		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00594	29301434	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-10 1st FLR)																							
158		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00595	29301435	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-11 1st FLR)																							
159		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00596	29301436	VARIABLE AIR BOX/SINGLE DUCT (1-MAU-12 1st FLR)																							
160		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00597	29301437	VARIABLE AIR BOX/SINGLE DUCT (2-2L-01 2nd FLR)																							
161		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00598	29301438	VARIABLE AIR BOX/SINGLE DUCT (2-2L-02 2nd FLR)																							
162		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00599	29301439	VARIABLE AIR BOX/SINGLE DUCT (2-2L-03 2nd FLR)																							
163		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00600	29301440	VARIABLE AIR BOX/SINGLE DUCT (2-2L-04 2nd FLR)																							
164		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00601	29301441	VARIABLE AIR BOX/SINGLE DUCT (2-2L-05 2nd FLR)																							
165		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00602	29301442	VARIABLE AIR BOX/SINGLE DUCT (2-2L-06 2nd FLR)																							
166		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00603	29301443	VARIABLE AIR BOX/SINGLE DUCT (2-2L-07 2nd FLR)																							
167		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00604	29301444	VARIABLE AIR BOX/SINGLE DUCT (2-2L-08 2nd FLR)																							
168		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00605	29301445	VARIABLE AIR BOX/SINGLE DUCT (2-2L-08A 2nd FLR)																							
169		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00606	29301446	VARIABLE AIR BOX/SINGLE DUCT (2-2L-09 2nd FLR)																							
170		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00607	29301447	VARIABLE AIR BOX/SINGLE DUCT (2-2L-10 2nd FLR)																							
171		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00608	29301448	VARIABLE AIR BOX/SINGLE DUCT (2-2L-11 2nd FLR)																							
172		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00609	29301449	VARIABLE AIR BOX/SINGLE DUCT (2-2L-12 2nd FLR)																							
173		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00610	29301450	VARIABLE AIR BOX/SINGLE DUCT (2-2L-12A 2nd FLR)																							
174		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00611	29301451	VARIABLE AIR BOX/SINGLE DUCT (2-3L-13 2nd FLR)																							
175		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00612	29301452	VARIABLE AIR BOX/SINGLE DUCT (2-3L-14 2nd FLR)																							
176		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00613	29301453	VARIABLE AIR BOX/SINGLE DUCT (2-3L-15 2nd FLR)																							
177		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00614	29301454	VARIABLE AIR BOX/SINGLE DUCT (2-3L-16 2nd FLR)																							
178		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00615	29301455	VARIABLE AIR BOX/SINGLE DUCT (2-3L-17 2nd FLR)																							
179		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00616	29301456	VARIABLE AIR BOX/SINGLE DUCT (2-3L-18 2nd FLR)																							
180		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00617	29301457	VARIABLE AIR BOX/SINGLE DUCT (2-3L-19 2nd FLR)																							
181		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00618	29301458	VARIABLE AIR BOX/SINGLE DUCT (2-3L-20 2nd FLR)																							
182		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00619	29301459	VARIABLE AIR BOX/SINGLE DUCT (2-3L-21 2nd FLR)																							
183		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00620	29301460	VARIABLE AIR BOX/SINGLE DUCT (2-3L-21A 2nd FLR)																							
184		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00621	29301461	VARIABLE AIR BOX/SINGLE DUCT (2-3L-21B 2nd FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
185		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00622	29301462	VARIABLE AIR BOX/SINGLE DUCT (2-4A-05 2nd FLR)																							
186		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00623	29301463	VARIABLE AIR BOX/SINGLE DUCT (2-4A-06 2nd FLR)																							
187		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00624	29301464	VARIABLE AIR BOX/SINGLE DUCT (2-4A-07 2nd FLR)																							
188		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00625	29301465	VARIABLE AIR BOX/SINGLE DUCT (2-4A-08 2nd FLR)																							
189		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00626	29301466	VARIABLE AIR BOX/SINGLE DUCT (2-4A-09 2nd FLR)																							
190		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00627	29301467	VARIABLE AIR BOX/SINGLE DUCT (2-4A-10 2nd FLR)																							
191		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00628	29301468	VARIABLE AIR BOX/SINGLE DUCT (2-4A-11 2nd FLR)																							
192		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00629	29301469	VARIABLE AIR BOX/SINGLE DUCT (2-4A-12 2nd FLR)																							
193		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00630	29301470	VARIABLE AIR BOX/SINGLE DUCT (2-4A-13 2nd FLR)																							
194		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00631	29301471	VARIABLE AIR BOX/SINGLE DUCT (2-4A-14 2nd FLR)																							
195		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00632	29301472	VARIABLE AIR BOX/SINGLE DUCT (2-4A-15 2nd FLR)																							
196		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00633	29301473	VARIABLE AIR BOX/SINGLE DUCT (2-4A-16 2nd FLR)																							
197		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00634	29301474	VARIABLE AIR BOX/SINGLE DUCT (2-4B-05 2nd FLR)																							
198		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00635	29301475	VARIABLE AIR BOX/SINGLE DUCT (2-4B-06 2nd FLR)																							
199		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00636	29301476	VARIABLE AIR BOX/SINGLE DUCT (2-4B-07 2nd FLR)																							
200		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00637	29301477	VARIABLE AIR BOX/SINGLE DUCT (2-4B-08 2nd FLR)																							
201		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00638	29301478	VARIABLE AIR BOX/SINGLE DUCT (2-4B-09 2nd FLR)																							
202		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00639	29301479	VARIABLE AIR BOX/SINGLE DUCT (2-4B-10 2nd FLR)																							
203		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00640	29301480	VARIABLE AIR BOX/SINGLE DUCT (3-2L-13 3rd FLR)																							
204		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00641	29301481	VARIABLE AIR BOX/SINGLE DUCT (3-2L-14 3rd FLR)																							
205		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00642	29301482	VARIABLE AIR BOX/SINGLE DUCT (3-2L-15 3rd FLR)																							
206		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00643	29301483	VARIABLE AIR BOX/SINGLE DUCT (3-2L-16 3rd FLR)																							
207		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00644	29301484	VARIABLE AIR BOX/SINGLE DUCT (3-2L-17 3rd FLR)																							
208		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00645	29301485	VARIABLE AIR BOX/SINGLE DUCT (3-2L-18 3rd FLR)																							
209		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00646	29301486	VARIABLE AIR BOX/SINGLE DUCT (3-2L-19 3rd FLR)																							
210		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00647	29301487	VARIABLE AIR BOX/SINGLE DUCT (3-2L-20 3rd FLR)																							
211		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00648	29301488	VARIABLE AIR BOX/SINGLE DUCT (3-3L-23 3rd FLR)																							
212		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00649	29301489	VARIABLE AIR BOX/SINGLE DUCT (3-2L-24 3rd FLR)																							
213		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00650	29301490	VARIABLE AIR BOX/SINGLE DUCT (3-2L-26 3rd FLR)																							
214		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00651	29301491	VARIABLE AIR BOX/SINGLE DUCT (3-2L-26A 3rd FLR)																							
215		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00652	29301492	VARIABLE AIR BOX/SINGLE DUCT (3-4A-17 3rd FLR)																							
216		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00653	29301493	VARIABLE AIR BOX/SINGLE DUCT (3-4A-18 3rd FLR)																							
217		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00654	29301494	VARIABLE AIR BOX/SINGLE DUCT (3-4A-19 3rd FLR)																							
218		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00655	29301495	VARIABLE AIR BOX/SINGLE DUCT (3-4A-20 3rd FLR)																							
219		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00656	29301496	VARIABLE AIR BOX/SINGLE DUCTv3-4A-21 3rd FLR)																							
220		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00657	29301497	VARIABLE AIR BOX/SINGLE DUCT (3-4A-22 3rd FLR)																							
221		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00658	29301498	VARIABLE AIR BOX/SINGLE DUCT (3-4A-23 3rd FLR)																							
222		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00659	29301499	VARIABLE AIR BOX/SINGLE DUCT (3-4A-24 3rd FLR)																							
223		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00660	29301500	VARIABLE AIR BOX/SINGLE DUCT (3-4A-25 3rd FLR)																							
224		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00661	29301501	VARIABLE AIR BOX/SINGLE DUCT (3-4A-26 3rd FLR)																							
225		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00662	29301502	VARIABLE AIR BOX/SINGLE DUCT (3-4A-27 3rd FLR)																							
226		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00663	29301503	VARIABLE AIR BOX/SINGLE DUCT (3-4A-27 3rd FLR)																							
227		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00664	29301504	VARIABLE AIR BOX/SINGLE DUCT (3-4A-28 3rd FLR)																							
228		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00665	29301505	VARIABLE AIR BOX/SINGLE DUCT (3-4A-28A 3rd FLR)																							
229		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00666	29301506	VARIABLE AIR BOX/SINGLE DUCT (3-4A-29 3rd FLR)																							
230		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00667	29301507	VARIABLE AIR BOX/SINGLE DUCT (3-4A-29A 3rd FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
231		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00668	29301508	VARIABLE AIR BOX/SINGLE DUCT (3-4A-30 3rd FLR)																							
232		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00669	29301509	VARIABLE AIR BOX/SINGLE DUCT (3-4A-31 3rd FLR)																							
233		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00670	29301510	VARIABLE AIR BOX/SINGLE DUCT (3-4A-32 3rd FLR)																							
234		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00671	29301511	VARIABLE AIR BOX/SINGLE DUCT (3-4A-32A 3rd FLR)																							
235		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00672	29301512	VARIABLE AIR BOX/SINGLE DUCT (3-4A-33 3rd FLR)																							
236		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00673	29301513	VARIABLE AIR BOX/SINGLE DUCT (3-4B-11 3rd FLR)																							
237		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00674	29301514	VARIABLE AIR BOX/SINGLE DUCT (3-4B-12 3rd FLR)																							
238		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00675	29301515	VARIABLE AIR BOX/SINGLE DUCT (3-4B-13 3rd FLR)																							
239		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00676	29301516	VARIABLE AIR BOX/SINGLE DUCT (3-4B-14 3rd FLR)																							
240		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00677	29301517	VARIABLE AIR BOX/SINGLE DUCT (3-4B-15 3rd FLR)																							
241		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00678	29301518	VARIABLE AIR BOX/SINGLE DUCTv3-4B-16 3rd FLR)																							
242		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00679	29301519	VARIABLE AIR BOX/SINGLE DUCT (4-2L-21 4th FLR)																							
243		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00680	29301520	VARIABLE AIR BOX/SINGLE DUCT (4-2L-22 4th FLR)																							
244		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00681	29301521	VARIABLE AIR BOX/SINGLE DUCT (4-2L-23 4th FLR)																							
245		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00682	29301522	VARIABLE AIR BOX/SINGLE DUCT (4-2L-24 4th FLR)																							
246		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00683	29301523	VARIABLE AIR BOX/SINGLE DUCT (4-2L-25 4th FLR)																							
247		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00684	29301524	VARIABLE AIR BOX/SINGLE DUCT (4-2L-26 4th FLR)																							
248		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00685	29301525	VARIABLE AIR BOX/SINGLE DUCT (4-2L-27 4th FLR)																							
249		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00686	29301526	VARIABLE AIR BOX/SINGLE DUCT (4-2L-28 4th FLR)																							
250		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00687	29301527	VARIABLE AIR BOX/SINGLE DUCT (4-2L-28A 4th FLR)																							
251		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00688	29301528	VARIABLE AIR BOX/SINGLE DUCT (4-2L-29 4th FLR)																							
252		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00689	29301529	VARIABLE AIR BOX/SINGLE DUCT (4-2L-30 4th FLR)																							
253		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00690	29301530	VARIABLE AIR BOX/SINGLE DUCT (4-2L-31 4th FLR)																							
254		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00691	29301531	VARIABLE AIR BOX/SINGLE DUCT (4-2L-32 4th FLR)																							
255		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00692	29301532	VARIABLE AIR BOX/SINGLE DUCT (4-2L-33 4th FLR)																							
256		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00693	29301533	VARIABLE AIR BOX/SINGLE DUCT (4-3L-27 4th FLR)																							
257		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00694	29301534	VARIABLE AIR BOX/SINGLE DUCT (4-3L-28 4th FLR)																							
258		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00695	29301535	VARIABLE AIR BOX/SINGLE DUCT (4-3L-29 4th FLR)																							
259		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00696	29301536	VARIABLE AIR BOX/SINGLE DUCT (4-3L-30 4th FLR)																							
260		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00697	29301537	VARIABLE AIR BOX/SINGLE DUCT (4-3L-31 4th FLR)																							
261		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00698	29301538	VARIABLE AIR BOX/SINGLE DUCT (4-3L-32 4th FLR)																							
262		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00699	29301539	VARIABLE AIR BOX/SINGLE DUCT (4-3L-33 4th FLR)																							
263		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00700	29301540	VARIABLE AIR BOX/SINGLE DUCT (4-3L-34 4th FLR)																							
264		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00701	29301541	VARIABLE AIR BOX/SINGLE DUCT (4-3L-35 4th FLR)																							
265		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00702	29301542	VARIABLE AIR BOX/SINGLE DUCT (4-3L-36 4th FLR)																							
266		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00703	29301543	VARIABLE AIR BOX/SINGLE DUCT (4-3L-37 4th FLR)																							
267		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00704	29301544	VARIABLE AIR BOX/SINGLE DUCT (4-3L-38 4th FLR)																							
268		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00705	29301545	VARIABLE AIR BOX/SINGLE DUCT (4-4A-32 4th FLR)																							
269		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00706	29301546	VARIABLE AIR BOX/SINGLE DUCT (4-4A-33 4th FLR)																							
270		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00707	29301547	VARIABLE AIR BOX/SINGLE DUCT (4-4A-34 4th FLR)																							
271		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00708	29301548	VARIABLE AIR BOX/SINGLE DUCT (4-4A-35 4th FLR)																							
272		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00709	29301549	VARIABLE AIR BOX/SINGLE DUCT (4-4A-36 4th FLR)																							
273		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00710	29301550	VARIABLE AIR BOX/SINGLE DUCT (4-4A-37 4th FLR)																							
274		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00711	29301551	VARIABLE AIR BOX/SINGLE DUCT (4-4A-38 4th FLR)																							
275		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00712	29301552	VARIABLE AIR BOX/SINGLE DUCT (4-4A-39 4th FLR)																							
276		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00713	29301553	VARIABLE AIR BOX/SINGLE DUCT (4-4A-40 4th FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
277		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00714	29301554	VARIABLE AIR BOX/SINGLE DUCT (4-4A-41 4th FLR)																							
278		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00715	29301555	VARIABLE AIR BOX/SINGLE DUCT (4-4A-42 4th FLR)																							
279		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00716	29301556	VARIABLE AIR BOX/SINGLE DUCT (4-4A-43 4th FLR)																							
280		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00717	29301557	VARIABLE AIR BOX/SINGLE DUCT (-4A-43A 4th FLR)																							
281		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00718	29301558	VARIABLE AIR BOX/SINGLE DUCT (4-4A-44 4th FLR)																							
282		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00719	29301559	VARIABLE AIR BOX/SINGLE DUCT (4-4B-17 4th FLR)																							
283		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00720	29301560	VARIABLE AIR BOX/SINGLE DUCT (4-4B-18 4th FLR)																							
284		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00721	29301561	VARIABLE AIR BOX/SINGLE DUCT (4-4B-19 4th FLR)																							
285		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00722	29301562	VARIABLE AIR BOX/SINGLE DUCT (4-4B-20 4th FLR)																							
286		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00723	29301563	VARIABLE AIR BOX/SINGLE DUCT (4-4B-21 4th FLR)																							
287		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00724	29301564	VARIABLE AIR BOX/SINGLE DUCT (4-4B-22 4th FLR)																							
288		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00725	29301565	VARIABLE AIR BOX/SINGLE DUCT (5-2L-28 4th FLR)																							
289		1004	AHFFCU	23-33 41 17 13	23 00 00	2104	VAB00726	29301566	VARIABLE AIR BOX/SINGLE DUCT (5-2L-34 4th FLR)																							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	VAPorizer	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	TYPE	TUBEMEDM	TUBMAXPR	SHELMEDM	SHLMAXPR	FLOWRATE	SHELMAXTM	TUBMAXTM	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1032	HEATEX	23-33 27 17	43 02 00.00 41	2104	VAP00021	29301567	VAPORIZER (LN2 DEWAR)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Variable Frequency Drive	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	VOLTAC	VOLTDC	AMPSAC	AMPSDC	CELLQTY	ENCLSR	FRQNCY	INRANGE	PHASES	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00094	29301568	VAR.FREQ. DR/AHU-1 HIRF (SF-1 SUPPLY FAN)																								
5		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00095	29301569	VAR.FREQ. DR/AHU-2 LAB (SF-2 SUPPLY FAN)																								
6		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00096	29301570	VAR.FREQ. DR/AHU-3 LAB (SF-3 SUPPLY FAN)																								
7		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00097	29301571	VAR.FREQ. DR/AHU-4A LAB (SF-4 SUPPLY FAN)																								
8		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00098	29301572	VAR.FREQ. DR/AHU-4B LAB (SF-5 SUPPLY FAN)																								
9		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00099	29301573	VAR.FREQ. DR/AHU-5 OFC (SF-6 SUPPLY FAN)																								
10		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00100	29301574	VAR.FREQ. DR/AHU-6 OFC (SF-7 SUPPLY FAN)																								
11		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00101	29301575	VAR.FREQ. DR/AHU-7 TOWER (SF-8 SUPPLY FAN)																								
12		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00102	29301576	VAR.FREQ. DR/MAU-1 (SF-9 SUPPLY FAN)																								
13		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00103	29301577	VAR.FREQ. DR/ERV-1 (ERV-1 SUPPLY FAN)																								
14		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00104	29301578	VAR.FREQ. DR/ERV-2 (ERV-2 SUPPLY FAN)																								
15		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00105	29301579	VAR.FREQ. DR/ERV-1 (ERV-1 RETURN FAN)																								
16		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00106	29301580	VAR.FREQ. DR/ERV-2 (ERV-2 RETURN FAN)																								
17		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00107	29301581	VAR.FREQ. DR/HV-1 (SF-10 SUPPLY FAN)																								
18		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00108	29301582	VAR.FREQ. DR/AHU-1 HIRF (RF-1 RETURN FAN)																								
19		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00109	29301583	VAR.FREQ. DR/AHU-2 LAB (RF-2 RETURN FAN)																								
20		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00110	29301584	VAR.FREQ. DR/AHU-3 LAB (RF-3 RETURN FAN)																								
21		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00111	29301585	VAR.FREQ. DR/AHU-4A LAB (RF-4 RETURN FAN)																								
22		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00112	29301586	VAR.FREQ. DR/AHU-4B LAB (RF-5 RETURN FAN)																								
23		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00113	29301587	VAR.FREQ. DR/AHU-5 OFC (RF-6 RETURN FAN)																								
24		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00114	29301588	VAR.FREQ. DR/AHU-6 OFC (RF-7 RETURN FAN)																								
25		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00115	29301589	VAR.FREQ. DR/AHU-7 TOWER (RF-8 RETURN FAN)																								
26		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00116	29301590	VAR.FREQ. DR/MAU-1 (RF-9 RETURN FAN)																								
27		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00117	29301591	VAR.FREQ. DR/EXHAUST FAN (EF-16 EXHAUST FAN)																								
28	Assets	1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00118	29301592	VAR.FREQ. DR/EXHAUST FAN (EF-1A EXHAUST FAN)																								
29		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00119	29301593	VAR.FREQ. DR/EXHAUST FAN (EF-1B EXHAUST FAN)																								
30		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00120	29301594	VAR.FREQ. DR/COOLING TOWER (CT-1 FAN)																								
31		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00121	29301595	VAR.FREQ. DR/COOLING TOWER (CT-2 FAN)																								
32		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00122	29301596	VAR.FREQ. DR/COOLING TOWER (CT-3 FAN)																								
33		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00123	29301597	VAR.FREQ. DR/CIRC WATER PMP (CWP-1 COND WATER)																								
34		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00124	29301598	VAR.FREQ. DR/CIRC WATER PMP (CWP-2 COND WATER)																								
35		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00125	29301599	VAR.FREQ. DR/CIRC WATER PMP (CWP-3 COND WATER)																								
36		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00126	29301600	VAR.FREQ. DR/CIRC WATER PMP (HWP-1 HTG HOT WTR)																								
37		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00127	29301601	VAR.FREQ. DR/CIRC WATER PMP (HWP-2 HTG HOT WTR)																								
38		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00128	29301602	VAR.FREQ. DR/CIRC WATER PMP (PCHWP-1 CHILL WATER)																								
39		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00129	29301603	VAR.FREQ. DR/CIRC WATER PMP (PCHWP-2 CHILL WATER)																								
40		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00130	29301604	VAR.FREQ. DR/CIRC WATER PMP (PCHWP-3 CHILL WATER)																								
41		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00131	29301605	VAR.FREQ. DR/CIRC WATER PMP (SCHWP-1 CHILL WATER)																								
42		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00132	29301606	VAR.FREQ. DR/CIRC WATER PMP (SCHWP-2 CHILL WATER)																								
43		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00133	29301607	VAR.FREQ. DR/CIRC WATER PMP (SCHWP-3 CHILL WATER)																								
44		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00134	29301608	VAR.FREQ. DR/CIRC WATER PMP (SCHWP-4 CHILL WATER)																								
45		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00135	29301609	VAR.FREQ. DR/ABSORBENT PMP (CH-4 ABSORBENT CHILLER)																								
46		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00136	29301610	VAR.FREQ. DR/REFRIGERANT PMP (CH-4ABSORBENT CHILLER)																								
47		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00137	29301611	VAR.FREQ. DR/VACUUM PMP (CH-4 ABSORBENT CHILLER)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
48		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00138	29301612	VAR.FREQ. DR/COMPRESSOR (CH-1 AIR COOLED CHILLER)																								
49		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00139	29301613	VAR.FREQ. DR/CONDENSOR FAN (CH-1 AIR COOLED CHILLER)																								
50		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00140	29301614	VAR.FREQ. DR/PRIMARY PUMP (CH-1 AIR COOLED CHILLER)																								
51		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00141	29301615	VAR.FREQ. DR/COMPRESSOR (CH-2 WATER COOLED CHILLER)																								
52		1021	ELECTRONIC	23-27 35 00	26 29 23	2104	VFD00142	29301616	VAR.FREQ. DR/COMPRESSOR (CH-3 WATER COOLED CHILLER)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Valve, Isolation, Hydrant	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)			Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	TYPE	WTRPRESS	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-27 31 25	21 12 00	842-10	VIH00086	15400079	VALVE/HYDRANT ISOLATION (NW W TAYLOR B-2104)																		
5		1026	FIRESYSTEM	23-27 31 25	21 12 00	842-10	VIH00087	15400090	VALVE/HYDRANT ISOLATION (SOUTH ENTRANCE B-2104)																		
6		1026	FIRESYSTEM	23-27 31 25	21 12 00	842-10	VIH00088	15400091	VALVE/HYDRANT ISOLATION (NE CORNER B-2104)																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	Valve, Isolation, Standpipe	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)							Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	SIZE	TYPE	WTRPRESS	TMPSWMFG	TMSMODNO	FLOSWMFG	FLSWMODN	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1026	FIRESYSTEM	23-29 33 00	33 11 00	2104	VIS00076	14800123	VALVE/INLET/FSS BACK FLO PREVENTER																						
5		1026	FIRESYSTEM	23-29 33 00	33 11 00	2104	VIS00077	14800124	VALVE/OUTLET/FSS BACK FLO PREVENTER																						
6		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00078	14800125	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT A, 1ST FLR																						
7		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00079	14800126	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT A, 2ND FLR																						
8		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00080	14800127	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT A, 3RD FLR																						
9		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00081	14800128	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT A, 4TH FLR																						
10		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00082	14800129	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT A, PENTHSE																						
11		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00083	14800130	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT B, 1ST FLR																						
12		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00084	14800131	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 3, SECT B, 2ND FLR																						
13		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00085	14800132	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 2, SECT A, 1ST FLR																						
14		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00086	14800133	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY2, SECT A, 2ND FLR																						
15		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00087	14800134	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 2, SECT A, 3RD FLR																						
16		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00088	14800135	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 2, SECT A, 4TH FLR																						
17		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00089	14800136	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 2, SECT A, PENTHSE																						
18		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00090	14800137	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 2, SECT B, 1ST FLR																						
19		1026	FIREFSS	23-29 33 00	21 12 00	2104	VIS00091	14800138	VALVE/CONTROL, FSS, TAMPER SWITCH STAIRWAY 2, SECT B, 2ND FLR																						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Valve	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	NOMSIZE	BODYMTRL	DISCMTRL	INPRESS	RLFSETPR	RLFTMPST	STATUS	TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1046	VALVE	23-27 27 13	23 22 26.00 20	2104	VLV03371	29301617	VALVE/PRESSURE REDUCING/STEAM (PRV-1A)																								
5		1046	VALVE	23-27 27 13	23 22 26.00 20	2104	VLV03372	29301618	VALVE/PRESSURE REDUCING/STEAM (PRV-1B)																								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
1	X(trans)for\\el\	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)																Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.tarcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	CLASS	PRIVLTAC	PHASES	KVARATE	IMPDANCE	SECVLTAC	FLUIDTYP	TNKOLCAP	TOTOLCAP	OILWT	LTC	TOTALWT	TOTOLCAP	TEMPRISE	TYPE	WINDGCFG	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certifcates	Warranty	Manufacturer Field Reports
4	Assets	1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00711	29301619	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
5		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00712	29301620	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
6		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00713	29301621	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
7		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00714	29301622	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
8		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00715	29301623	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
9		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00716	29301624	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
10		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00717	29301625	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
11		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00718	29301626	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
12		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00719	29301627	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
13		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00720	29301628	TRANSFORMER/480/208/120V 112.5KVA/AIR [redacted]																															
14		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00721	29301629	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
15		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00722	29301630	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
16		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00723	29301631	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
17		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00724	29301632	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
18		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00725	29301633	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
19		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00726	29301634	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
20		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00727	29301635	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
21		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00728	29301636	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
22		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00729	29301637	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
23		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00730	29301638	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
24		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00731	29301639	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
25		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00732	29301640	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
26		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00733	29301641	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
27		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00734	29301642	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
28		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00735	29301643	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
29		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00736	29301644	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
30		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00737	29301645	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
31		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00738	29301646	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
32		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00739	29301647	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
33		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00740	29301648	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
34		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00741	29301649	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
35		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00742	29301650	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
36		1044	TRANSFMR	23-35 13 17 15 11	26 20 00	2104	XMR00743	29301651	TRANSFORMER /480/208/120V 112.5KVA/AIR [redacted]																															
37		1044	TRANSFMR	23-35 13 17 15 13	26 11 16	2104	XMR00744	29301652	TRANSFORMER /23KV/480/277V 1500.0 KVA/OIL [redacted]																															
38		1044	TRANSFMR	23-35 13 17 15 13	26 11 16	2104	XMR00745	29301653	TRANSFORMER /23KV/480/277V 1500.0 KVA/OIL [redacted]																															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Asset Description Acronym	Equipment Record Data Fields NASA Form 491				MSL Asset Specs						Asset Module Fields					Specifications (The following attributes or equivalent attributes are required)									Documents							
2	COBie Schema Table.Key Column	type.classstructureID	type.category	type.omniclass	type.masterspecID	component.roomtag	component.barcode	component.larcid	component.name	type.extidentifier	Component.extidentifier	type.manufacturer	type.modelnumber	component.serialnumber	component.installationdate	component.enddate	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	attribute.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name	document.name
3	NASA Attribute	Class Structure Id	Classification Id	OMNI Class#	Master Spec ID	Location	Asset ID	LaRC ID#	Description	Revit Family ID	Revit Family Instance ID	MANUFACTURER	CL_MODELNUM	SERIALNUM	INSTALLDATE	WARRANTY ENDDATE	TYPE	NOMSIZE	BODYMTRL	DISCMTRL	INPRESS	RLFSETPR	RLFTMPST	STATUS	TYPE	Shop Drawings	Product Data	Design Data	Test Reports	O&M Manual	Certificates	Warranty	Manufacturer Field Reports
4	Assets	1234	TYPE	23-00 00 00	00 00 00.00 00	2000	XXX00000	11199999	ASSET DESCRIPTION																								

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0008	06/09/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA, PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA, PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICITATION NO.
	☐	9B. DATED *(SEE ITEM 11)*
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED *(SEE ITEM 13)*
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

INSTRUCTIONS

Instructions for items other than those that are self-explanatory, are as follows:

(a) Item 1 (Contract ID Code). Insert the contract type identification code that appears in the title block of the contract being modified.

(b) Item 3 (Effective date).

(1) For a solicitation amendment, change order, or administrative change, the effective date shall be the issue date of the amendment, change order, or administrative change.

(2) For a supplemental agreement, the effective date shall be the date agreed to by the contracting parties.

(3) For a modification issued as an initial or confirming notice of termination for the convenience of the Government, the effective date and the modification number of the confirming notice shall be the same as the effective date and modification number of the initial notice.

(4) For a modification converting a termination for default to a termination for the convenience of the Government, the effective date shall be the same as the effective date of the termination for default.

(5) For a modification confirming the contacting officer's determination of the amount due in settlement of a contract termination, the effective date shall be the same as the effective date of the initial decision.

(c) Item 6 (Issued By). Insert the name and address of the issuing office. If applicable, insert the appropriate issuing office code in the code block.

(d) Item 8 (Name and Address of Contractor). For modifications to a contract or order, enter the contractor's name, address, and code as shown in the original contract or order, unless changed by this or a previous modification.

(e) Item 9, (Amendment of Solicitation No. - Dated), and 10, (Modification of Contract/Order No. - Dated). Check the appropriate box and in the corresponding blanks insert the number and date of the original solicitation, contract, or order.

(f) Item 12 (Accounting and Appropriation Data). When appropriate, indicate the impact of the modification on each affected accounting classification by inserting one of the following entries.

(1) Accounting classification .....
Net increase $ .....

(2) Accounting classification .....
Net decrease $ .....

NOTE: If there are changes to multiple accounting classifications that cannot be placed in block 12, insert an asterisk and the words "See continuation sheet".

(g) Item 13. Check the appropriate box to indicate the type of modification. Insert in the corresponding blank the authority under which the modification is issued. Check whether or not contractor must sign this document. (See FAR 43.103.)

(h) Item 14 (Description of Amendment/Modification).

(1) Organize amendments or modifications under the appropriate Uniform Contract Format (UCF) section headings from the applicable solicitation or contract. The UCF table of contents, however, shall not be set forth in this document

(2) Indicate the impact of the modification on the overall total contract price by inserting one of the following entries:

(i) Total contract price increased by $ .....

(ii) Total contract price decreased by $ .....

(iii) Total contract price unchanged.

(3) State reason for modification.

(4) When removing, reinstating, or adding funds, identify the contract items and accounting classifications.

(5) When the SF 30 is used to reflect a determination by the contracting officer of the amount due in settlement of a contract terminated for the convenience of the Government, the entry in Item 14 of the modification may be limited to --

(i) A reference to the letter determination; and

(ii) A statement of the net amount determined to be due in settlement of the contract.

(6) Include subject matter or short title of solicitation/contract where feasible.

(i) Item 16B. The contracting officer's signature is not required on solicitation amendments. The contracting officer's signature is normally affixed last on supplemental agreements.

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0007

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended, effective 9 June, 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0008.
2. The above referenced solicitation is hereby extended as follows:

Technical Proposal Are Due – June 23, 2016 at 1:00 pm

- 5 CD Copies of Technical Proposals
- DO NOT SEND FAX OR PDFs

Price Proposals Are Due – July 7, 2016 at 1:00 pm

- 1 CD Copy of Price Proposal
- DO NOT SEND FAX OR PDFs

All Proposals Are Due to:
Ray Porter, GSA Mid-Atlantic Region
The Dow Building
100 S. Independence Mall West
Philadelphia, PA. 19106

3. The Due Date for Submitting RFIs has been extended to C.O.B. June 16, 2016.
4. In response to questions submitted to date, the NASA MSL Project RFI log is provided to clarify information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.
5. The Report of Subsurface Investigation and Geotechnical Engineering Services for the NASA Measurement Systems Laboratory is hereby provided for informational purposes.
6. All other terms and conditions remain unchanged.

Measurement Systems Laboratory (MSL) **June 3, 2016**
Phase II Solicitation

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
12	01 23 60	The specifications and drawings reference a number of deduct and add bid options. However, the bid form provided in amendment 0003 does not list the bid options. Please confirm that the options are to be provided and clarify how they shall be included in the price form.	See the "Options" tab in the Excel file that was sent.
40	01. 01 33 00	Specification 01. 01 33 00, 1.10e Submittal Review Period: Requires Contracting Officer to have 30 working days for approval of submittals. Due to the nature of the project, we request to reduce this approval time to 15 working days.	The timeframe specified in section 01 33 29, paragraph 1.10.e for submittal review by the Contracting Officer is reduced from thirty (30) working days to fifteen (15)working days.
41	01 23. 60, 01 33 29	Specification 01 33 29 LEED Documentation, Section 1.3 states project designed for LEED Silver. 01 23 60 Options, deduct alternate 8 requests credit to achieve LEED Silver. Please clarify that the base bid requires LEED Silver be obtained.	Specification 01 33 29, paragraph 1.3 is in error. The LEED rating in the first sentence should state "GOLD" and not "SILVER".
42	31 23 19	The geotechnical report does not appear to be provided in the RFP documents per Specification 31 23 19, 1.4.1. Can a copy of the geotechnical report be provided?	A Report of Subsurface Investigation and Geotechnical Engineering Services was prepared for this project by GET Solutions, Inc. dated July 23, 2014. The information contained in this report is being provided as requested. The government accepts no responsibility or liability for the information contained in this document.
44	01 10 00	At the end of section 01 10 00 there is a section 2.14 Site Signage. Please confirm the only purpose of this is to define the requirements of the construction sign.	Confirmed.
45	01 31 10	Section 01 31 10, 1.5,F,4.e Time Impact Analysis. Please consider making the TIA due 15 work days from the beginning of a delay caused by unforeseeable circumstances in lieu of the 5 work days specified.	The timeframe specified in section 01 31 10, paragraph 1.5.F.4.e.iii for submission of a TIA in the event of an unforeseeable delay is extended from five (5) days to fifteen (15) days, provided that written notification to the Contracting Officer is provided as soon as practicable after the delay begins and in no case more than the five (5) days originally specified.
62	Amendment 0002	Revised Technical Evaluation Factors for Phase II still require a narrative on the contractor's approach to procuring and installing the HIRF laboratory even though the same amendment replaced the HIRF lab with the WISE3R space. Please clarify.	For the purposes of the Technical Evaluation, please assume that the WISE3R will be substantially similar to the HIRF and will be furnished by the same vendor.
63	Amendment 0002	Technical Evaluation Factors for Phase II state there is a maximum of five (5) pages allowed for Factor 1 PROJECT MANAGEMENT/DELIVERY PLAN (PMDP). There are no less that fourteen (14) sub-factors to respond to in Factor 1. Five (5) pages will not be enough to properly address each sub-factor. Request at least fifteen (15) pages be allowed. Would prefer thirty (30) page maximum.	The page limits remain as stated. Please note that a schedule and staging plan do not count against the stated page limit.
72	316213.20 - Precast/Prestsressed Concrete Piles 2.1.10 Pile Driving Points	Is $100,000 waste of money, not normally used or needed in Tidewater-Hampton Roads area of Virginia?	The requirements are as stated in the contract documents.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
111	J&A Documents	Please confirm the GSA will not accept alternative manufactures for the items identified in the J&A's included in Amendment 0002.	Confirmed.
112	Amendment 0003	Confirm we to write in the actual actual quantities in the No. Units column for Bid Items 0001B and 0001C.	Confimed.
114	Amendment 0003	Confirm the TOTAL BASE BID cost on the GC Price Proposal Form by Division breakdown should equal the TOTAL BASE BID cost on the GC Price Proposal Form by Paragraphs 0001A - 0001D.	Confirmed. The total amounts on the two tabs should equal.
116	08 41 13	Please provide ATFP blast requirement, charge weight and level of protection for aluminum storefront and curtainwall.	See response to Question 09.
118	01 33 29 LEED Documentation	Paragraph 1.3 states that no substitutions or variations to the credits will be allowed without written consent from the Contracting Officer. The documents require Silver certification. In achieving Silver certification on our previous projects, we generally apply for a total of 54-58 points. Table 1 shows a total of 66 required points. This puts the project in the Gold certification range. Will the contractor be allowed to submit for Silver certification or will we be required to submit for Gold certification, thus complying with all of the indicated Contractor credits?	Specification 01 33 29, paragraph 1.3 is in error. The LEED rating in the first sentence should state "GOLD" and not "SILVER".
120		Please provide the anticipated delivery date and the installation duration of the owner-furnished/owner installed WISE3R lab so that we may address this item in our proposal schedule.	The WISE3R delivery date is not yet known The installation duration is to be determined by the General Contractor.
124		Please advise where Oral Discussions will be held. NASA Langley or GSA Mid-Atlantic Region Philadelphia. This has a cost impact to the project.	Oral Discussions will be held at NASA Langley.
125		Respectfully request an extension to the proposal due date to June 23. Monday bid dates are unconventional as it will require travel on Sunday in order to hand deliver the proposal.	The proposal due date remains unchanged. Any extension will be communicated via an official amendment. Please note that all submissions are to be made electronically. Hand delivery is neither permitted nor desired.
127	C201 and 01 30 00 and 01 35 26.00 41	Phase I submission requirements outline the Key Personnel as does Section 01 30 00. C201 states the Construction Project Manager, the Construction Superintendent, the Construction MEP Coordinator and the Quality Control Manager be on the construction site, full time and totally dedicated to the project, i.e. no other duties. It seems odd Section 01 35 26.00 41 NASA LANGLEY SAFETY REQUIREMENTS does not indicate a Site Safety and Health Officer (SSHO) requirement to be full time and on-site. Section 01 45 00.00 10 QUALITY CONTROL refers to the Safety and Health Manager (SHM) as part of the QC staff, but does not provide duties or state they are required full-time. Please advise what the GSA requirements are for the SSHO or SHM.	The requirements for the Safety and Health Manager are as stated in specification 01 45 00.00 10 (Quality Control). The General Contract has complete responsibility for jobsite safety and is given the latitude to manage safety in a manner it deems most effective.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
128	01 35 26.00 41	The specifications refer to asbestos abatement. However, we do not find any on the drawings. Please advise if asbestos abatement is required.	No asbestos containing materials are anticipated to be encountered on this project.
129	31 23 19	Please provide a copy of the geotechnical report and soil borings. It is not included in the project manual.	A Report of Subsurface Investigation and Geotechnical Engineering Services was prepared for this project by GET Solutions, Inc. dated July 23, 2014. The information contained in this report is being provided as requested. The government accepts no responsibility or liability for the information contained in this document.

Measurement Systems Laboratory (MSL) **June 6, 2016**
Phase II Solicitation

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
21	Dwg S040	Drawing S040 indicates and notes two existing foundation that are not clearly shown on the Existing Conditions Plan. It is noted that these underground foundations are to be demolished prior to building construction and grading. Will the removal of the these foundations with 24" of finish grade outside MSL building footprint and within 15' of the MSL building face be by others? If removal of foundations is to be included as part of this bid please provide as-builts so scope or work can be determined.	The drawings for the demolition of Buildings 1192, 1192C, 1192D, 1192E and associated site and utility features are provided in the Bid Set as Reference Drawings RC-003 – RC-006. No as-builts were provided.
72	316213.20 - Precast/Prestsressed Concrete Piles 2.1.10 Pile Driving Points	Is $100,000 waste of money, not normally used or needed in Tidewater-Hampton Roads area of Virginia?	The design team takes no exception to the elimination of the pile driving points provided the contractor's geotechnical engineer and the pile subcontractor have no concerns that the piles will be damaged during the driving operations.
119	Q-403	Please confirm all O/O equipment shown on Q-403 will be delivered and installed by the GSA during the 730 construction period, before BOD.	No. It is anticipated that the O/O items will be installed after substantial completion.
121	A-101B	Does the GSA anticipated requiring access over and beyond the access provided by the exterior opening for Door 170-D for the WISE3R lab components?	ETS-Lindgren does not require additional openings beyond those available for assembling the Chambers. They do require laydown space equal to about half the area of the chambers, which we believe can be covered by the remaining space within Room 170.
122	Q-403	Will the GSA be responsible for all hoisting of O/O equipment?	Yes.
123	Q-403	Will the GSA require use of the elevator during delivery and installation of O/O equipment?	Yes, but it is anticipated that any such requirements will be after substantial completion.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
115	08 44 00 and Details 2 & 3/A511	Paragraph 2.1.13 requires aluminum sunshades with fixed airfoil extrusion shapes attached ot the outriggers. The drawings require flat metal panel with a perforated hole pattern supported by the outriggers. Please clarify which sunshade assembly is desired.	The horizontal sunshades are to be flat metal panel with a perforated hole pattern supported by the outriggers. See also response to Question 60.
117	S-101A, S-101B and S-525	Please provide the depth of Combined Pile Caps (CPC) 1 through 6. Depth is not indicated on the drawings.	See below for pertinent combined pile cap thicknesses: 18/S-525 – 42" Thick 20/S-525 – 48" Thick 1/S-526 – 48" Thick 2/S-526 – 48" Thick 10/S-526 – 48" Thick 8/S-526 – 42" Thick
126	A-701	FGL-1 is indicated on the Finish Schedule on A-701. No specification section is provided. Confirm this is Section 06 73 01 FIBERGLASS REINFORCED PLASTIC (FRP) GRATING.	Confirmed. FGL-1 as specified in 06 73 01 FIBERGLASS REINFORCED PLASTIC (FRP) GRATING.

REPORT OF SUBSURFACE INVESTIGATION AND GEOTECHNICAL ENGINEERING SERVICES

Measurement Systems Laboratory
NASA Langley Research Center

Hampton, Virginia

G E T Project No: WM11-175G

July 23, 2104

PREPARED FOR:

1592-E Penniman Road • Williamsburg, VA 23185
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GET Solutions, Inc.

Geotechnical • Environmental • Testing

July 23, 2014

TO: **AECOM**
3101 Wilson Boulevard, Suite 900
Arlington, Virginia 22201

Attn: Ms. [redacted] (b) (6)

RE: Report of Subsurface Investigation and Geotechnical Engineering Services
Measurement Systems Laboratory
NASA Langley Research Center
Hampton, Virginia
G E T Project No: WM11-175G

Dear Ms [redacted] (b) (6)

In compliance with your instructions, we have completed our Subsurface Investigation and Geotechnical Engineering Services for the referenced project. The results of this study and our recommendations for geotechnical aspects of the project are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **G E T Solutions, Inc.** would be pleased to continue its role as Geotechnical Engineer during the project implementation.

Thank you for the opportunity to work with you on this project. We trust that the information contained herein meets your immediate needs. Should you have any questions or if we can be of further assistance, please do not hesitate to contact us.

Respectfully Submitted,
G E T Solutions, Inc.

[redacted] (b) (6)

Project Geologist

[redacted] (b) (6)

Bruce R Spiro, P.E.
Principal Engineer

COMMONWEALTH OF VIRGINIA
BRUCE R SPIRO
Lic. No. 015791
PROFESSIONAL ENGINEER

Copies: (1) Client via e-mail [redacted] (b) (6)

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1.0 PROJECT INFORMATION

1.1 Project Authorization

G E T Solutions, Inc. has completed our subsurface investigation and geotechnical engineering services for the Measurement Systems Laboratory project located at the NASA Langley Research Center in the City of Hampton, Virginia. Initial (preliminary) geotechnical engineering services were conducted in general accordance with **G E T** Proposal No. PWM11-223G dated July 31, 2011. Supplementary geotechnical engineering services were conducted in general accordance with **G E T** Proposal No. PWM13-389G (Revision #2) dated March 19, 2014. Authorization to proceed with our services was received from the client in the form of a signed subconsultant agreements.

1.2 Project Location and Site Description

The project site is located at the NASA Langley Research Center in the City of Hampton, Virginia. Specifically, the project site is located within the east, southeast, and northwest quadrants of the intersection of Victory Street and W. Taylor Street. At the time of our field reconnaissance, an existing building, utilities, and asphalt/concrete pavements were located within the proposed building footprint surrounded by grassy areas and few trees. Based on our site reconnaissance, the site grades were observed to be relatively flat with visually estimated grade changes generally less than 2 feet in every 100 linear feet.

1.3 Project Construction Description

The development at this site will consist of demolishing Building #1192 and constructing the Measurement Systems Laboratory Building. It is noted that a preliminary investigation for this project was completed back in 2012 by **G E T Solutions, Inc.** and a preliminary geotechnical engineering report was issued (dated April 12, 2012). Since the completion of this preliminary investigation, the design of the project, particularly the proposed structure which will now require a deep foundation system, has changed. As a result of the design changes and in order to finalize our preliminary recommendations and make adjustments where necessary a supplementary investigation has been completed. The results of the initial, preliminary investigation and supplementary investigation have been included in this report.

The new design will include a 4-story structure with a penthouse and a rooftop laboratory. The total gross area of this proposed structure will be roughly 150,000 SF. The structure will be entirely a cast-in-place concrete structure with the exception of the penthouse rooftop which will include a metal deck. As reported by the structural engineer the maximum column and wall foundation loads associated with this proposed structure are expected to be on the order of about 40 to 850 kips and 4 kips per linear foot, respectively. The first floor slab will be constructed on-grade. The distributed floor loads are expected to be on the order of 150 pounds per square foot. The finish floor elevation will be at 12.45 feet MSL. Therefore, cuts and fills required to establish finish floor elevation will be limited to about 4 feet or less.

This development will also include the construction of additional pavement areas around the perimeter of the proposed structure, installation of multiple storm water management facilities, the re-construction of an existing parking lot located to the northwest of the intersection of W. Taylor Street and Victory Street that will include the installation of an underground geothermal system, along with other associated infrastructure. The investigation associated with the design and installation of this geothermal well system was not included as part of our services and will be performed by others.

If any of the noted information is incorrect or has changed, please inform **G E T Solutions, Inc.** so that we may amend the recommendations presented in this report, if appropriate.

1.4 Purpose and Scope of Services

The purpose of this study was to obtain information on the general subsurface conditions at the project site. The subsurface conditions encountered were evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

1. General assessment of the soils revealed by the borings performed at the project site.

2. General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.

3. Evaluation of earthwork requirements, to include subgrade stripping and preparation, Structural Fill suitability, and fill placement procedures. Evaluation of the suitability of on-site soils for re-use as Structural Fill.

4. Shrink/Swell characteristics of the shallow subsurface soils.

5. Feasibility of utilizing a deep foundation system for support of the proposed building. Design parameters required for the foundation system, including pile type, pile length, allowable capacities, and expected total and differential settlements. Also, pile installation and testing criteria is evaluated and discussed in this report.

6. Evaluation of a slab-on-grade floor system, to include subgrade modulus.

7. Evaluation of the subsurface profile to determine the site class definition for earthquake design considerations based on the 2009 International Building Code (IBC).

8. Typical pavement sections based on the field exploration and our experience with similar soil conditions.

9. Determine pertinent information regarding the subsurface soil and groundwater conditions at the site for storm water management purposes (11 SWM borings and 11 associated infiltration tests).

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around this site.

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

A field exploration program was completed back in 2012 as part of our initial preliminary investigation. In order to explore the general subsurface soil types and to aid in developing the preliminary design parameters, our initial field exploration program included the following:

- Ten (10) 50-foot deep Standard Penetration Test (SPT) borings (designated as B-1 through B-10) were drilled within the vicinity of the two structures that were proposed at that time.

- Two (2) 15-foot deep SPT borings (designated as SW-1 and SW-2) were drilled within the vicinity of the proposed screen wall, which has now been eliminated from the design.

- Five (5) 10-foot deep SPT borings (designated as CBR-1 through CBR-5) were drilled within the proposed new and existing pavement areas. In addition, five (5) bulk soil samples (designated as CBR-1 through CBR-5) were collected from the proposed new pavement areas at their respective boring locations. The bulk subgrade soil samples were collected from depths ranging from 1 to 2.5 feet below existing grades. The bulk soil samples were returned to our laboratory and subjected to CBR, Proctor, and classification testing in accordance with ASTM standards.

Since the completion of our preliminary investigation, the project design has changed from two smaller structures into one larger structure with substantially larger foundation loads resulting in the need for a deep foundation system. As a result of the redesign and in order to finalize our preliminary report, a supplementary field exploration has been completed. This supplementary investigation consisted of the following:

- Five (5) 80-foot deep Standard Penetration Test (SPT) borings (designated as SB-1 through SB-5) were drilled within the vicinity of the new proposed structure.

- Eleven (11) 10-foot deep SPT borings (designated as INF-1 through INF-11) were drilled within the vicinity of proposed SWM facilities. An in-situ soil permeability test was performed at each of these SWM boring locations. Also, a temporary groundwater monitoring well was installed at four of these SWM boring locations.

The results of the both the initial preliminary investigation and the recently completed supplementary investigation have been combined and are included with this report.

The SPT borings were performed with the use of rotary wash "mud" drilling procedures in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to a depth of 12 feet, and at 5-foot intervals thereafter. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using an automatic hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, sealed, labeled, and returned to our laboratory for review.

The boring and CBR locations were established and located in the field by a representative of **G E T Solutions, Inc.** The approximate boring and CBR locations are shown on the attached Boring Location Plans (Appendix I), which were reproduced from drawings provided by the client.

2.2 Laboratory Testing

Representative portions of all soil samples collected during drilling were sealed in glass jars, labeled, and transferred to our laboratory for classification and analysis. The soil classification was performed by a Geologist in accordance with ASTM D2488. The classification system for soil exploration is included in Appendix II.

Thirty-one (31) representative soil samples were selected and subjected to natural moisture, -#200 sieve wash, and Atterberg Limits testing and analysis in order to corroborate the visual classification. These test results are tabulated on the following page and are also presented on the "Boring Log" sheets in Appendix III.

Table I – Laboratory Test Results

Boring No.	Depth (Feet)	Natural Moisture (%)	Percent Passing #200	Atterberg Limits (LL/PL/PI)	USCS Classification
B-1	6-8	30	17	Non Plastic	SM
B-3	2-4	13	32	39/25/14	SC
B-5	4-6	39	47	34/20/14	SC
B-6	8-10	34	24	Non Plastic	SM
B-8	8-10	32	25	Non Plastic	SM
B-10	6-8	45	33	36/24/12	SC
SW-1	4-6	49	62	45/22/23	CL
SB-1	48-50	51	78	49/14/35	CL
SB-1	73-75	38	96	54/17/37	CH
SB-2	48-50	40	48	38/19/19	SC
SB-2	58-60	31	43	28/18/10	SC
SB-4	2-4	17	57	38/19/19	CL
SB-4	48-50	51	75	46/17/29	CL
SB-4	53-55	27	20	Not Tested	SM
SB-5	4-6	44	54	42/15/27	CL
INF-1	0-2	11	35	Not Tested	SC
INF-1	2-4	18	67	Not Tested	CL
INF-2	0-2	12	30	Not Tested	SC
INF-2	2-4	11	30	Not Tested	SC
INF-3	0-2	11	21	Not Tested	SC
INF-3	2-4	42	56	Not Tested	CL
INF-4	2-4	32	56	Not Tested	CL
INF-5	0-2	12	22	Not Tested	SM
INF-6	0-2	6	44	Not Tested	SC
INF-6	2-4	11	20	Not Tested	SC
INF-7	0-2	10	18	Not Tested	SM
INF-8	0-2	11	45	Not Tested	SC
INF-9	2-4	13	39	Not Tested	SC
INF-10	0-2	9	27	Not Tested	SM
INF-10	2-4	36	52	Not Tested	CL
INF-11	0-2	8	60	Not Tested	CL

The five (5) bulk soil samples were subjected to Atterberg Limits, natural moisture content, -#200 sieve wash, Proctor, and CBR testing in general accordance with ASTM standards. A summary of the CBR test results and the moisture density relationship curves (Proctor curves) are provided in Appendix VI.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The project site is located within the Atlantic Coastal Plain physiographic province. Bedrock of the Late Mesozoic age is present at depths of greater than 2,000 ft, and is overlain by Lower and Upper Cretaceous, Tertiary, Pleistocene and Recent Sediments.

Across the outer Coastal Plain, the Pliocene age Yorktown Formation of the Tertiary Period is widespread, occurring from Maryland to North Carolina. Its age is estimated as between 4.8 million and 2.8 million years and is estimated to have been deposited during three transgressive episodes. The depositional environment was shallow marine in nature, consisting of inner shelf, barrier-island, estuarine and lagoonal patterns. The Yorktown Formation is a glauconitic, fossiliferous, Silty to Clayey greenish-gray fine Sand. This material has been preconsolidated by an increased effective overburden pressure generated due to a drop in the sea level at the end of the Tertiary Period, and by previously overlying sediments, which eroded away as the sea level subsequently lowered.

As sea levels rose during the Pleistocene Epoch of the Quaternary Period, areas were filled and overlain by soils of the Lynnhaven and Poquoson Members of the Tabb Formation. The Tabb Formation is composed of fluvial and estuarine sand, clay, organic soil and peat. In localized areas, Recent Holocene sediments, primarily marsh or swamp, colluvium, and alluvium, overlie the Tabb Formation.

Based on our review of existing geologic and soil boring data, the geologic stratigraphy encountered in our subsurface explorations generally consisted of marine deposited Sands, Silts and Clays of the Lynnhaven and Poquoson Members of the Tabb Formation overlain by Recent sediments and man-placed Fill deposits. The Yorktown Formation underlies the project site, and extends to significant depth.

3.2 Existing Pavement

The results of our coring/soil boring exploration program indicated the presence of 2 to 3 inches of asphalt underlain by 0 to 18 inches of aggregate base or 8.75 inches of concrete at some of the boring locations. The pavement section thicknesses should be expected to vary at other locations across the study area. The pavement thicknesses encountered are presented in Table II on the following page.

Table II – Pavement Thickness

Boring Location	Concrete Pavement (inches)	Asphalt Pavement (inches)	Aggregate Base Material (inches)
B-9	8.75	-	-
CBR-3	-	3.0	-
CBR-4	-	3.0	18.0
CBR-5	-	2.0	12.0
SB-5	-	-	4.0
INF-3	-	1.5	7.0
INF-4	-	8.0	14.5
INF-5	-	2.5	2.5
INF-6	-	2.0	6.0
INF-7	-	2.0	3.0
INF-8	-	-	7.0
INF-9	-	2.0	2.5
INF-10	-	2.5	8.0
INF-11	-	2.0	2.0

3.3 Subsurface Soil Conditions

The results of our soil test borings indicated the presence of approximately 2 to 8 inches of topsoil materials or various pavement sections ranging in total thickness between 4 to 22.5 inches. The topsoil material and pavement section thicknesses are expected to vary at other locations across the site. Underlying the topsoil materials or pavement sections, FILL materials were encountered at multiple boring locations. Underlying the FILL materials and extending to the boring termination depths of 10 to 80 feet below the existing site grades, the natural subsurface soils were arranged into three stratums.

FILL FILL/Possible FILL materials were encountered at boring locations B-1 through B-9, SW-1, SW-2, CBR-1 through CBR-5, SB-1, SB-2, SB-5, INF-1, INF-2, INF-3, INF-5, and INF-10. These FILL/Possible FILL materials extended beneath the topsoil materials and pavement sections to depths ranging from 1 to 6 feet below the existing site grades. The recovered soils were comprised mainly of Silty and Clayey SAND (SM and SC) and lean CLAY (CL), with lesser amounts of poorly graded GRAVEL (GP) and Sandy SILT (ML). These FILL materials contained varying amounts of Gravel, Sand, Silt, Clay, organics, marine shell fragments, and/or asphalt fragments.

The Standard Penetration Test (SPT) Results, N-values, recorded within these granular soils ranged from 2 to 16 blows-per-foot (BPF), indicating a very loose to medium dense relative density. The N-values recorded within the cohesive soils ranged from 5 to 15 BPF, indicating a medium stiff to stiff consistency.

Stratum I The initial soil stratum extended beneath the FILL materials, topsoil materials, and/or pavement sections to depths ranging from 4 to 9 feet below the existing site grades. The recovered soils were comprised of Sandy lean CLAY (CL) and Clayey SAND (SC), some of which contained trace amounts of Gravel. The N-values recorded within the granular soils ranged from 3 to 15 BPF, indicating a very loose to medium dense relative density. The N-values recorded within the cohesive soils ranged from 4 to 18 BPF, indicating a soft to very stiff consistency.

Stratum II The second soil stratum extended beneath the initial soil stratum and extended to depths ranging from 8 to 11 feet below the existing site grades (B-1). The recovered soils were comprised of Silty and Clayey SAND (SM and SC) with varying amounts of Sand, Silt, Clay, and marine shell fragments. The N-values recorded within these granular soils ranged from 3 to 13 BPF, indicating a very loose to medium dense relative density.

Stratum III The third and final soil stratum extended beneath the second soil stratum to the boring termination depths ranging from 10 to 80 feet below the existing site grades. The recovered soils were generally comprised of Silty and Clayey SAND (SM and SC) with lesser deposits of lean and fat CLAY (CL and CH) with varying amounts of Sand. These soils contained trace amounts of marine shell fragments. This stratum is part of the Yorktown Formation. The N-values recorded within the granular soils ranged from 3 to 15 BPF, indicating a very loose to medium dense relative density. The N-values recorded within the cohesive soils ranged from 4 to 11 BPF, indicating a soft to stiff consistency.

The subsurface description is of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface Investigation are included in Appendix III (Boring Log sheets) and Appendix IV (Generalized Subsurface Profile sheet), which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface Investigation represent the conditions only at the actual boring locations. Variations may occur and should be expected across the site. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual. It is noted that the topsoil designation references the presence of surficial organic laden soil, and does not represent any particular quality specification. It is recommended that this material be tested for approval prior to use.

3.4 Shrink/Swell Characteristics

The soils recovered during our field exploration were tested and evaluated for their potential to expand or contract with moisture changes (typically termed shrink-swell). Shallow foundations constructed on expansive soils at certain depths may be subjected to detrimental uplift or horizontal forces caused by the swelling of these soils as a result of an increase in the moisture content. Conversely, as these Clays loose moisture they may shrink, adversely affecting the foundations. The depth to which soils are normally affected by moisture changes extends to about 3 to 6 feet below existing grades in this area, depending on site topography and drainage characteristics.

The soils within the project limits are mapped by the USDA Soil Survey of the City of Hampton as Urban Land Series soils. Since it's designated as Urban Land no soil classification is provided. Based on our field and laboratory investigation, the natural soils at this project site to a depth of 10 feet are considered to have a low to moderate expansive (shrink-swell) potential.

3.5 Groundwater Information

The groundwater level was recorded at the boring locations and as observed through the wetness of the recovered soil samples during the drilling operations. The initial groundwater table was measured to occur at depths ranging from 4 to 7 feet below the existing site grades at the boring locations. The boreholes were backfilled upon completion for safety considerations. As such, the reported groundwater levels may not be indicative of static groundwater levels.

Temporary groundwater monitoring wells were installed at the location of borings INF-1, INF-3, INF-5, and INF-10, and groundwater readings were obtained at 24-hours after installation. The groundwater information associated with these wells is presented below (Table III).

Table III - Groundwater Readings

Boring No.	Initial Groundwater Reading (ft)*	24-hour Groundwater Reading (ft)*
INF-1	6	4
INF-3	6	5.5
INF-5	6	5.5
INF-10	5	4.5

* Depth below existing site grades

As subsurface soils begin to dry moisture moves upwards through the soil profile by means of capillary action. Based on the subsurface soil composition (soils containing more than 30% of fines by weight), these initial groundwater readings (based on the relative wetness of the soils) could be in part attributed to the capillary action of the soils. As such, if the static groundwater elevation is critical to the design of the proposed structures and site infrastructure it is recommended to install temporary groundwater monitoring wells to substantiate these initial readings.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.). In the project's area, seasonal groundwater fluctuations of ± 2 feet are common; however, greater fluctuations have been documented. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedures, if necessary.

4.0 EVALUATION AND RECOMMENDATIONS

Our recommendations are based on the previously discussed project information, our interpretation of the soil test borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what was described, **G E T Solutions, Inc.** requests the opportunity to review our recommendations and make any necessary changes.

On the basis of the results of our soil test borings and in conjunction with the anticipated high foundation loads associated with the Measurement Systems Laboratory building, it is our opinion that the proposed structure should be supported by means of a deep foundation system comprised of driven square pre-stressed pre-cast concrete (SPPC) piles. The proposed building's first floor slab can be supported as a slab-on-grade, provided the subgrade passes a proofroll test prior to foundation construction. Some undercut and replacement of the existing FILL materials may be required at the time of construction. FILL materials were observed at the boring locations to depths of up to 6 feet below existing grades at the boring locations.

Due to the large amount of energy required to install driven deep foundations, vibrations and noise of considerable magnitude are generated. These vibrations would likely affect nearby structures. At a minimum these vibrations will be perceptible to the occupants of the adjacent structures and may even become unpleasant at time.

The vibrations commonly associated with driven pile installation can adversely affect these adjacent structures. Based on our experience with similar projects, it is expected that the pile installation process can result in estimated peak particle velocities on the order of 0.10 in/sec to 0.25 in/sec (typical frequency of 10 to 40 Hz) at distances of 25 to 50 feet from the impact area. These vibration levels can be expected to attenuate as you move further away from the impact area (i.e. at 100 feet away, vibrations are expected to be less than 0.05 in/sec to 0.1 in/sec). The guidelines for vibration thresholds are generally vague and subjective; however, it is common to recommend peak particle velocities of less than 0.15 in/sec to 0.25 in/sec adjacent to existing structures. Accordingly, it is expected that if driven piles are utilized the Measurement Systems Laboratory building will be subjected to vibration levels which could exceed the commonly accepted threshold. In these cases some minor damage is possible, which would be expected to be observed in the exterior/interior finishes of the structures (minor brick or drywall cracking).

At a minimum, a comprehensive pre-construction condition survey program is recommended. Refer to Section 4.6.9 for a further discussion and recommendations to address adjacent structures. In addition, it is recommended to monitor the vibrations during the pile installation process. Alternatively, an auger cast pile foundation system could be implemented to minimize the vibrations and reduce the risk for potential minor structural damage to the adjacent buildings. However, installing SPPC piles is generally more economical than auger cast piles. Recommendations for auger cast piles can be provided upon your request. The final selection of the pile (whole or in combination) will have to be determined by the owner and structural engineer based on risk level tolerance.

4.1 Clearing and Grading

The proposed construction areas should be cleared by means of removing all topsoil, root mat, existing asphalt and concrete pavements, building foundations, utilities, unsuitable FILL, or any otherwise unsuitable materials. It is estimated that a cut of up to 9 inches in depth will be required to remove the topsoil, asphalt, or concrete materials. This cut is expected to extend deeper in isolated areas to remove deeper deposits of unsuitable soils, organics, existing pavements, and/or unsuitable FILL, which becomes evident during the clearing. Also, FILL/Possible FILL materials were observed as deep as 6 feet below existing site grades at the boring locations which may be required to be undercut pending proofroll, test pits, and densification testing at the time of construction. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction areas.

The results of our field exploration program indicated that the soils below the topsoil materials and pavement sections generally consisted of Silty and Clayey SAND (SM and SC) and lean CLAY (CL). These soils generally contained appreciable amounts of fines (Silt/Clay). Combinations of excess surface moisture from precipitation ponding on the site and the construction traffic, including heavy compaction equipment, may create pumping and general deterioration of the bearing capabilities of the surface soils. At the time of this investigation, the natural moistures of the CBR samples were up to 11% above their optimum moisture (as determined by means of laboratory testing). Soils with moisture contents above their optimum moisture contents tend to soften during the stripping and grading activities. In this regard, and in order to reduce the potential for undercutting, care should be exercised during the grading and construction operations at the site. Furthermore, inherently wet subgrade soils combined with potential poor site drainage make this site particularly susceptible to subgrade deterioration. Thus, grading should be performed during a dry season if at all possible. This should minimize these potential problems, although they may not be eliminated. As such, it is recommended to include a contingency in the budget to account for potential subgrade improvements.

4.2 Subgrade Preparation

As previously stated, existing buildings and other associated infrastructure (pavements, sidewalks, utilities, etc.) are planned for demolition and removal in order to accommodate the new construction. All excavations associated with the demolition process should be backfilled with Structural Fill, placed, and compacted as indicated in Section 4.3 of this report. We recommend that these backfill operations be monitored on a full-time basis by a representative of **GET Solutions, Inc.**

After the subgrade soils have been compacted, they should be evaluated by the Geotechnical Engineer for stability. Accordingly, the subgrade soils should be proofrolled to check for pockets of loose material hidden beneath a crust of better soil. Several passes should be made by a large rubber-tired roller or loaded dump truck over the construction areas, with the successive passes aligned perpendicularly. The number of passes will be determined in the field by the Geotechnical Engineer depending on the soil conditions. Any pumping and unstable areas observed during proofrolling (beyond the initial cut) should be undercut and/or stabilized at the direction of the Geotechnical Engineer.

In addition to the proofroll, several 3 to 7-foot deep test pits should be excavated within the proposed construction areas. The test pits are considered necessary to determine the thickness and composition of the FILL materials. The test pits should be performed under the observation of the Geotechnical Engineer who will evaluate the composition of the recovered soils. In addition to the test pits, several compaction tests should be performed on the fill material within the proposed building and pavement areas to further substantiate the suitability of the existing FILL material. It is possible that some subgrade improvements will be required to provide suitable soils for building, slab, and pavement support. The fill material may remain in place under slabs and pavements if approved by the Geotechnical Engineer (to be determined following the completion of the test pit and compaction testing investigation). Recommendations concerning the subgrade improvements (as necessary) will be provided in the field following the testing procedures. Again, the project's budget should include an allowance for subgrade improvements (undercut/backfill with structural fill).

Following the clearing operation and approved by the Geotechnical Engineer, the exposed subgrade soils should be densified with a large static drum or sheepsfoot roller. Subgrades to a depth of at least 12 inches should be compacted to a dry density of at least 95% of the Modified Proctor maximum dry density, in accordance with ASTM D 1557. The moisture content of the subgrade should be within +/- 2% of the optimum moisture content at the time of compaction.

4.3 Structural Fill and Placement

Any material to be used for structural fill should be evaluated and tested by the Geotechnical Engineer prior to placement to determine if they are suitable for the intended use. Suitable structural fill material should consist of sand or gravel containing less than 25% by weight of fines (SP, SM, SW, GP, GW - with dimensions not to exceed 2 inches in diameter), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All structural fill should be compacted to a dry density of at least 95% of the Modified Proctor maximum dry density, in accordance with ASTM D 1557. The moisture content of the structural fill should be within +/- 2% of the optimum moisture content at the time of placement. In general, the compaction should be accomplished by placing the fill in maximum 8-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density.

We recommend that fill placement be monitored on a full-time basis by a qualified Geotechnical Engineering firm to verify that the specified materials are used and the required degree of compaction is achieved.

Surface water control measures should be instituted to protect the new fill from erosion. A protective cover of grass or other vegetation should be established on permanent slopes as soon as possible during construction.

It does not appear that dewatering will be required for mass grading, except where localized surface moisture might be present. Utility excavations could encounter the groundwater table, depending on utility depth and location on site. Dewatering at depths below the groundwater level may require well pointing. Seepage from shallow perched water may require pumping from sumps, depending on seasonal conditions. Prior to bidding and/or construction, the grading contractor should determine actual groundwater conditions at the location of deep excavations so its impact on the project can be determined.

4.4 Suitability of On-site Soils

The naturally occurring soils encountered at the boring locations to depths of 4 to 9 feet consisted of Sandy, Lean CLAY (CL), which is not considered suitable for reuse as Structural Fill, but may be used as fill within green areas. Soils classified as Silty SAND (SM) which were encountered below the surface Clay layer may be used as Structural Fill; however, these soils will be difficult to work and compact due to high fines (Silt and Clay) content and also high moisture content as these soils were encountered below the groundwater table. These soils will require moisture conditioning to achieve the desired degree of compaction.
As such, it will likely be necessary to import structural fill.

Further classification testing (natural moisture content, plasticity, gradation analysis, and Proctor testing) should be performed during construction to evaluate the suitability of excavated soils for reuse as Structural Fill within building and pavement areas.

4.5 Slab-on-Grade Design

The floor slabs may be constructed as a slab-on-grade provided the previously recommended earthwork activities and evaluations are properly accomplished. It is recommended that all ground floor slabs be "floating". That is, generally ground supported and not rigidly connected to walls or foundations. This is to minimize the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation.

It is recommended that all ground floor slabs be directly supported by a Porous Fill layer. Below lightly loaded office space slabs, the Porous Fill can consist of at least 4 inches of relatively clean, compacted, poorly graded Sand (SP) or gravel (GP) with less than 5% passing the No. 200 Sieve (0.074 mm). For slabs supporting heavier loads, the Porous Fill layer should consist of a minimum of 6 inches of Porous Fill. ASTM C33 Concrete Sand and VDOT Size No. 57 Stone are considered suitable for this purpose. The purposes of the Porous Fill layer are to serve as a capillary barrier, equalizing moisture conditions beneath the slab, and to provide for more uniform slab support.

It is recommended that a vapor barrier be employed over the Porous Fill in heated areas to minimize the potential for floor dampness, which can affect the performance of glued tile, carpet, and finishes.

Floor slabs-on-grade constructed as discussed herein can be designed assuming a subgrade modulus of 150 pci.

4.6 Driven Concrete Pile Foundation Recommendations

The following sections describe the pile capacity analyses and provide our recommendations for static axial compressive pile capacities, pile testing program, and pile construction criteria. In addition, we have provided estimates of potential settlement.

4.6.1 Axial Compression Capacity Recommendations

For this project, it is our opinion that driven SPPC piles will be most economical of the driven pile options. We conducted pile capacity analyses using static formulas with coefficients recommended by Geoffrey Myerhoff and George Sowers. The analyses include the contributions of shaft friction and end bearing to the pile capacity. The piles are expected to derive the majority of their capacity from shaft friction and end bearing in the deeper sand layer commonly known as the Yorktown Formation, at the depth presented in Table IV Pile Length and Capacities for 12” and 14” SPPC piles.

The soil materials typically exhibit time-dependent strength characteristics; consequently shaft friction and end bearing support tend to increase from initial installation through a process termed “soil setup”. Essentially, the dynamics of driving piles will cause excess pore pressures to develop, thereby decreasing driving resistance during initial pile installation. The pile capacities developed during driving are usually much lower than the design values. Once driving is complete, the excess pore pressures dissipate with time (and soil setup occurs) and the bearing capacity of the pile increases. Based upon our experience with similar projects in the area, 7 days is usually required for the pore pressures dissipation and soil setup to occur.

For the reasons previously described, it will not be possible to confirm pile capacities with a simple driving criterion such as number of hammer blows per foot of advanced pile. Instead, driving criteria will likely consist of a target tip elevation and/or certain embedded length in a bearing material with specified driving resistance. The specified driving resistance should be based on a Wave Equation Analysis of the contractor’s selected hammer.

Table IV below provides our recommended pile types and tip elevation for the structure's foundations. The allowable capacity for the piles includes a safety factor of at least 2.0 for bearing and 2.5 for tension requiring a pile load test program consisting of a static load test of dynamic testing. The capacity of a group of piles spaced at least 3 pile diameters apart, center to center, can be taken as the sum of the individual capacities with no reduction factor. If closer pile spacing is anticipated, the geotechnical engineer should be contacted to evaluate the efficiency of the specific pile group. The final order lengths and tip elevations will be adjusted based on the results of the test piles and load test programs.

Table IV – Pile Length and Capacities

Pile Type	Embedment Depth (ft)[1]	Allowable Compression Capacity[2] (tons)	Allowable Tension Capacity[3] (tons)	Maximum Auger Depth[4] (ft)
12" SPPC	60	55	15	10
14" SPPC	60	74	25	10

Notes: (1) Embedment depth beneath current grades
(2) Compressive capacity is based on a factor of safety is 2.0.
(3) Uplift capacity based on Factor of Safety of 2.5.
(4) Deeper pre-augering may further reduce vibration, but not sufficiently to eliminate risk.

We also conducted lateral analyses using L-Pile Plus, a computer software package by ENSOFT©. The software requires as input, quantitative data related to strength and deformation behavior of the subsurface materials, the structural properties of the pile, and an understanding of shaft/soil interaction during lateral loading. The program calculates the lateral deflections, internal moment forces and internal shear forces experienced by a pile subjected to the specific loading conditions. The program does not analyze whether the pile is structurally capable of resisting the moments and shear stresses generated. This analysis should be performed by the project structural engineer.

According to the 2009 IBC, Section 1810.3.3.2, the allowable lateral load is not more than one-half of the load that produces a gross lateral movement of 1 inch at the lower of the top of foundation element and the ground surface. Therefore, the lateral capacity analysis was divided in two steps. Step one consisted of determining the lateral load that produces a gross lateral movement of 1 inch. The second step consisted of performing the lateral capacity in Appendix V – L-Pile Analysis: Design Load. The results of these analyses are presented in Table V on the following page.

Table V – SPPC Pile Lateral Capacity Analysis*

Pile Type	Embedment Depth (ft)[1]	Pile-Head Fixity Conditions	P_1 = Allowable Capacity that Produces 1-inch of Lateral Movement	P_2 = ½ P_1 (per 2009 IBC, Section 1810.3.3.2)	Maximum Horizontal Deflection	Axial Load	Maximum Moment Reaction	Maximum Shear Reaction
12" SPPC	60	Free-end	14.3 kips	7.2 kips	0.33 inches	40 kips	327.4 in-kips	7.2 kips
		Fixed-end	39.1 kips	19.5 kips	0.38 inches	40 kips	1,032.6 in-kips	19.5 kips
14" SPPC	60	Free-end	19.5 kips	9.7 kips	0.34 inches	40 kips	502.0 in-kips	9.7 kips
		Fixed-end	52.9 kips	26.4 kips	0.39 inches	40 kips	1,559.5 in-kips	26.4 kips

Notes: (1) Embedment depth beneath current grades

Based on the information provided by the structural engineer, battered piles may be implemented at the shear wall locations in order to increase the allowable lateral load per pile above what has been provided in the table above. Installation of battered piles is acceptable as long as the same tip elevation as the corresponding vertical piles is achieved, which is a tip elevation of 60 feet beneath current grades. The axial load on the battered pile can be resolved into corresponding vertical and horizontal components based on the angle of batter.

We recommend pre-augering the pile locations prior to driving installation of piles to a depth of approximately 10 feet maximum, unless otherwise recommend by **GET Solutions, Inc**. This is necessary to help in minimizing the effects of vibrations from the driving effort on adjacent buildings, and to reduce the potential for pile breakage. Following the pre-augering, the piles should be installed and advanced by driving with an impact hammer to their design tip elevations. If for some reason during construction, pile driving "capacity" is encountered before the piles reach their design tip elevations, the Geotechnical Engineer should be retained to review driving records and field reports to determine whether the pile can adequately support the design loads. If the pile driving hammer is not properly matched to the pile type, size and subsurface conditions, it may reach practical refusal before the pile reaches the design tip elevation, or the required capacity.

4.6.2 Pile Group Settlement

Based on the results of load tests performed on piles driven in similar soils conditions, it is anticipated that the total butt settlements (including elastic shortening) will not exceed about ½-inch, which is the settlement necessary to mobilize the soil/pile capacity in combination with the pile group settlements due to the stress increase in the underlying soils.

4.6.3 Test Piles

We recommend that a test pile program be implemented for the purpose of assisting in the development of final tip elevations and to confirm that the contractor's equipment and installation methods are acceptable. The test program should involve at least five (5) test piles to provide an indication of various driving and/or installation conditions. The test pile locations should be established by the Geotechnical Engineer based on the structural characteristics. It is important to note the relationship between the required testing and our design assumptions. We chose safety factors based upon the recommended pile testing program. We expect that the pile testing program will include primarily dynamic evaluation with a Pile Driving Analyzer (PDA).

The piles should be driven using the drive system submitted by the contractor and approved by the geotechnical engineer. Test pile lengths should be at least ten feet longer than anticipated production pile lengths to ensure that the required capacity is developed, to allow for refinement of estimated capacities, and for dynamic and static testing reasons. The indicator piles installed during the Test Pile Program, which satisfy the geotechnical engineer's requirements for proper installation, may also be used as permanent production piles.

The contractor should include in his equipment submittal a Wave Equation Analyses (using GRLWEAP™ software) modeling the behavior of the test piles during driving, or what is termed by GRL as a "Drivability Study." The primary intent of the Wave Equation Analyses is to estimate the feasibility of the contractor's proposed pile driving system with respect to installing the piles. Since the results of the Wave Equation Analyses are dependent on the chosen hammer, the pile type and length, and the subsurface conditions, it is likely that at least one Wave Equation Analysis per hammer will be required.

Pile driving equipment should not be mobilized for the test piles until the Wave Equation Analyses have been submitted and approved by the geotechnical engineer. If the contractor's proposed pile driving system is rejected, subsequent submittals of alternative drive systems should also include appropriate Wave Equation Analyses that are subject to the approval of the geotechnical engineer. The Wave Equation Analyses are also used to estimate*:*

- Compressive and tensile stresses experienced by the modeled pile during driving
- The total number of blows required to install the pile
- Driving resistance (in terms of blows per foot) within the various soil strata the pile is embedded in
- Driving time

The results of the WEAP analyses are highly dependent on the many input parameters related to the soil conditions, static pile capacity estimates, as well as specific characteristics associated with different makes and models of pile driving hammers.

4.6.4 Dynamic Testing

Dynamic testing was developed as a method of improving upon the reliability of the wave equation and other dynamic predictions by actually measuring the acceleration and strain of a pile during driving. This technique was developed in the mid-1960's and has been continually refined. The use of dynamic pile testing has permitted the possibility of checking the driving stresses in the pile and the hammer performance during pile driving. It is also possible to estimate the static capacity of the pile based upon the strain and acceleration measurements taken during pile driving.

The test pile installation should be monitored by the Geotechnical Engineer using the PDA, an electronic device that records driving stresses and pile/soil interactions, among other things. The PDA results will confirm that the pile driving system (hammer type/energy, cushion type/ thickness, etc.) can successfully install the piles without over stressing them in compression or tension. It is essential the test pile restrikes be monitored with the PDA.

No sooner than 7 days after installation, all of the test piles should be re-struck while being monitored with the PDA. This test establishes the “static capacity” of the pile. The initial hammer blow during re-strike activities is critical to the quality of dynamic data with respect to capacity interpretation. The contractor should make every effort to insure an initial high-energy blow of the hammer. After several blows during re-strike activities, pore pressures increase, soil setup diminishes, and ultimately pile capacities (as recorded by the PDA) decrease. Loss of estimated static capacity following repeated hammer blows is the reason the initial blows are critical.

The dynamic data recorded by the PDA during restrike testing should be further refined by using CAPWAP® analysis. CAPWAP® analysis, not the initial assessment of capacity determined by the PDA, should be the basis of static pile capacity estimates. Interpretation of CAPWAP® data, in the context of the soils subsurface conditions and previous static pile capacity estimates, should allow the Geotechnical Engineer to estimate ultimate pile capacities and recommend appropriate production pile lengths.

Our previous experience with the PDA indicates that a significant cost savings may be realized if the PDA is properly utilized to monitor the installation of test piles, confirm pile capacity in production installations, and monitor potentially damaging stresses during driving. The use of the PDA permits the confirmation of allowable compression and uplift capacities and pile integrity on several piles for a cost similar to or less than that of a single full-scale static load test. We recommended the design builder retain the services of the Geotechnical Engineer to perform the dynamic testing, not the installation contractor, to avoid possible conflicts of interest.

4.6.5 Establishing Pile Driving Criteria

Prior to driving production piles, the geotechnical engineer should establish the criteria for pile installation. The criteria will be based on the data collected during monitoring of the test pile installation and the subsequent restriking. The intent of establishing driving criteria is to facilitate installation of the production piles without damage and to provide a means of establishing when piles have achieved the design capacities. The driving criteria may include: hammer type, hammer energy, ram weight, pile cushion and thickness, hammer cushion type and thickness, required tip elevations and driving resistance necessary to achieve capacities, and possibly predrilling recommendations (if the test pile results warrant the need).

4.6.6 Allowable Driving Stresses

Guidelines from the Prestressed Concrete Institute (PCI), American Society of Civil Engineers (ASCE), and the Association of State Highway Transportation Officials (AASHTO) indicate that maximum compressive stresses, imposed on driven precast concrete piles during installation, should be less than the following equation: 0.85 x f'_c (concrete compressive strength, psi) - f_{pe} (effective pre-stressing after losses from relaxation). The three groups differ on the maximum tensile stresses. PCI recommends 6 x square root of $f'_c + f_{pe}$; ASHTO and ASCE recommend 3 x square root $f'_c + f_{pe}$. We recommend using the consensus value for the maximum compressive stress, and the ASCE/AASHTO recommended value for the maximum tensile stress.

4.6.7 Hammer Types and Energies

In comparing hammers of equal energy, the Prestressed Concrete Institute (PCI) states that hammers with heavier rams and lower impact velocities are less likely to cause damaging stresses in concrete piles. Hammers with proportionally higher ram weights and short stroke heights (low impact velocities) are usually air or steam driven, and not diesel fueled. It has been our experience that air/steam hammers are more appropriate for the installation of precast concrete piles than similarly sized (in terms of energy) diesel hammers. We recommend that the contractor use an air or steam driven hammer whose ram weight is roughly equal to 0.5 to 1.0 times the weight of the pile itself. The actual determination of an acceptable ram weight should be determined through the results of the Test Pile Program. If the contractor elects to use a diesel hammer, we recommend a critical, detailed review of the contractor's Wave Equation Analysis prior to driving the test piles.

4.6.8 Driven Pile Installation Monitoring

The geotechnical engineer should observe the installation of the test pile and all production piles. The purpose of the geotechnical engineer's observations is to determine if production installations are being performed in accordance with the previously derived Pile Driving Criteria. Continuous driving and installation records should be maintained for all driven piles. Production piles should be driven utilizing the approved system established as a result of the Test Program.

The field duties of the geotechnical engineer (or a qualified engineer's representative) should include the following:

- Being knowledgeable of the subsurface conditions at the site and the project-specific Pile Driving Criteria.
- Being aware of aspects of the installation including type of pile driving equipment and pile installation tolerances.
- Keeping an accurate record of pile installation and driving procedures.
- Documenting that the piles are installed to the proper depth indicative of the intended bearing stratum. Also documenting that appropriate pile splicing techniques are used, if necessary.
- Recording the number of hammer blows for each foot of driving.
- Generally confirming that the pile driving equipment is operating as anticipated.
- Record the energy rating of the hammer.
- Informing the geotechnical engineer of any unusual subsurface conditions or driving conditions.
- Notifying the design builder and structural engineer when unanticipated difficulties or conditions are encountered.
- Confirming from visual appearance that the piles are not damaged during installation and observing the piles prior to installation for defective workmanship. The geotechnical engineer should review all driving records prior to pile cap construction.

4.6.9 Adjacent Structures

When considering the suitability of a driven pile foundation, consideration should be given to the integrity of nearby structures. Due to the large amount of energy required to install driven deep foundations, vibrations of considerable magnitude are generated. These vibrations may affect nearby structures. These structures can, due to their proximity, be detrimentally affected by the construction unless proper protection measures are taken. In addition, experience has shown that these construction features will often lead adjacent property owners to conclude that damage to their property has taken place, even though none has occurred. It is therefore recommended that a thorough survey of the adjacent property be made prior to starting construction. This will help to better evaluate real claims and refute groundless nuisance claims.

The survey should include, but not be limited to, the following:

1. Visually inspect adjacent structures, noting and measuring all cracks and other signs of distress. Take photographs as needed.

2. Visually inspect adjacent pavements, noting and measuring any significant cracks, depressions, etc. Take photographs as needed.

3. Establish several benchmarks along foundation walls on adjacent structures. Both vertical and horizontal control should be employed.

4. Determine if equipment in any adjacent building is sensitive to vibration, and if so, establish proper control and monitoring system.

4.7 Below Grade Foundation and Wall Design Parameters

With regard to the design of the below grade walls (elevator pits and foundation walls) to resist lateral earth pressures, the estimated soil parameters provided in Table VI below can be used:

Table VI – Below Grade Foundation and Wall Soil Design Parameters

Stratum	FILL	FILL	I	I	II & III	Structural Fill (as per Section 4.3)
Depth[1] (ft)	0 to 1-6	0 to 1-6	1-6 to 4-9	1-6 to 4-9	4-9 to 15	-
Soil Classification (USCS)	CL	SM, SC	CL	SC	SM, SC	SP, SP-SM, SM
SPT N-values	5 - 15	2 - 16	4 - 18	3 - 15	3 - 15	-
Estimated Moist Unit Weight (pcf)	115	120	115	120	120	120
Estimated Submerged Unit Weight (pcf)	53	58	53	58	58	58
Friction Angle (ϕ) (degrees)	5	28	5	30	30	30
Cohesion (c) (psf)	400	0	500	0	0	0
Active Soil Pressure K_a	0.84	0.36	0.84	0.33	0.33	0.33
Passive Soil Pressure K_p	1.2	2.8	1.2	3.0	3.0	3.0
At Rest Soil Pressure K_o	0.91	0.53	0.91	0.50	0.50	0.50

Notes: (1) Depth below existing grades at the individual boring location.

The Structural Fill soil parameters provided above are considered appropriate for materials satisfying the requirements for Structural Fill as outlined in Section 4.3 of this report.

In order to minimize lateral earth pressure, drainage of the backfill behind the wall must be provided. This drainage system may consist of drain lines located around the perimeter of the wall foundation which discharge to a suitable outlet. These drain lines should be surrounded by a minimum of 6 inches of free-draining granular filter or by No. 57 Stone wrapped in filter fabric. The space between the back face of the walls and the excavation should be backfilled with an 18 inch thick, free draining granular fill to serve as a wall drain. Suitable man-made drainage materials (drain board) may be used in lieu of the granular backfill adjacent to the below-grade walls. The material should be placed in accordance with the manufacturer's recommendations and should be hydraulically connected to the foundation drainage system, which in turn should be properly drained. Where exposed to weather, the top 1.5 feet of retaining wall backfill should consist of a Clay material to minimize the amount of surface water infiltration into the granular material, and thus reduce the excess water to be handled by the drainage system. The ground surface adjacent to the below-grade walls should be kept properly graded to prevent ponding of water adjacent to the below-grade walls.

4.8 Seismic Site Class

On the basis of the results of the soil test borings drilled at this site (80 feet maximum explored depth) and our experience in the project area, it is our opinion that this site should be considered a [redacted] (b) (5) in accordance with Table 20.3-1 Site Classification of the ASCE 7-10 Minimum Design Loads for Buildings and Other Structures, Chapter 20 (referenced in the 2009 IBC). However, the seismic evaluation requires soils information associated with the upper 100 feet. If the site classification is critical to the structural design it will be necessary to perform a 100-foot deep CPT boring with shear wave velocity testing to substantiate the site classification.

4.9 Pavement Design

Our design assumes that either curbs and gutters or ditches and swales will be provided along the edges of all pavements to prevent water penetration of the subgrade soils. Based on the results of our soil borings, it appears that the soils that will be exposed as pavement subgrade will consist mainly FILL materials comprised of Clayey SAND (SC). The soaked CBR value was multiplied by a factor of two-thirds to determine a pavement design CBR value. The two-thirds factor provides the necessary safety margins to compensate for some non-uniformity of the soil. Therefore, a design CBR value of 12.5 should be used to evaluate the pavement sections at this project site. Typical pavement section designs are provided in Table VII on the following page.

Table VII – Typical Pavement Sections

Section	Reinforced Portland Cement Concrete (min. 4,000 psi)	Hot Mix Asphalt		Aggregate Base[1]	Subgrade[2]
		Surface	Base		
Light Duty Parking Lot	-	2”	-	8”	Stable and Compacted
Heavy Duty Parking Lot Drive Isle/Entrances	-	2”	3”	8”	Stable and Compacted
Heavy Duty Dumpster Pad/Loading Dock	6”	-	-	8”	Stable and Compacted

1 - VDOT Type 21-A, compacted to a dry density of at least 100% of the Modified Proctor maximum dry density (ASTM D 1557).
2 - Compacted to a dry density of at least 95% of the Modified Proctor maximum dry density (ASTM D 1557).

As previously stated, the subgrade soils consisted primarily of FILL materials comprised of Clayey SAND (SC), which has an appreciable amount of fines (Silt and/or Clay) and is moisture sensitive. Accordingly, during the subgrade testing (proofrolling and compaction testing) isolated areas of unstable subgrade soils will probably become evident. Subgrade scarification, aeration, and drying or subgrade stabilization in the form of undercutting may be required to achieve a stable subgrade.

Actual pavement section thickness should be provided by the design Civil Engineer based on traffic loads, volume, and the owners design life requirements. The above section corresponds to thickness representative of typical local construction practices and periodic maintenance should be anticipated.

Following pavement rough grading operations, the exposed subgrade should be observed under proofrolling. This proofrolling should be accomplished with a fully loaded dump truck or 7 to 10 ton drum roller to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed should be removed and replaced with a well-compacted granular material. The inspection of these phases should be performed by the Geotechnical Engineer or his representative. The subgrade soils are likely to be unstable at the time of construction and some ground improvement requirements are anticipated. Considering this, the project’s budget should include a contingency to accommodate the potential subgrade improvements.

Where excessively unstable subgrade soils are observed during proofrolling and/or fill placement, it is expected that these weak areas can be stabilized by means of thickening the aggregate base course layer by 4 to 6 inches, adding 12 inches of Structural Fill subbase, and/or lining the subgrade with geotextile fabric. These recommendations are to be addressed by the Geotechnical Engineer during construction, if necessary, who will recommend the most economical approach at the time.

4.10 Infiltration Testing

The design of the three proposed SWM facilities has not been completely developed at the time this report was prepared. Based on our conversations with the Civil Engineer, the SWM facilities will likely be infiltration trench or bioretention type facilities. It is expected that these SWM facilities will be created mainly by excavation.

Eleven (11) infiltration tests (designated as INF-1 through INF-11) were performed within the vicinity of the proposed SWM facilities corresponding to boring locations INF-1 through INF-11, respectively. The infiltration test boreholes were prepared utilizing a planer auger to remove soil clippings from its base. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

A support stand was assembled and placed adjacent to the boreholes. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 2-meter (6.6 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended 6-inches above the bottom of the boreholes. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until a relatively consistent flow rate was documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate K_s utilizing the Glover Solution.

Based on the field testing and corroborated with laboratory testing results (published values compared to classification results), the hydraulic conductivity of the shallow soils as identified at the location and depth of the infiltration tests are presented on the Infiltration Test Data in Appendix VII and is illustrated in Table VIII - Infiltration Test Results on the following page.

Table VIII – Infiltration Test Results

Infiltration Test	Test Depth (feet)	-#200 Sieve (%)	Classification	Hydraulic Conductivity	
				(in/hr)	(cm/sec)
INF-1	2.5	67	CL	0.058	4.12×10^{-5}
INF-2	3.0	30	SC (FILL)	0.109	7.71×10^{-5}
INF-3	3.0	56	CL	0.034	2.39×10^{-5}
INF-4	3.0	56	CL	0.052	3.65×10^{-5}
INF-5	2.0	22	SM (FILL)	0.394	2.78×10^{-4}
INF-6	1.5	44	SC	0.068	4.78×10^{-5}
INF-7	1.5	18	SM	0.788	5.56×10^{-4}
INF-8	2.0	45	SC	0.041	2.89×10^{-5}
INF-9	3.0	39	SC	0.244	1.72×10^{-4}
INF-10	1.5	27	SM (FILL)	1.028	7.25×10^{-4}
INF-11	2.0	60	CL	0.038	2.70×10^{-5}

Groundwater was encountered at depths ranging from 4 to 7 feet below existing grades at our boring locations during our field exploration. Due to encountering low infiltration rates, some depth of over-excavation and replacement with a structural fill material would be required in order to provide suitable infiltration, if necessary.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Drainage and Groundwater Concerns

It is expected that dewatering may be required for excavations that extend near or below the groundwater table. Dewatering above the groundwater level could probably be accomplished by pumping from sumps. Dewatering at depths below the groundwater level will require well pointing. In addition, it is recommended to tie roof drains to the storm water system and situate downspouts in such a manner to prevent ponding water near the foundations.

It would be advantageous to construct all fills early in the construction. If this is not accomplished, disturbance of the existing site drainage could result in collection of surface water in some areas, thus rendering these areas wet and very loose. Temporary drainage ditches should be employed by the contractor to accentuate drainage during construction. We recommend that the contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on this project.

5.2 Site Utility Installation

The naturally occurring soils encountered at the boring locations to depths of 4 to 9 feet consisted of Sandy, Lean CLAY (CL), which is not considered suitable for reuse as Structural Fill, but may be used as fill within green areas. Soils classified as Silty SAND (SM) which were encountered below the surface Clay layer may be used as Structural Fill; however, these soils will be difficult to work and compact due to high fines (Silt and Clay) content and also high moisture content as these soils were encountered below the groundwater table. These soils will require moisture conditioning to achieve the desired degree of compaction.
As such, it will likely be necessary to import structural fill.

Further classification testing (natural moisture content, plasticity, gradation analysis, and Proctor testing) should be performed during construction to evaluate the suitability of excavated soils for reuse as Structural Fill within building and pavement areas.

It is possible that isolated utility pipes and structures will bear within the wet granular materials located at depths in excess of (b) (5) feet below current grades. In these instances additional bedding materials (VDOT No. 57 stone) may be required to facilitate suitable pipe and/or structure bedding.

5.3 Excavations

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its “Construction Standards for Excavations, 29 CFR, part 1926, Subpart P”. This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor’s responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. **G E T Solutions, Inc.** is not assuming responsibility for construction site safety or the contractor’s activities; such responsibility is not being implied and should not be inferred.

6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by **G E T Solutions, Inc.** and the information supplied by the client and its consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **G E T Solutions, Inc.** should be notified immediately to determine if changes in the foundation recommendations are required. If **G E T Solutions, Inc.** is not retained to perform these functions, **G E T Solutions, Inc.** can not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to assure our engineering recommendations have been properly incorporated into the design documents so that the earthwork and foundation recommendations can be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of **AECOM** and their consultants for the specific application to the Measurement Systems Laboratory project located in the NASA Langley Research Center within the City of Hampton, Virginia.

APPENDICES

I. BORING LOCATION PLANS

II. CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

III. BORING LOGS

IV. GENERALIZED SOIL PROFILE

V. L-PILE ANALYSES – DESIGN LOAD

VI. SUMMARY OF CBR TEST RESULTS

VII. INFILTRATION TEST RESULTS

APPENDIX I

BORING LOCATION PLANS

Locations are approximate based on site visit sketch.

Boring Location Plan (Page 1 of 2)

`

Project: Measurement Systems Laboratory
NASA Langley Research Center
Hampton, Virginia

Project No: WM11-175G

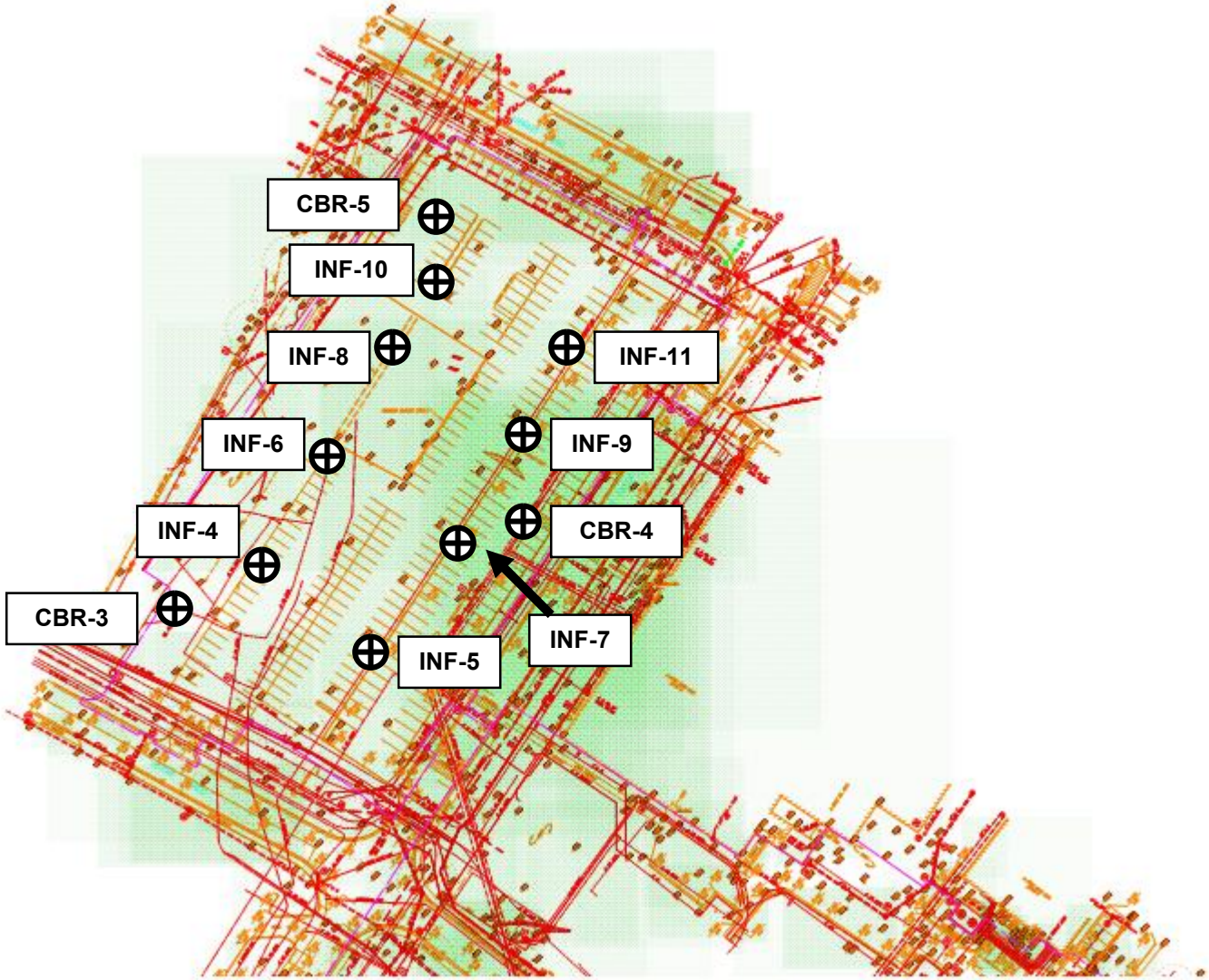
Client: AECOM

Scale: As Drawn

Date: 7/23/2014

Plot By: JW

Locations are approximate based on site visit sketch.



Boring Location Plan

` **Project:** Measurement Systems Laboratory
NASA Langley Research Center
Hampton, Virginia

Project No: WM11-175G

Client: AECOM

Scale: As Drawn

Date: 7/23/2014

Plot By: JW

APPENDIX II

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach Office
204 Grayson Road
Virginia Beach, VA 23462
(757) 518-1703

Williamsburg Office
1592 Penniman Rd. Suite E
Williamsburg, Virginia 23185
(757) 564-6452

Elizabeth City Office
504 East Elizabeth St. Suite 2
Elizabeth City, NC 27909
(252) 335-9765

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

Standard Penetration Test (SPT), N-value

Standard Penetration Tests (SPT) were performed in the field in general accordance with ASTM D 1586. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment (4 increments for each soil sample) of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value.

NON COHESIVE SOILS

(SILT, SAND, GRAVEL and Combinations)

Relative Density

Very Loose	4 blows/ft. or less
Loose	5 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	31 to 50 blows/ft.
Very Dense	51 blows/ft. or more

COHESIVE SOILS

(CLAY, SILT and Combinations)

Consistency

Very Soft	2 blows/ft. or less
Soft	3 to 4 blows/ft.
Medium Stiff	5 to 8 blows/ft.
Stiff	9 to 15 blows/ft.
Very Stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

Particle Size Identification

Boulders	8 inch diameter or more	
Cobbles	3 to 8 inch diameter	
Gravel	Coarse	1 to 3 inch diameter
	Medium	$^1/_2$ to 1 inch diameter
	Fine	$^1/_4$ to $^1/_2$ inch diameter
Sand	Coarse	2.00 mm to $^1/_4$ inch (diameter of pencil lead)
	Medium	0.42 to 2.00 mm (diameter of broom straw)
	Fine	0.074 to 0.42 mm (diameter of human hair)
Silt		0.002 to 0.074 mm (cannot see particles)

Relative Proportions

Descriptive Term	Percent
Trace	0-5
Few	5-10
Little	15-25
Some	30-45
Mostly	50-100

Strata Changes

In the column "Description" on the boring log, the horizontal lines represent approximate strata changes.

Groundwater Readings

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as tidal influences and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.).

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

More than 50% retained on No. 200 sieve

GW - Well-graded Gravel
GP - Poorly graded Gravel
GW-GM - Well-graded Gravel w/Silt
GW-GC - Well-graded Gravel w/Clay
GP-GM - Poorly graded Gravel w/Silt
GP-GC - Poorly graded Gravel w/Clay
GM - Silty Gravel
GC - Clayey Gravel
GC-GM - Silty, Clayey Gravel
SW - Well-graded Sand
SP - Poorly graded Sand
SW-SM - Well-graded Sand w/Silt
SW-SC - Well-graded Sand w/Clay
SP-SM - Poorly graded Sand w/Silt
SP-SC - Poorly graded Sand w/Clay
SM - Silty Sand
SC - Clayey Sand
SC-SM - Silty, Clayey Sand

Fine-Grained Soils

50% or more passes the No. 200 sieve

CL - Lean Clay
CL-ML - Silty Clay
ML - Silt
OL - Organic Clay/Silt

Liquid Limit 50% or greater

CH - Fat Clay
MH - Elastic Silt
OH - Organic Clay/Silt

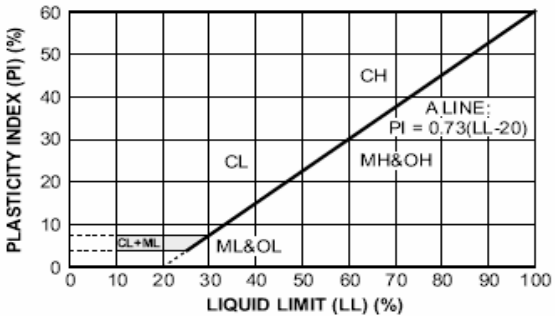
Highly Organic Soils

PT - Peat

Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW,SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

Plasticity Chart



APPENDIX III

BORING LOGS

GET Solutions, Inc.
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BORING LOG B-1

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-27-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)		1	12	SS	1 1 4 4	5	
			Brownish gray, moist, Sandy SILT (ML) with trace Gravel, Clay, marine shell fragments, and organics, FILL, Medium Stiff (2)		2	24	SS	6 5 6 4	11	
			Gray to orangish brown-gray, moist, Clayey, fine to medium SAND (SC) with trace organics, Loose to Medium Dense		3	24	SS	5 5 5 3	10	
	2	5	(6)							
			Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fragments, Loose (8)		4	24	SS	2 3 3 2	6	17
			Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		5	24	SS	3 1 3 3	4	
		10			6	24	SS	2 2 3 4	5	
	4				7	24	SS	2 2 3 4	5	
		15								
	6	20			8	24	SS	3 3 5 8	8	
		25			9	24	SS	2 3 5 5	8	
	8				10	24	SS		4	
		30								
	10				11	24	SS	8 2 4 5	6	
		35								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-1

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-27-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200	TEST RESULTS (Plastic Limit ├┤ Liquid Limit; Moisture Content - ●; N-Value - ▨; 10 20 30 40 50 60 70)
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		12	24	SS	3 4 4 5	8		
	14	45	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose	43	13	4	SS	3 3 5 5	8		
		50			14	24	SS	3 3 4 5	7		
	16	55	Boring terminated at 50 ft.								
	18	60									
	20	65									
	22	70									
		75									

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-2

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-22-2012
DEPTH TO WATER - INITIAL*: 5' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)		1	18	SS	2 3 4 5	7	
			Grayish brown, moist, Silty, fine to medium SAND (SM) with trace Gravel, Clay, organics, FILL, Loose (2)		2	18	SS	5 6 5 8	11	
			Gray, moist, Sandy, Lean CLAY (CL) with trace organics, Stiff (5)		3	18	SS	7 7 6 6	13	
	2	5	Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fragments, Loose to Medium Dense		4	24	SS	4 3 3 3	6	
			(9)		5	24	SS	2 2 3 4	5	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		6	24	SS	3 3 3 5	6	
	4				7	24	SS	2 2 2 3	4	
		15								
	6	20			8	24	SS	2 3 3 5	6	
		25			9	24	SS	2 3 4 5	7	
	8									
		30			10	24	SS	3 2 5 6	7	
	10									
		35			11	24	SS	2 3 3 5	6	

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-2

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-22-2012
DEPTH TO WATER - INITIAL*: 5' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200	TEST RESULTS (Plastic Limit ⊢ Liquid Limit; Moisture Content - •; N-Value - ▨; 10 20 30 40 50 60 70)
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		12	24	SS	2 3 4 5	7		
	14	45			13	24	SS	3 2 3 5	5		
	16	50			14	24	SS	3 3 3 5	6		
	18	55	Boring terminated at 50 ft.								
	20	60									
	22	65									
		70									
		75									

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG B-3

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-22-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			3 Inches of Topsoil (0.25)		1	18	SS	1 1 1 2	2	
			Grayish brown, moist, Silty, fine to medium SAND (SM) with trace organics, FILL, Very Loose (2)		2	24	SS	2 4 4 4	8	32
			Gray and orangish brown, moist, Clayey, fine to medium SAND (SC) with trace Gravel, Possible FILL, Loose (4)		3	24	SS	3 5 5 3	10	
	2	5	Orangish brown, wet, Clayey, fine SAND (SC) with trace marine shell fragments, Loose (6)		4	24	SS	3 3 3 4	6	
			Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fagments, Loose (9)		5	24	SS	2 3 3 4	6	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		6	24	SS	3 3 4 6	7	
	4				7	24	SS	3 3 4 5	7	
		15								
	6	20			8	24	SS	3 5 4 4	9	
		25			9	24	SS	2 3 4 6	7	
	8				10	24	SS	2 3 4 4	7	
		30								
	10				11	24	SS	3 2 3 4	5	
		35								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-3

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-22-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		12	24	SS	2 3 4 4	7	
	14	45			13	24	SS	2 3 4 5	7	
	16	50			14	24	SS	3 3 4 4	7	
	18	55	Boring terminated at 50 ft.							
	20	60								
	22	65								
		70								
		75								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-4

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-22-2012
DEPTH TO WATER - INITIAL*: 7' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			8 Inches of Topsoil (0.67')		1	24	SS	2 3 3 3	6	
			Brown, moist, Sandy, Lean CLAY (CL) with trace Gravel and organics, FILL, Medium Stiff (2)		2	18	SS	3 4 5 6	9	
			Slightly mottled, gray-orangish brown, moist, Sandy, Lean CLAY (CL) with trace Gravel, Medium Stiff to Stiff		3	12	SS	4 5 4 5	9	
	2	5			4	24	SS	4 3 3 3	6	
			Orangish brown, wet, Silty, fine to medium SAND (SM) with trace marine shell fragments, Loose (7)		5	24	SS	2 2 4 4	6	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose (9)		6	24	SS	3 3 5 7	8	
	4				7	24	SS	2 2 4 4	6	
		15								
	6	20			8	24	SS	3 3 3 6	6	
		25			9	24	SS	3 3 5 8	8	
	8									
		30			10	24	SS	3 2 4 4	6	
	10									
		35			11	24	SS	2 3 3 5	6	

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-4

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-22-2012
DEPTH TO WATER - INITIAL*: 7' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200	TEST RESULTS (Plastic Limit ⊢ Liquid Limit; Moisture Content - •; N-Value - ▨; 10 20 30 40 50 60 70)
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		12	24	SS	3 3 3 5	6		
	14	45			13	24	SS	2 2 3 5	5		
		50			14	24	SS	2 3 4 5	7		
	16	55	Boring terminated at 50 ft.								
	18	60									
	20	65									
	22	70									
		75									

Notes:

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

*The initial groundwater reading may not be indicative of the static groundwater level.

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-5

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-23-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)							
			Dark brown, moist, Sandy, Lean CLAY (CL), with trace Gravel and organics, FILL, Stiff (2)		1	18	SS	3 4 5 6	9	
			Brown and orangish brown, moist, Sandy, Lean CLAY (CL) with trace organics, Possible Fill, Stiff (4)		2	24	SS	6 8 6 5	14	
		5	Orangish brown and brown, moist, Clayey, fine to medium SAND (SC) with trace marine shell fragments, "Yorktown Formation", Loose (6)		3	12	SS	3 3 3 2	6	47
	2		Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fragments, Loose		4	24	SS	3 4 3 4	7	
					5	24	SS	3 3 4 5	7	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose (10)		6	24	SS	2 3 3 4	6	
	4				7	24	SS	2 2 3 4	5	
		15								
	6	20			8	24	SS	3 3 5 7	8	
		25			9	24	SS	2 3 4 5	7	
	8									
		30			10	24	SS	2 3 4 4	7	
	10									
		35			11	24	SS	3 3 3 5	6	

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-5

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-23-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		12	24	SS	2 3 4 4	7	
	14	45			13	24	SS	2 3 4 5	7	
		50			14	24	SS	3 2 3 4	5	
	16	55	Boring terminated at 50 ft.							
	18	60								
	20	65								
	22	70								
		75								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-6

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-23-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)		1	12	SS	2 4 3 4	7	
			Brown and gray, moist, Poorly graded GRAVEL (GP) with Sand, FILL, Loose (2)		2	18	SS	6 7 8 8	15	
		5	Grayish brown, moist, Sandy, Lean CLAY (CL) with trace Gravel, organics and marine shell fragments, FILL, Stiff (4)		3	12	SS	6 8 8 7	16	
	2		Dark gray and orangish brown, moist, Clayey, fine to medium SAND (SC) with trace Gravel, FILL, Medium Dense (6)		4	12	SS	6 5 4 2	9	
			Orangish brown, wet, Silty, fine SAND (SM) with trace marine shell fragments, Very Loose (8)		5	24	SS	1 2 2 2	4	24
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		6	24	SS	2 3 3 3	6	
	4				7	24	SS	2 2 3 4	5	
		15								
	6	20			8	24	SS	3 3 5 6	8	
		25			9	24	SS	3 4 5 6	9	
	8									
		30			10	24	SS	3 4 4 4	8	
	10									
		35			11	24	SS	2 2 4 4	6	

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG B-6

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-23-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200	TEST RESULTS (Plastic Limit ⊢ Liquid Limit; Moisture Content - •; N-Value - ▨; 10 20 30 40 50 60 70)
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		12	24	SS	2 2 4 5	6		
	14	45			13	24	SS	2 3 4 4	7		
		47	Gray, wet, Lean CLAY (CL) with Sand and trace marine shell fragments, "Yorktown Formation," Medium Stiff		14	24	SS	2 2 3 4	5		
		50	Boring terminated at 50 ft.								
	16	55									
	18	60									
	20	65									
	22	70									
		75									

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-7

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-23-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)		1	24	SS	2 4 5 5	9	
			Grayish brown and brown, moist, Silty, fine to medium SAND (SM) with trace Gravel, Clay and organics, FILL, Loose (2)		2	24	SS	4 5 6 6	11	
			Dark gray and orangish brown, moist, Clayey, fine to medium SAND (SC), Possible FILL, Medium Dense (4)		3	24	SS	6 8 5 5	13	
	2	5	Mottled, gray and brown, moist to wet, Lean CLAY (CL) with Sand and trace Gravel, Medium Stiff to Stiff		4	24	SS	6 6 5 5	11	
			Wet Below 6 Feet (9)		5	24	SS	1 2 5 6	7	
		10	Brown to gray, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, Loose (10)		6	24	SS	2 3 4 5	7	
	4		Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		7	24	SS	2 3 4 4	7	
		15								
	6	20			8	24	SS	2 4 5 6	9	
		25			9	24	SS	2 2 3 4	5	
	8									
		30			10	24	SS	2 2 3 4	5	
	10									
		35			11	24	SS	2 3 4 5	7	

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-7

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-23-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200	TEST RESULTS (Plastic Limit ⊢ Liquid Limit; Moisture Content - •; N-Value - ▨; 10 20 30 40 50 60 70)
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		12	24	SS	3 3 3 5	6		
	14	45			13	24	SS	3 2 4 4	6		
		50			14	24	SS	2 2 2 5	4		
	16	55	Boring terminated at 50 ft.								
	18	60									
	20	65									
	22	70									
		75									

Notes:

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

*The initial groundwater reading may not be indicative of the static groundwater level.

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-8

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-23-2012
DEPTH TO WATER - INITIAL*: 7' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil							
			.5 Grayish brown, moist, Sandy, Lean CLAY (CL) with trace Gravel and organics, FILL, Medium Stiff		1	24	SS	1 2 4 4	6	
			2 Dark gray, moist, Sandy, Lean CLAY (CL) with trace Gravel, Very Stiff		2	24	SS	7 8 9 9	17	
		5	4 Gray and orangish brown, moist, Clayey, fine to medium SAND (SC) with trace Gravel, Loose to Medium Dense		3	12	SS	6 7 6 5	13	
	2		7 Orangish brown, moist, Silty, fine to medium SAND (SM) with trace Clay and marine shell fragments, Loose		4	24	SS	4 2 3 2	5	
			8 Gray, moist to wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		5	24	SS	3 2 1 3	3	25
		10			6	24	SS	2 3 3 5	6	
	4				7	24	SS	2 2 3 4	5	
		15								
	6	20			8	24	SS	2 3 4 4	7	
		25			9	24	SS	3 3 4 4	7	
	8									
		30			10	24	SS	2 3 3 4	6	
	10									
		35			11	24	SS	2 3 3 5	6	

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG B-8

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-23-2012
DEPTH TO WATER - INITIAL*: 7' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	12	40	Brown to gray, moist to wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		12	24	SS	2 3 3 5	6	
	14	45			13	24	SS	2 3 3 4	6	
		47	Gray, wet, Sandy, Lean CLAY (CL) with trace marine shell fragments, "Yorktown Formation", Soft		14	24	SS	2 2 2 3	4	
	16	50	Boring terminated at 50 ft.							
	18	55								
	20	60								
	22	65								
		70								
		75								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-9

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 5' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			8.75 Inches of Concrete (0.73')		1	12	SS	- - 3 2	5	
			Dark gray, moist, Sandy, Lean CLAY (CL) with trace Gravel, Possible FILL, Soft to Stiff (2.5')		2	18	SS	4 5 4 4	9	
			Brown to orangish brown, moist, Clayey, fine to medium SAND (SC) with trace Gravel, Loose (5)		3	24	SS	3 3 2 3	5	
	2	5	Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fragments and trace Clay, Loose		4	24	SS	3 2 3 5	5	
			(9)		5	24	SS	3 2 3 3	5	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		6	24	SS	2 3 3 4	6	
	4				7	24	SS	2 3 2 4	5	
		15								
	6	20			8	24	SS	2 3 4 5	7	
		25			9	24	SS	3 2 4 5	6	
	8		(27)							
			Gray, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, "Yorktown Formation," Loose		10	24	SS	2 3 4 5	7	
		30								
	10		(32) Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		11	24	SS	2 3 4 5	7	
		35								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-9

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-24-2012
DEPTH TO WATER - INITIAL*: 5' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	12	40	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		12	24	SS	3 3 4 6	7	
		42	Gray, wet, Clayey, fine SAND (SC) with little marine shell fragments, "Yorktown Formation," Loose		13	24	SS	3 3 4 5	7	
	14	45								
		47	Gray, wet, Lean CLAY (CL) with Sand and little marine shell fragments, "Yorktown Formation," Medium Stiff		14	24	SS	3 3 4 5	7	
		50	Boring terminated at 50 ft.							
	16	55								
	18	60								
	20	65								
	22	70								
		75								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-10

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-24-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)		1	18	SS	2 3 3 3	6	
			Dark gray, moist, Sandy, Lean CLAY (CL) with trace Gravel, Possible Fill, Medium Stiff (2)		2	18	SS	3 5 6 8	11	
			Slightly mottled, dark gray-brown, moist, Sandy, Lean CLAY (CL) with trace Gravel, Stiff (4)		3	24	SS	8 6 5 3	11	
	2	5	Orangish brown, moist, Lean CLAY (CL) with Sand and little Gravel, Stiff (6)		4	18	SS	3 2 1 3	3	33
			Orangish brown, wet, Clayey, fine to medium SAND (SC) with trace marine shell fragments, Very Loose (8)		5	24	SS	3 3 3 3	6	
		10	Orangish brown, wet, Silty, fine to medium SAND (SM) with trace marine shell fragments, Loose (11)		6	24	SS	2 3 4 4	7	
	4		Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Very Loose to Loose		7	24	SS	3 2 2 4	4	
		15								
	6	20			8	24	SS	3 3 4 5	7	
		25			9	24	SS	3 2 5 5	7	
	8									
		30			10	24	SS	3 3 4 5	7	
	10		Gray, wet, Clayey, fine SAND (SC) with trace marine shell fragments, "Yorktown Formation," Loose (32)							
		35			11	24	SS	2 3 3 5	6	
			(37)							

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG B-10

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia **PROJECT NO.:** WM11-175G
BORING LOCATION: See Attached Boring Location Plan **SURFACE ELEVATION:**
DRILLER: GET Solutions Inc. **LOGGED BY:** (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling **DATE:** 2-24-2012
DEPTH TO WATER - INITIAL*: 6' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	12	40	Gray, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, "Yorktown Formation," Loose Gray, wet, Clayey, fine SAND (SC) with trace marine shell fragments, "Yorktown Formation," Loose		12	24	SS	3 3 3 5	6	
	14	45			13	24	SS	2 3 4 4	7	
		47	Gray, wet, Lean CLAY (CL) with Sand and trace marine shell fragments, "Yorktown Formation," Medium Stiff		14	24	SS	4 4 4 5	8	
	16	50	Boring terminated at 50 ft.							
	18	55								
	20	60								
	22	65								
		70								
		75								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG SW-1

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			4 Inches of Topsoil (0.33)		1	24	SS	2 3 4 3	7	
			Dark gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel and marine shell fragments, FILL, Loose (1)		2	12	SS	3 4 5 3	9	
			Dark gray and orangish brown, moist, Clayey, fine to medium SAND (SC) with trace Gravel, Loose (4)							
		5	Orangish brown, wet, Sandy, Lean CLAY (CL), Soft (6)		3	18	SS	5 2 2 2	4	62
	2		Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fragments and trace Clay, Loose		4	24	SS	2 3 3 4	6	
					5	24	SS	3 4 5 5	9	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose (10)		6	24	SS	5 5 5 6	10	
	4				7	24	SS	4 4 4 6	8	
		15	Boring terminated at 15 ft.							
	6	20								
		25								
	8									
		30								
	10									
		35								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG SW-2

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			6 Inches of Topsoil (0.5)							
			Brown and dark gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel, organics, and marine shell fragments, FILL, Loose (2)		1	18	SS	3 3 4 8	7	
			Dark gray and brown, moist, Clayey, fine to medium SAND (SC) with trace organics, Possible Fill, Medium Dense (4)		2	24	SS	5 5 6 5	11	
		5	Orangish brown and dark gray, wet, Sandy, Lean CLAY (CL) with trace organics and marine shell fragments, Stiff (6)		3	18	SS	3 6 5 6	11	
	2		Orangish brown, moist, Silty, fine to medium SAND (SM) with marine shell fragments and trace Clay, Very Loose		4	24	SS	2 2 2 3	4	
					5	24	SS	2 2 2 3	4	
		10	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose (10)		6	24	SS	3 4 4 7	8	
	4		Gray, wet, Clayey, fine to medium SAND (SC) with trace marine shell fragments, "Yorktown Formation," Loose (12)		7	24	SS	3 3 3 5	6	
		15	Boring terminated at 15 ft.							
	6	20								
		25								
	8									
		30								
	10									
		35								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG
CBR-1

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0	6 Inches of Topsoil							
			Grayish brown, moist, Clayey, fine to medium SAND (SC), FILL, Loose (0.5)		1	24	SS	2 3 4 4	7	
	0.8	2	Gray, moist, Sandy, Lean CLAY (CL) with trace Gravel and marine shell fragments, Stiff (2)		2	24	SS	5 5 6 4	11	
	1.6	4	Orangish brown, wet, Silty, fine SAND (SM) with marine shell fragments and trace Clay, Loose (4)		3	24	SS	6 5 3 2	8	
	2.4	6			4	24	SS	3 2 3 4	5	
		8			5	24	SS	2 3 4 5	7	
	3.2	10	Boring terminated at 10 ft.							
	4	12								
		14								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG
CBR-2

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)redacted
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0	6 Inches of Topsoil							
		.5	Dark brown and dark gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel and organics, FILL, Medium Stiff		1	24	SS	1 3 5 5	8	
	0.8	2	Slightly mottled, brown-dark gray, moist, Sandy, Lean CLAY (CL) with some Gravel, Very Stiff		2	18	SS	7 8 10 7	18	
	1.6	4	Orangish brown and gray, wet, Clayey, fine SAND (SC) with trace marine shell fragments, Loose		3	24	SS	5 6 3 3	9	
	2.4	6	Orangish brown, wet, Clayey, fine to medium SAND (SC) with marine shell fragments, Loose		4	24	SS	3 3 2 3	5	
	3.2	8	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose		5	24	SS	4 3 5 5	8	
	4	10	Boring terminated at 10 ft.							
		12								
		14								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

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BORING LOG
CBR-3

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0	3 Inches of Asphalt (0.25)							
			Gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel and organics, FILL, Loose		1	12	SS	- 4 3 3	7	
	0.8	2	Orangish brown and gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel, Medium Dense (2.5)		2	18	SS	4 6 5 4	11	
	1.6	4	Brown, wet, Sandy, Lean CLAY (CL), Medium Stiff (4)		3	18	SS	5 4 4 3	8	
	2.4	6	Orangish brown, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, Loose (6)		4	24	SS	3 3 2 2	5	
	3.2	8	Gray, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, "Yorktown Formation," Loose (8)		5	24	SS	2 2 4 5	6	
	4	10	Boring terminated at 10 ft.							
		12								
		14								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG
CBR-4

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			3 Inches of Asphalt (0.25)							
			18 Inches of Aggregate Base (1.75)		1	12	SS	- - - -	-	
		2	Gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel, FILL, Medium Dense (2.5)							
	0.8		Gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel, Medium Dense (4)		2	18	SS	3 6 7 3	13	
		4 ▽	Orangish brown, wet, Clayey, fine SAND (SC) with little marine shell fragments, Loose (6)		3	18	SS	4 3 2 2	5	
	1.6	6	Orangish brown, wet, Silty, fine to medium SAND (SM) with marine shell fragments, Loose (9)		4	24	SS	4 2 3 4	5	
	2.4	8	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose (10)		5	24	SS	3 4 5 6	9	
	3.2	10	Boring terminated at 10 ft.							
		12								
	4									
		14								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
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BORING LOG
CBR-5

PROJECT: Measurement Systems Laboratory - NASA Langley Research Center
CLIENT: AECOM
PROJECT LOCATION: Hampton, Virginia
PROJECT NO.: WM11-175G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION:
DRILLER: GET Solutions Inc.
LOGGED BY: (b) (6)
DRILLING METHOD: Rotary Wash "Mud" Drilling
DATE: 2-24-2012
DEPTH TO WATER - INITIAL*: 4' **AFTER 24 HOURS:** NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N-Value	% < #200
	0	0								
			2 Inches of Asphalt (0.17)							
			12 Inches of Aggregate Base Material (1.17)		1	6	SS	- 4 5 3	9	
			Dark gray, moist, Clayey, fine to medium SAND (SC) with trace Gravel and organics, FILL, Loose							
		2	Slightly mottled, dark gray-brown, moist to wet, Lean CLAY (CL) with Sand and trace Gravel, Medium Stiff to Stiff		2	24	SS	3 4 5 2	9	
	0.8	4	Wet Below 4 Feet		3	6	SS	3 3 2 2	5	
	1.6		Orangish brown, wet, Clayey, fine to medium SAND (SC) with marine shell fragments, Loose		4	24	SS	2 3 3 4	6	
	2.4	8			5	24	SS	3 3 3 5	6	
			Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, "Yorktown Formation," Loose							
		10	Boring terminated at 10 ft.							
	3.2									
		12								
	4									
		14								

TEST RESULTS
Plastic Limit ├┤ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes:

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
204 Grayson Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID SB-1

PROJECT NAME: Measurement Systems Laboratory
CLIENT: AECOM
PROJECT LOCATION: Hampton, VA
BORING LOCATION: See Attached Boring Location Plan
DRILLING METHOD(S): Rotary wash "mud"
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: WM11-175G
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: 4/28/2014
DATE COMPLETED: 4/28/2014
DRILLER: GET Solutions, Inc.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.3	4-in Topsoil					
		Brown, moist, Silty fine to medium SAND (SM) with trace Gravel, organics and marine shell fragments, loose "Fill"	1	SS	20	2-3-4-4 (7)	
	2.0	Dark gray, moist, Sandy lean CLAY (CL), stiff Pocket Penetrometer= 2.0 tons/ft^2	2	SS	22	5-5-7-8 (12)	
	4.0	Mottled, gray and orange-brown, Sandy lean CLAY (CL), stiff Pocket Penetrometer= 1.5 tons/ft^2	3	SS	24	6-7-6-7 (13)	
▽	6.0	Light brown, wet, Silty fine to medium SAND (SM) with marine shell fragments and trace Clay, loose	4	SS	24	4-4-3-3 (7)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with varying amounts of marine shell fragments, very loose to loose "Yorktown Formation"	5	SS	24	1-2-2-3 (4)	
			6	SS	24	2-3-4-6 (7)	
			7	SS	24	2-2-4-5 (6)	
			8	SS	24	3-4-4-7 (8)	
	21.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"	9	SS	24	2-3-4-5 (7)	
			10	SS	24	2-2-3-4 (5)	

Depth (E): 5, 10, 15, 20, 25, 30

TEST RESULTS
Plastic Limit ✕——✕ Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
204 Grayson Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID SB-1

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **4/28/2014**
DATE COMPLETED: **4/28/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation" *(layer continued from previous page)*					
	31.5	Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"					
			11	SS	24	1-3-2-5 (5)	
	35						
			12	SS	24	2-2-4-5 (6)	
	40						
			13	SS	24	2-4-4-5 (8)	
	45						
	46.5	Gray, wet, lean CLAY (CL) with Sand and trace marine shell fragments, medium stiff "Yorktown Formation"					
		Pocket Penetrometer= 2.25 tons/ft^2	14	SS	24	2-3-3-5 (6)	78
	50						
	51.5	Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose "Yorktown Formation"					
			15	SS	24	2-2-3-5 (5)	
	55						
			16	SS	24	2-2-4-11 (6)	
	60						

TEST RESULTS
Plastic Limit ×——× Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
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106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID SB-1

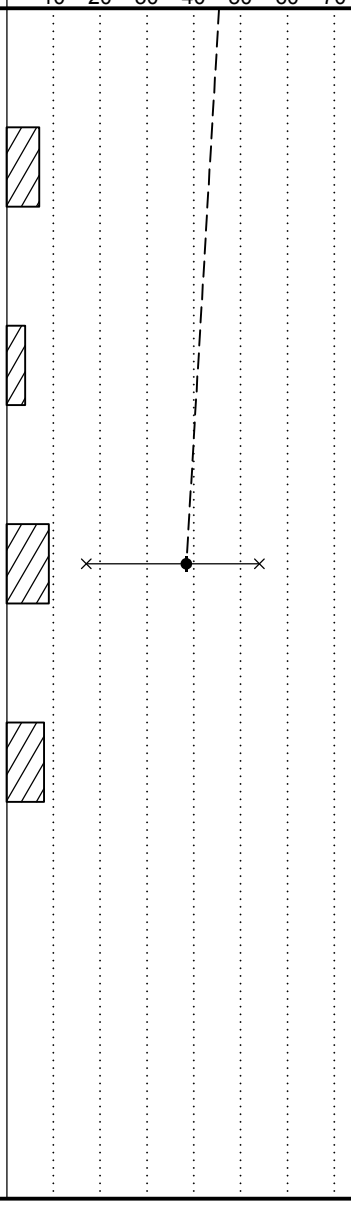
PROJECT NAME: **Measurement Systems Laboratory**
PROJECT NUMBER: **WM11-175G**
CLIENT: **AECOM**
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: **Hampton, VA**
LOGGED BY: (b) (6)
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **4/28/2014**
DRILLING METHOD(S): **Rotary wash "mud"**
DATE COMPLETED: **4/28/2014**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: **GET Solutions, Inc.**

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose "Yorktown Formation" *(layer continued from previous page)*					
	61.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"					
			17	X	24	2-3-4-4 (7)	
	65						
			18	X	24	2-2-2-4 (4)	
	70						
	71.5	Gray, wet, fat CLAY (CH) with trace Sand, medium stiff to stiff "Yorktown Formation"					
		Pocket Penetrometer= 2.75 tons/ft^2	19	X	24	2-4-5-7 (9)	96
	75						
		Pocket Penetrometer= 2.5 tons/ft^2	20	X	24	2-3-5-8 (8)	
	80.0	Boring terminated at 80 feet below existing grade.					
	80						

TEST RESULTS

Plastic Limit ×——× Liquid Limit
Water Content - ●
Penetration - ▨



Sample Type(s):

X SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
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106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID SB-2

PROJECT NAME: Measurement Systems Laboratory
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, VA
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 4/28/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 4/28/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.5	6-in Topsoil					
		Brown, moist, Clayey fine to medium SAND (SC) with trace organics and marine shell fragments, loose "Fill"	1	SS	18	1-3-4-8 (7)	
	2.0	Mottled, gray and orange-brown, moist, Sandy lean CLAY (CL), stiff Pocket Penetrometer= 4.0 tons/ft^2	2	SS	24	4-6-8-10 (14)	
	5	Pocket Penetrometer= 3.5 tons/ft^2	3	SS	20	8-6-7-6 (13)	
▽	6.0	Orange-brown to light brown, wet, Silty fine to medium SAND (SM) with marine shell fragments and trace Clay, loose	4	SS	24	3-2-3-3 (5)	
			5	SS	24	2-4-4-5 (8)	
	10	10.0 Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"	6	SS	24	2-4-3-7 (7)	
			7	SS	24	2-3-2-3 (5)	
	15						
			8	SS	24	3-4-6-8 (10)	
	20	21.5 Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"					
			9	SS	24	3-3-6-6 (9)	
	25						
	30		10	SS	24	2-3-4-5 (7)	

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID SB-2

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **4/28/2014**
DATE COMPLETED: **4/28/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation" *(layer continued from previous page)*					
	31.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"					
			11	SS	24	2-2-3-4 (5)	
	35						
			12	SS	24	2-3-5-7 (8)	
	40						
	41.5	Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"					
			13	SS	24	3-4-5-6 (9)	
	45						
	46.5	Gray, wet, Clayey fine to medium SAND (SC) with trace marine shell fragments, loose "Yorktown Formation"					
			14	SS	24	3-3-4-5 (7)	48
	50						
			15	SS	24	2-3-4-6 (7)	
	55						
	56.5	Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, medium dense "Yorktown Formation"					
			16	SS	24	3-4-8-10 (12)	43
	60						

TEST RESULTS
Plastic Limit ×——× Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID SB-2

PROJECT NAME: **Measurement Systems Laboratory**
PROJECT NUMBER: **WM11-175G**
CLIENT: **AECOM**
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: **Hampton, VA**
LOGGED BY: (b) (6)
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **4/28/2014**
DRILLING METHOD(S): **Rotary wash "mud"**
DATE COMPLETED: **4/28/2014**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: **GET Solutions, Inc.**

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, medium dense "Yorktown Formation" *(layer continued from previous page)*					
	61.5	Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"					
	65		17	SS	24	3-3-4-5 (7)	
	70		18	SS	24	2-3-3-5 (6)	
	71.5	Gray, wet, fat CLAY (CH), stiff "Yorktown Formation"					
	75	Pocket Penetrometer= 4.0 tons/ft^2	19	SS	24	3-5-6-8 (11)	
	80	Pocket Penetrometer= 3.75 tons/ft^2	20	SS	24	3-4-6-9 (10)	
	80.0	Boring terminated at 80 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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BORING ID SB-3

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **5.5** AFTER ____ HOURS (E) ▼: ____ CAVE-IN (E) ◌: ____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ____
LOGGED BY: (b) (6)
DATE STARTED: **4/29/2014**
DATE COMPLETED: **4/29/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.5	6-in Topsoil					
		Dark gray, moist, Sandy lean CLAY (CL) with trace Gravel and organics, medium stiff	1	SS	20	1-2-3-5 (5)	
	2.0	Pocket Penetrometer= 2.25 tons/ft^2					
		Mottled, gray and orange-brown, moist, Clayey fine to medium SAND (SC) with trace gravel, loose to medium dense	2	SS	18	4-6-8-6 (14)	
▽ 5	5.5		3	SS	24	3-2-3-3 (5)	
		Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments and trace Clay, very loose to loose	4	SS	24	3-2-2-4 (4)	
			5	SS	24	2-4-5-5 (9)	
10	10.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"	6	SS	24	3-4-6-6 (10)	
			7	SS	24	2-3-5-7 (8)	
15	16.5	Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose to medium dense "Yorktown Formation"					
			8	SS	24	3-5-8-10 (13)	
20							
			9	SS	24	3-3-5-8 (8)	
25							
30			10	SS	24	3-3-6-7 (9)	

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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BORING ID
SB-3

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **5.5** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **4/29/2014**
DATE COMPLETED: **4/29/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose to medium dense "Yorktown Formation" *(layer continued from previous page)*					
			11	SS	24	3-3-4-6 (7)	
	35						
	36.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"					
			12	SS	24	2-3-5-5 (8)	
	40						
			13	SS	24	3-3-5-7 (8)	
	45						
			14	SS	24	2-2-4-4 (6)	
	50						
			15	SS	24	2-2-4-6 (6)	
	55						
	56.5	Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose to medium dense "Yorktown Formation"					
			16	SS	24	3-5-8-10 (13)	
	60						

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

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BORING ID SB-3

PROJECT NAME: **Measurement Systems Laboratory**
PROJECT NUMBER: **WM11-175G**
CLIENT: **AECOM**
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: **Hampton, VA**
LOGGED BY: (b) (6)
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **4/29/2014**
DRILLING METHOD(S): **Rotary wash "mud"**
DATE COMPLETED: **4/29/2014**
GROUNDWATER*: INITIAL (E) ▽: **5.5** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: **GET Solutions, Inc.**

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS (Plastic Limit ×——× Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70)
		Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose to medium dense "Yorktown Formation" *(layer continued from previous page)*							
	61.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"							
				17	X	24	3-3-6-6 (9)		
	65								
				18	X	24	2-3-4-5 (7)		
	70								
	71.5	Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose "Yorktown Formation"							
				19	X	24	2-3-7-10 (10)		
	75								
				20	X	24	3-4-5-8 (9)		
	80	80.0 Boring terminated at 80 feet below existing grade.							

Sample Type(s):
X SS - Split Spoon

Notes:

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BORING ID SB-4

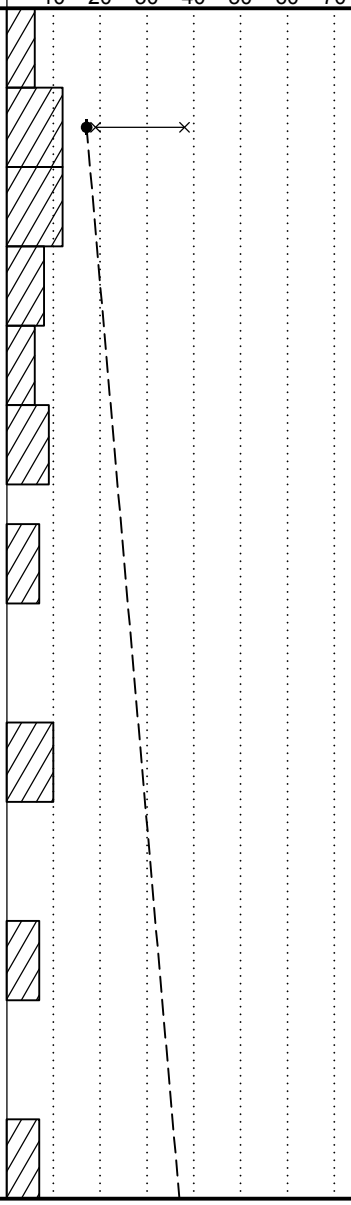
PROJECT NAME: **Measurement Systems Laboratory**
PROJECT NUMBER: **WM11-175G**
CLIENT: **AECOM**
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: **Hampton, VA**
LOGGED BY: (b) (6)
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **4/29/2014**
DRILLING METHOD(S): **Rotary wash "mud"**
DATE COMPLETED: **4/29/2014**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: **GET Solutions, Inc.**

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.7	8-in Topsoil					
		Dark gray, moist, Clayey fine to medium SAND (SC) with trace Gravel, loose	1	SS	24	1-2-4-4 (6)	
	2.0	Mottled, gray and orange-brown, Sandy lean CLAY (CL) with trace Gravel, stiff Pocket Penetrometer= 2.25 tons/ft^2	2	SS	20	5-6-6-7 (12)	57
	5	Pocket Penetrometer= 2.0 tons/ft^2	3	SS	20	7-7-5-4 (12)	
▽	6.0	Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments and trace Clay, loose	4	SS	24	3-4-4-5 (8)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"	5	SS	24	1-3-3-6 (6)	
	10		6	SS	24	2-4-5-6 (9)	
			7	SS	24	2-3-4-6 (7)	
	15						
	16.5	Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"					
			8	SS	24	3-4-6-8 (10)	
	20						
			9	SS	24	2-3-4-6 (7)	
	25						
			10	SS	24	2-3-4-6 (7)	
	30						

TEST RESULTS

Plastic Limit ×——× Liquid Limit
Water Content - ●
Penetration - ▨



Sample Type(s):

SS - Split Spoon

Notes:

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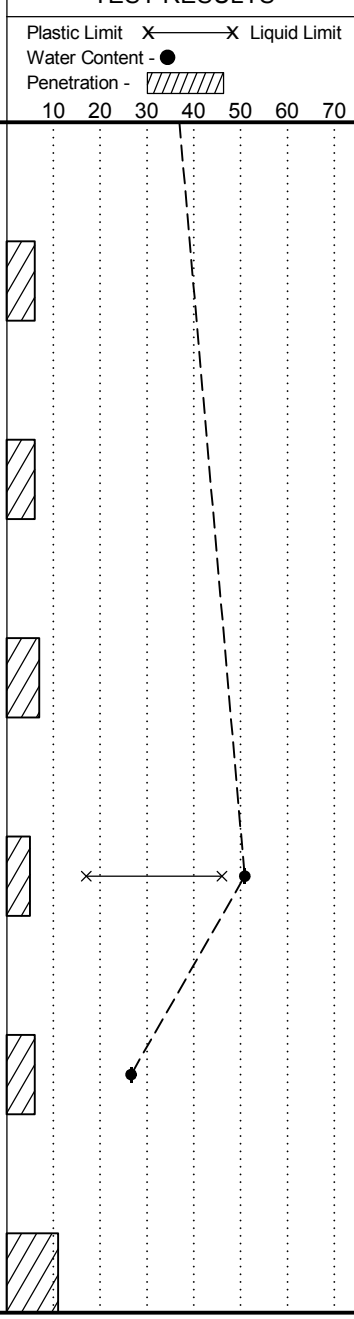
BORING ID SB-4

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **4/29/2014**
DATE COMPLETED: **4/29/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose "Yorktown Formation" *(layer continued from previous page)*					
	35		11	X	24	2-2-4-5 (6)	
	40		12	X	24	2-2-4-5 (6)	
	41.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"					
	45		13	X	24	2-3-4-6 (7)	
	46.5	Gray, wet, lean CLAY (CL) with Sand and trace marine shell fragments, medium stiff Pocket Penetrometer= 1.5 tons/ft^2	14	X	24	1-2-3-4 (5)	75
	50						
	51.5	Gray, wet, Silty fine to medium SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"					
	55		15	X	24	1-2-4-5 (6)	20
	60		16	X	24	3-4-7-9 (11)	

TEST RESULTS



Sample Type(s):
SS - Split Spoon

Notes:

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BORING ID SB-4

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **4/29/2014**
DATE COMPLETED: **4/29/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS (Plastic Limit ×——× Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70)
	61.5	Gray, wet, Silty fine to medium SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation" *(layer continued from previous page)*							
		Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, very loose to loose "Yorktown Formation"		17	X	24	2-3-4-6 (7)		
	65								
				18	X	24	2-2-2-3 (4)		
	70								
	71.5	Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose "Yorktown Formation"							
				19	X	24	2-2-3-8 (5)		
	75								
				20	X	24	3-3-4-7 (7)		
	80	80.0 Boring terminated at 80 feet below existing grade.							

Sample Type(s):
X SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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BORING ID SB-5

PROJECT NAME: Measurement Systems Laboratory
CLIENT: AECOM
PROJECT LOCATION: Hampton, VA
BORING LOCATION: See Attached Boring Location Plan
DRILLING METHOD(S): Rotary wash "mud"
GROUNDWATER*: INITIAL (E) ▽: 7 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: WM11-175G
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: 5/1/2014
DATE COMPLETED: 5/1/2014
DRILLER: GET Solutions, Inc.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.3	4-in Aggregate Base Material					
	1.5	Brown, moist, Silty fine to medium SAND (SM), medium dense "Fill"	1	SS	20	4-4-7-7 (11)	
	2.0	Dark gray, moist, Clayey fine to medium SAND (SC) with trace fine Gravel and organics, medium dense "Fill"	2	SS	12	14-7-6-7 (13)	
	4.0	Mottled, orange-brown and gray-brown, moist, Clayey fine to medium SAND (SC) with trace fine Gravel, medium dense "Possible Fill"	3	SS	22	5-4-6-5 (10)	54
5		Orange-brown, moist, Sandy lean CLAY (CL), medium stiff to stiff					
▽	7.0	Pocket Penetrometer= 1.0 tons/ft^2	4	SS	24	4-3-3-3 (6)	
		Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments, loose	5	SS	24	2-3-2-3 (5)	
10	10.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose to medium dense "Yorktown Formation"	6	SS	24	2-3-3-4 (6)	
			7	SS	24	3-2-5-6 (7)	
15							
			8	SS	24	2-3-5-6 (8)	
20							
			9	SS	24	2-4-5-6 (9)	
25							
			10	SS	24	3-4-7-8 (11)	
30							

TEST RESULTS
Plastic Limit ×——× Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

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BORING ID SB-5

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **7** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **5/1/2014**
DATE COMPLETED: **5/1/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS (Plastic Limit ×——× Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70)
		Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose to medium dense "Yorktown Formation" *(layer continued from previous page)*							
				11	SS	24	4-4-5-7 (9)		
	35								
				12	SS	24	3-3-6-7 (9)		
	40								
				13	SS	24	4-5-6-8 (11)		
	45								
	46.5	Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose to medium dense "Yorktown Formation"							
				14	SS	24	3-4-4-5 (8)		
	50								
				15	SS	24	3-3-4-7 (7)		
	55								
				16	SS	24	4-6-9-11 (15)		
	60								

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID
SB-5

PROJECT NAME: **Measurement Systems Laboratory**
CLIENT: **AECOM**
PROJECT LOCATION: **Hampton, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (E) ▽: **7** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM11-175G**
SURFACE ELEVATION (MSL) (E): ___
LOGGED BY: (b) (6)
DATE STARTED: **5/1/2014**
DATE COMPLETED: **5/1/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS (Plastic Limit ×——× Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70)
		Gray, wet, Silty fine SAND (SM) with trace marine shell fragments, loose to medium dense "Yorktown Formation" *(layer continued from previous page)*							
	61.5	Gray, wet, Silty fine SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"							
				17	X	24	3-4-6-8 (10)		
	65								
				18	X	24	3-3-6-6 (9)		
	70								
				19	X	24	2-2-3-4 (5)		
	75								
	76.5	Gray, wet, Clayey fine SAND (SC) with trace marine shell fragments, loose "Yorktown Formation"							
				20	X	24	3-4-6-9 (10)		
	80	80.0 Boring terminated at 80 feet below existing grade.							

Sample Type(s):
X SS - Split Spoon

Notes:

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BORING ID INF-1

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/1/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/1/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER 24 HOURS (E) ▼: 4 CAVE-IN (E) ◌:
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		6-in Topsoil (0.5)					
		Dark brown, moist, Clayey fine to medium SAND (SC) with trace Gravel and organics, medium dense "Fill" (2.0)	1	SS	15	3-5-7-6 (12)	35
		Mottled, dark gray and orange-brown, moist to wet, Sandy lean CLAY (CL), medium stiff to stiff Pocket Penetrometer= 1.5 tons/ft^2	2	SS	20	2-4-6-7 (10)	67
▼		Wet below 4 ft					
	5	Pocket Penetrometer= 1.25 tons/ft^2 (5.5)	3	SS	18	3-3-4-6 (7)	
▽		Brown and orange-brown, wet, Clayey fine to medium SAND (SC) with trace Gravel and marine shell fragments, loose (6.0)					
		Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments, loose (8.0)	4	SS	24	2-4-5-8 (9)	
		Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation" (10.0)	5	SS	24	2-5-5-8 (10)	
	10	Boring terminated at 10 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID INF-2

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.3	4-in Topsoil					
		Brown, moist, Clayey fine to medium SAND (SC) with trace Gravel, organics and asphalt fragments, very loose "Fill"	1	SS	17	2-2-3-3 (5)	30
			2	SS	3	1-2-2-3 (4)	30
	4.0	Brown, moist, Silty fine to medium SAND (SM) with trace Gravel, loose "Fill"	3	SS	12	1-2-4-3 (6)	
	5.0	Orange-brown to brown, moist to wet, Silty fine to medium SAND (SM) with marine shell fragments, loose					
▽	5	Wet below 6 ft.	4	SS	24	2-3-4-4 (7)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"	5	SS	24	2-3-4-6 (7)	
	10	10.0 Boring terminated at 10 feet below existing grade.					

TEST RESULTS

Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨

10 20 30 40 50 60 70

Sample Type(s):

SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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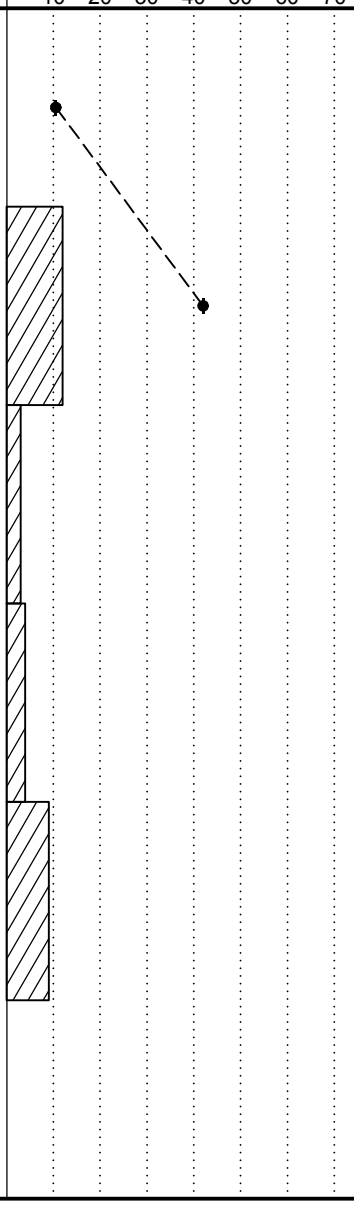
BORING ID INF-3

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER 24 HOURS (E) ▼: 5.5 CAVE-IN (E) ◌:
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.1	1.5-in Asphalt						
	0.7	7-in Aggregate Base Material						
		Brown, moist, Clayey fine to medium SAND (SC) with Gravel, loose "Fill"		1		6	5-3	21
	2.0	Orange-brown, moist, Sandy lean CLAY (CL) with trace Gravel, stiff Pocket Penetrometer= 3.0 tons/ft^2		2		24	3-4-8-6 (12)	56
	4.0	Orange-brown, moist to wet, Clayey fine to medium SAND (SC), very loose Wet below 5.5 ft		3		24	3-2-1-1 (3)	
5	6.0	Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments and trace Clay, very loose		4		24	2-2-2-3 (4)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"		5		24	3-4-5-7 (9)	
10	10.0	Boring terminated at 10 feet below existing grade.						

TEST RESULTS



Sample Type(s):
SS - Split Spoon

Notes:

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BORING ID INF-4

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		8-in Asphalt (0.7)					
		14.5-in Aggregate Base Material (1.9)	1	SS	0		
		Mottled, orange-brown and gray, moist, Sandy lean CLAY (CL), medium stiff Pocket Penetrometer= 3.0 tons/ft^2 (4.0)	2	SS	18	3-4-3-4 (7)	56
		Orange-brown, moist to wet, Silty fine to medium SAND (SM) with marine shell fragments, loose	3	SS	18	2-3-3-3 (6)	
	5	Wet below 6 ft (8.0)	4	SS	24	1-2-3-2 (5)	
		Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation" (10.0)	5	SS	24	1-3-3-4 (6)	
	10	Boring terminated at 10 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID INF-5

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER 24 HOURS (E) ▼: 5 CAVE-IN (E) ◌:
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS (Plastic Limit ×——× Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70)
		0.2 2.5-in Asphalt; 0.4 2.5-in Aggregate Base Material; Gray, moist, Silty fine to medium SAND (SM) with Gravel and trace Clay, medium dense "Fill"		1	SS	3	5-6-8-5 (14)	22	
		2.0 No Recovery		2	SS	0	4-5-3-3 (8)		
		4.0 Mottled, orange-brown and gray, moist, Sandy lean CLAY (CL), medium stiff; Pocket Penetrometer= 2.25 tons/ft^2		3	SS	8	1-3-3-2 (6)		
▼	5	5.0 Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments, loose							
▽		6.0 Orange-brown, wet, Clayey fine to medium SAND (SC) with marine shell fragments, loose		4	SS	24	4-4-3-3 (7)		
		8.0 Gray, wet, Silty fine to medium SAND (SM) with trace Clay and marine shell fragments, loose "Yorktown Formation"		5	SS	24	2-4-6-7 (10)		
	10	10.0 Boring terminated at 10 feet below existing grade.							

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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BORING ID INF-6

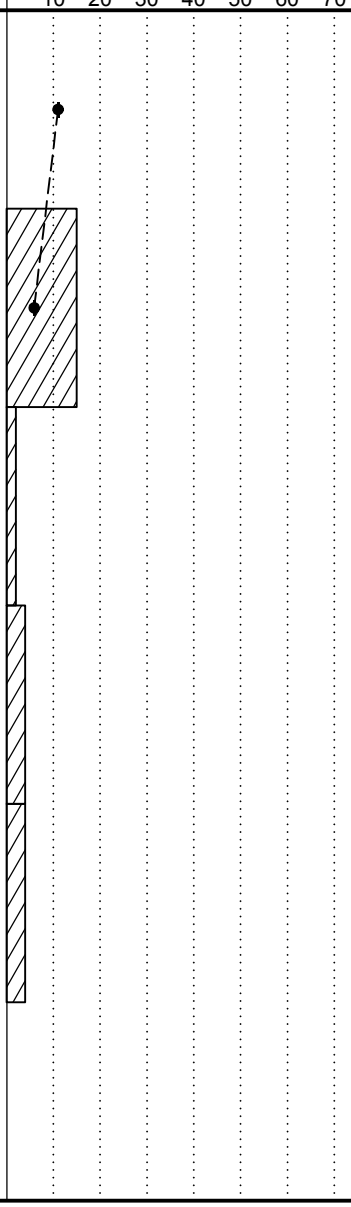
PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 6 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.2	2-in Asphalt					
	0.7	6-in Aggregate Base Material					
		Gray, moist, Clayey fine to medium SAND (SC) with trace Gravel and organics, very loose	1	SS	6	2-4	44
	2.0						
		Gray, moist, Clayey fine to medium SAND (SC) with trace Gravel, medium dense	2	SS	8	4-6-9-7 (15)	20
	4.0						
		No Recovery	3	SS	0	2-1-1-2 (2)	
5							
▽	6.0						
		Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments, very loose	4	SS	24	2-2-2-3 (4)	
	9.0		5	SS	24	1-1-3-5 (4)	
		Gray, wet, Silty fine to medium SAND (SM) with marine shell fragments, very loose "Yorktown Formation"					
10	10.0						
		Boring terminated at 10 feet below existing grade.					

TEST RESULTS

Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨



Sample Type(s):

SS - Split Spoon

Notes:

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BORING ID INF-7

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 5 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.2	2-in Asphalt					
	0.4	3-in Aggregate Base Material					
		Gray, moist, Silty fine to medium SAND (SM) with trace Gravel and Clay, very loose	1	SS	12	1-3-4 (4)	18
	2.0	Gray to orange-brown, moist, Sandy lean CLAY (CL) with trace Gravel, stiff Pocket Penetrometer= 3.0 tons/ft^2	2	SS	6	4-5-4-6 (9)	
	4.0	Orange-brown, moist to wet, Clayey fine to medium SAND (SC) with marine shell fragments, very loose Wet below 5 ft	3	SS	10	3-2-2-2 (4)	
▽	5						
	6.0	Orange-brown, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, very loose	4	SS	20	1-2-1-2 (3)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"	5	SS	24	1-2-3-4 (5)	
	10	10.0 Boring terminated at 10 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID INF-8

PROJECT NAME: **Measurement Systems Laboratory - NASA Langley Research Center**
PROJECT NUMBER: **WM11-175G**
CLIENT: **AECOM**
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: **Hampton, Virginia**
LOGGED BY: (b) (6)
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **5/2/2014**
DRILLING METHOD(S): **Rotary wash "mud"**
DATE COMPLETED: **5/2/2014**
GROUNDWATER*: INITIAL (E) ▽: **6** AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: **GET Solutions, Inc.**

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
		7-in Aggregate Base Material (0.6)					
		Brown-gray, moist, Clayey fine to medium SAND (SC) with trace Gravel, loose to medium dense	1	SS	6	3-5	45
			2	SS	12	7-8-7-5 (15)	
		(4.0) Brown and gray, moist to wet, Silty fine to medium SAND (SM) with trace Clay and marine shell fragments, very loose to loose	3	SS	16	4-2-2-2 (4)	
	5	Wet below 6 ft	4	SS	24	2-2-3-4 (5)	
		(8.0) Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, medium dense "Yorktown Formation"	5	SS	24	3-4-7-7 (11)	
	10	(10.0) Boring terminated at 10 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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BORING ID INF-9

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 5 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ▽: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.2	2-in Asphalt					
	0.4	2.5-in Aggregate Base Material					
		Gray, moist, Clayey fine to medium SAND (SC) with trace Gravel, very loose to loose	1	SS	8	1-2-3 (3)	
			2	SS	24	2-3-4-4 (7)	39
	4.0	Gray to orange-brown, moist to wet, Sandy lean CLAY with trace gravel, medium stiff					
▽	5	Wet below 5 ft Pocket Penetrometer= 2.25 tons/ft^2	3	SS	8	5-4-3-3 (7)	
	6.0	Orange-brown, wet, Silty fine to medium SAND (SM) with marine shell fragments, loose	4	SS	24	2-3-3-3 (6)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, loose "Yorktown Formation"	5	SS	24	1-2-3-6 (5)	
	10	10.0 Boring terminated at 10 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

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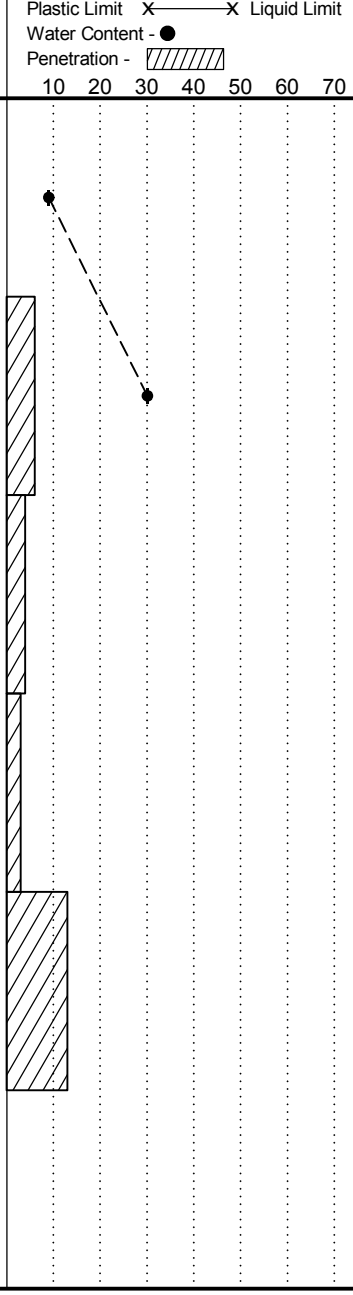
BORING ID INF-10

PROJECT NAME: **Measurement Systems Laboratory - NASA Langley Research Center**
PROJECT NUMBER: **WM11-175G**
CLIENT: **AECOM**
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: **Hampton, Virginia**
LOGGED BY: (b) (6)
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **5/2/2014**
DRILLING METHOD(S): **Rotary wash "mud"**
DATE COMPLETED: **5/2/2014**
GROUNDWATER*: INITIAL (E) ▽: **5** AFTER **24** HOURS (E) ▼: **4.5** CAVE-IN (E) ◌:
DRILLER: **GET Solutions, Inc.**

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.2	2.5-in Asphalt 8-in Aggregate Base Material					
	0.9	Gray, moist, SIlty fine to medium SAND (SM) with Gravel and trace Clay and asphalt fragments, very loose "Fill"	1	SS	5	2-2	27
	2.0	Orange-brown, moist, Sandy lean CLAY (CL), medium stiff Pocket Penetrometer= 3.25 tons/ft^2	2	SS	18	2-3-3-4 (6)	52
▼ ▽	5	Orange-brown, moist to wet, Silty fine to medium SAND (SM) with marine shell fragments and trace Clay, very loose Wet below 4.5 ft	3	SS	16	2-2-2-2 (4)	
	6.0	Orange-brown, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, very loose	4	SS	24	2-1-2-3 (3)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, medium dense "Yorktown Formation"	5	SS	24	5-6-7-7 (13)	
	10	10.0 Boring terminated at 10 feet below existing grade.					

TEST RESULTS



Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
204 Grayson Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID INF-11

PROJECT NAME: Measurement Systems Laboratory - NASA Langley Research Center
PROJECT NUMBER: WM11-175G
CLIENT: AECOM
SURFACE ELEVATION (MSL) (E):
PROJECT LOCATION: Hampton, Virginia
LOGGED BY: (b) (6)
BORING LOCATION: See Attached Boring Location Plan
DATE STARTED: 5/2/2014
DRILLING METHOD(S): Rotary wash "mud"
DATE COMPLETED: 5/2/2014
GROUNDWATER*: INITIAL (E) ▽: 5 AFTER ___ HOURS (E) ▼: ___ CAVE-IN (E) ◌: ___
DRILLER: GET Solutions, Inc.

The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (E)	Depth (E)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.2	2-in Asphalt					
	0.3	2-in Aggregate Base Material					
		Gray, moist, Sandy lean CLAY (CL) with trace Gravel, medium stiff Pocket Penetrometer= 1.75 tons/ft^2	1	SS	12	2-3-5 (5)	60
		Pocket Penetrometer= 1.25 tons/ft^2	2	SS	4	5-4-4-5 (8)	
	4.0	Orange-brown, moist to wet, Silty fine to medium SAND (SM) with marine shell fragments, very loose					
▽	5	Wet below 5 ft	3	SS	18	3-2-2-2 (4)	
	6.0	Orange-brown, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, very loose					
			4	SS	24	1-2-2-3 (4)	
	8.0	Gray, wet, Silty fine to medium SAND (SM) with trace marine shell fragments, very loose "Yorktown Formation"					
			5	SS	20	2-3-4-6 (7)	
	10	10.0 Boring terminated at 10 feet below existing grade.					

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

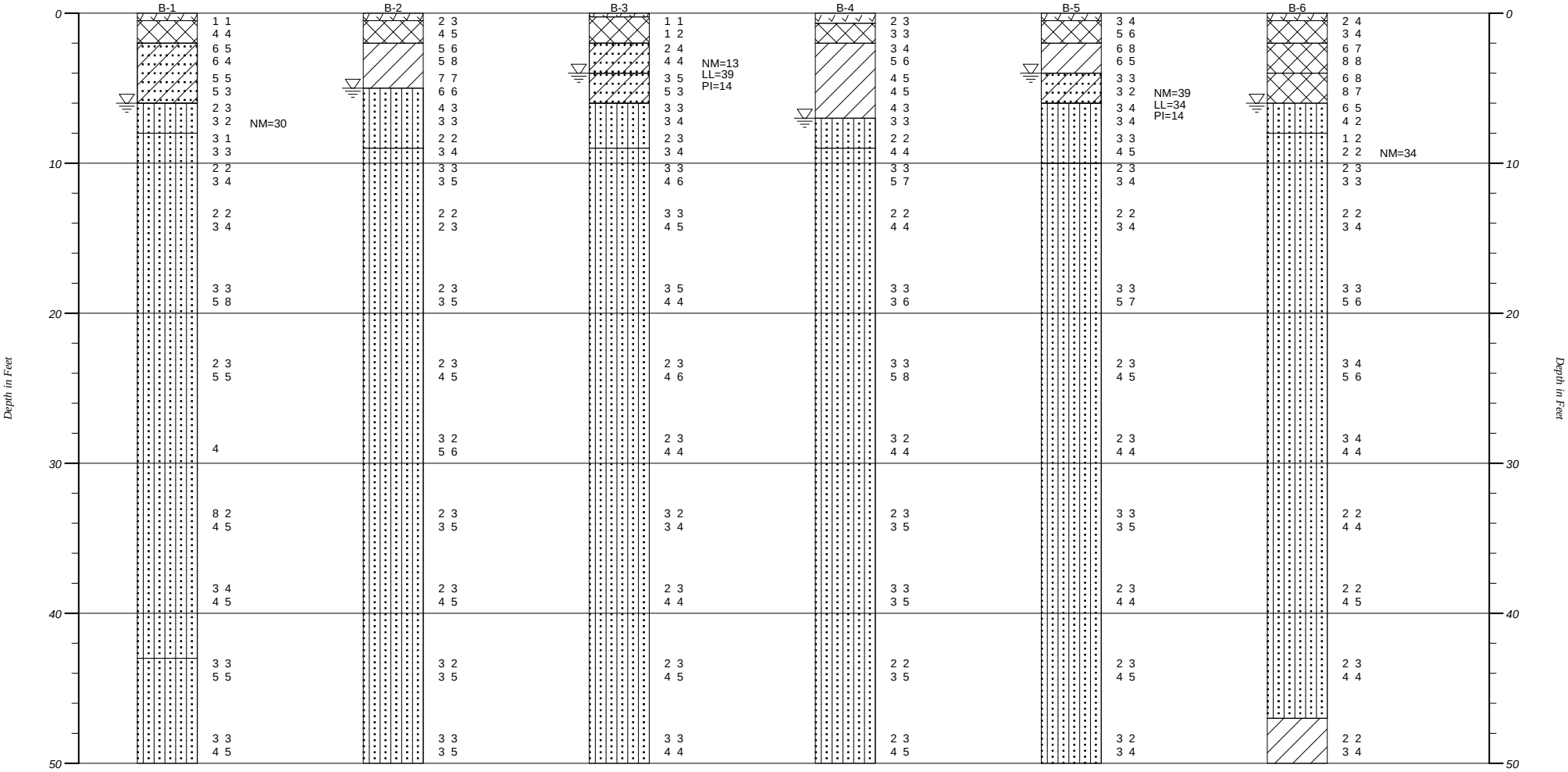
Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

APPENDIX IV

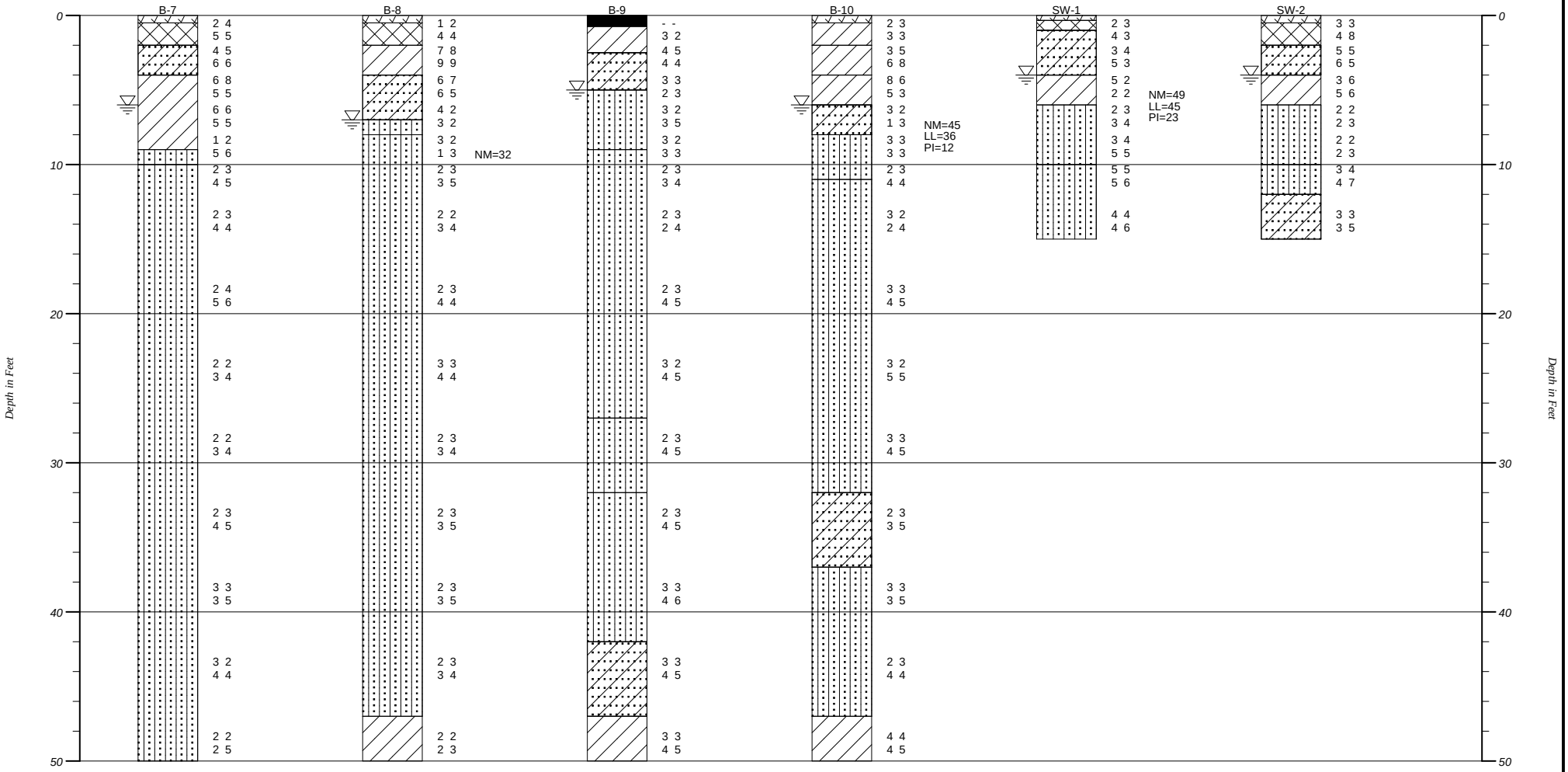
GENERALIZED SOIL PROFILE



Strata symbols

- Topsoil
- Fill
- Clayey Sand
- Silty Sand
- Lean Clay

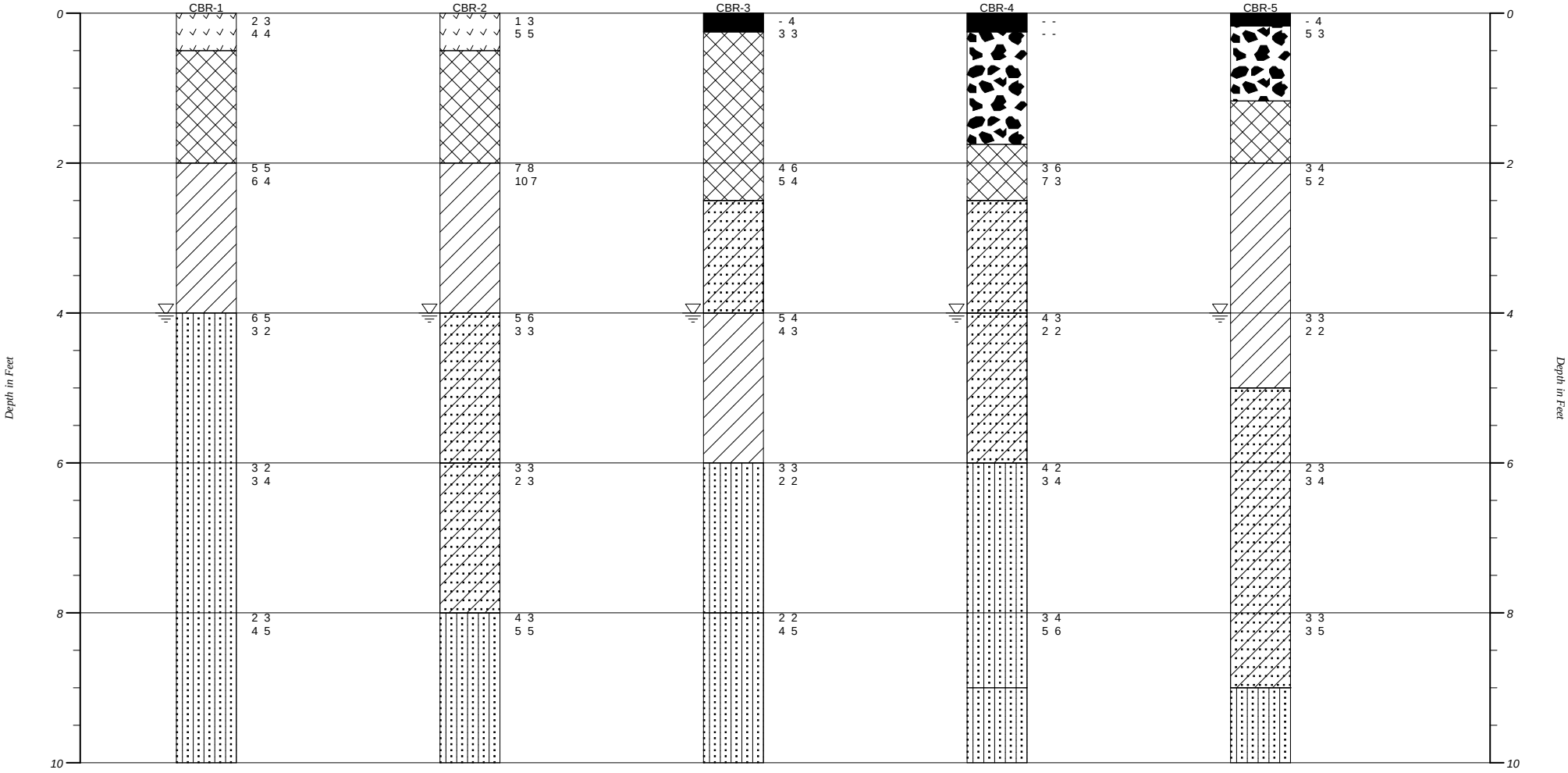
GET Solutions, Inc. GENERALIZED SOIL PROFILE		
HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=10'	JW	6/18/2014
Measurement Systems Laboratory - NASA Langley Research Center		
PROJECT NO. WM11-175G		FIGURE NUMBER 1



Strata symbols

- Topsoil
- Fill
- Clayey Sand
- Silty Sand
- Lean Clay
- Paving

GET Solutions, Inc. GENERALIZED SOIL PROFILE		
HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=10'	JW	6/18/2014
Measurement Systems Laboratory - NASA Langley Research Center		
PROJECT NO. WM11-175G		FIGURE NUMBER 2



Strata symbols

- Topsoil
- Fill
- Lean Clay
- Silty Sand
- Clayey Sand
- Paving
- Gravel

GET Solutions, Inc. GENERALIZED SOIL PROFILE		
HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=2'	JW	6/18/2014
Measurement Systems Laboratory - NASA Langley Research Center		
PROJECT NO. WM11-175G		FIGURE NUMBER

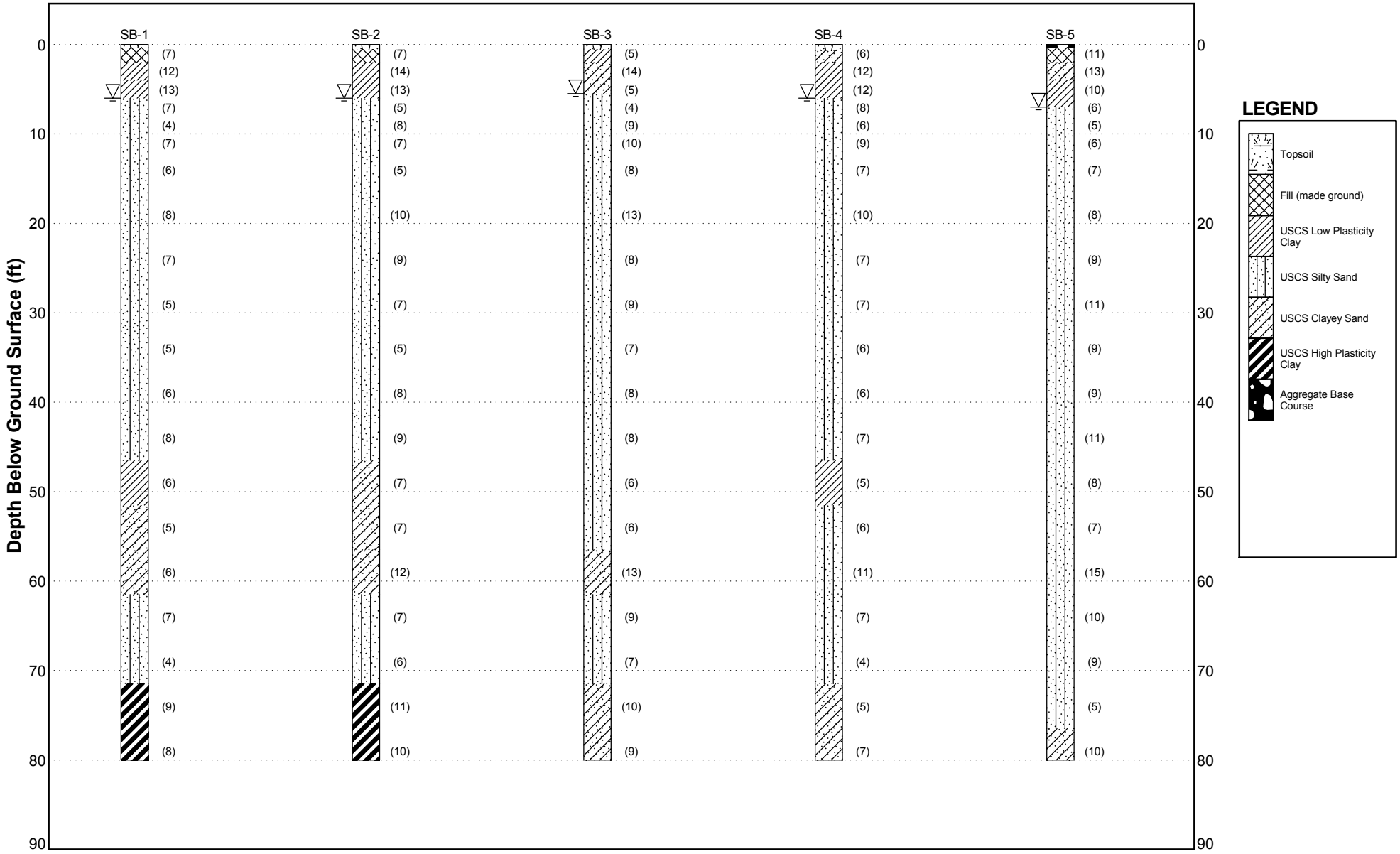
GENERALIZED SOIL PROFILE

PROJECT NAME: **Measurement Systems Laboratory - NASA Langley Research Center**

PROJECT NUMBER: **WM11-175G**

PROJECT LOCATION: **Hampton, Virginia**

CLIENT: **AECOM**



(Numerical Value) = Sample N-Value

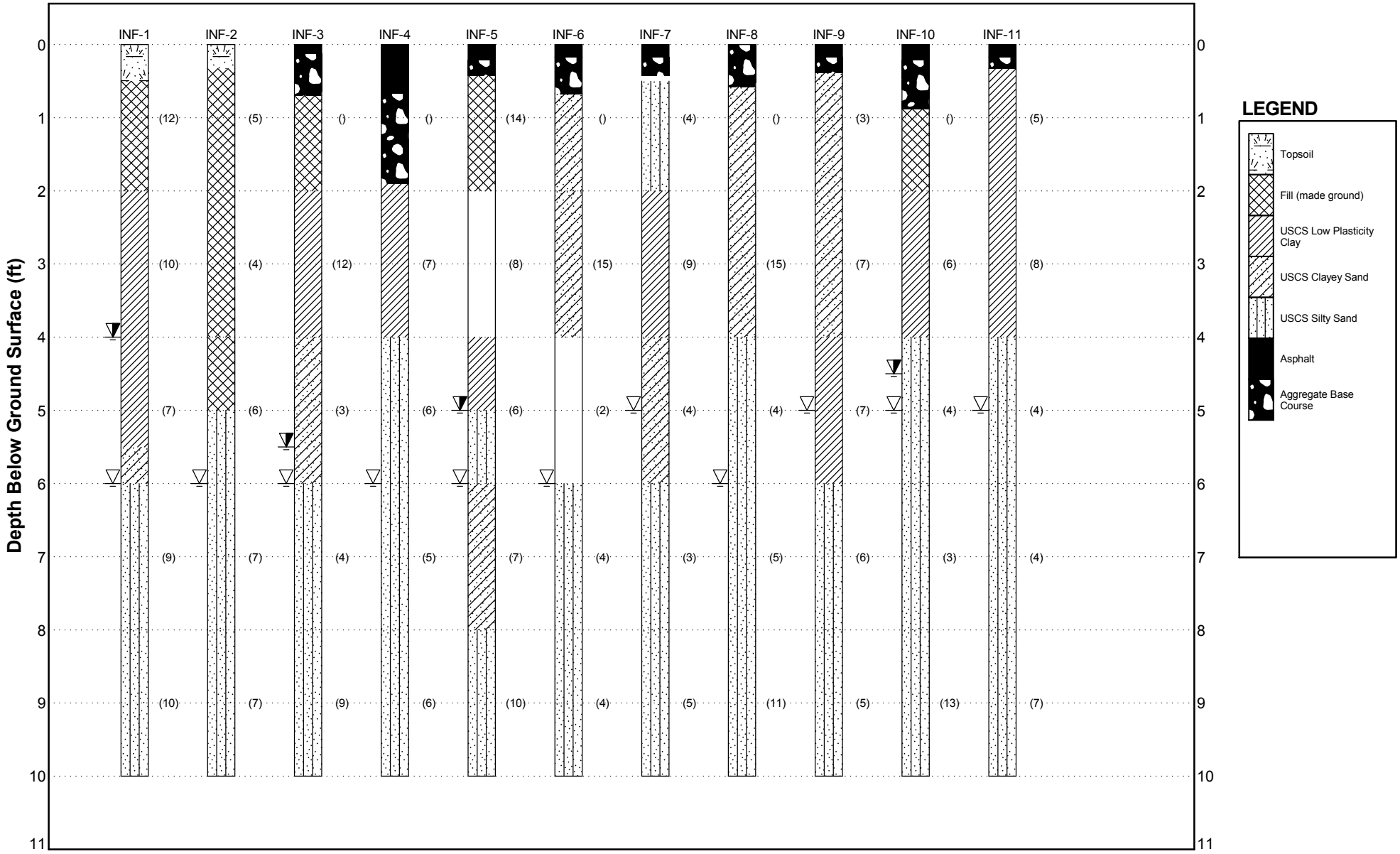
GENERALIZED SOIL PROFILE

PROJECT NAME: **Measurement Systems Laboratory - NASA Langley Research Center**

PROJECT NUMBER: **WM11-175G**

PROJECT LOCATION: **Hampton, Virginia**

CLIENT: **AECOM**



(Numerical Value) = Sample N-Value

APPENDIX V

L-PILE ANALYSES – DESIGN LOAD

==========

LPILE Plus for Windows, Version 5.0 (5.0.46)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

(c) 1985-2010 by Ensoft, Inc.
All Rights Reserved

==========

This program is licensed to:

[redacted] (b) (6)
get solutions inc.

Files Used for Analysis

Path to file locations: G:\documents\GET W\geotech\2011 GEO\WM11-175G Measurement Sciences Laboratory Bldgs\Calculations\L-Pile for total load\
Name of input data file: 60-ft piles with total load.lpd
Name of output file: 60-ft piles with total load.lpo
Name of plot output file: 60-ft piles with total load.lpp
Name of runtime file: 60-ft piles with total load.lpr

Time and Date of Analysis

Date: June 18, 2014 Time: 22:38:46

Problem Title

12" SPPC for Measurement Systems Laboratory - NASA Langley Research Center

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Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 720.00 in

Depth of ground surface below top of pile = 0.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	12.00000000	1728.0000	144.0000	4286825.
2	720.0000	12.00000000	1728.0000	144.0000	4286825.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 0.000 in
Distance from top of pile to bottom of layer = 24.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 24.000 in
Distance from top of pile to bottom of layer = 72.000 in

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 558.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 4 is stiff clay with water-induced erosion
Distance from top of pile to top of layer = 558.000 in

Distance from top of pile to bottom of layer = 618.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 618.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

(Depth of lowest layer extends 0.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 10 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.06940
2	24.00	0.06940
3	24.00	0.06650
4	72.00	0.06650
5	72.00	0.03760
6	558.00	0.03760
7	558.00	0.03647
8	618.00	0.03647
9	618.00	0.03760
10	720.00	0.03760

Shear Strength of Soils

Shear strength parameters with depth defined using 10 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	0.00000	28.00	------	------
2	24.000	0.00000	28.00	------	------
3	24.000	4.17000	0.00	------	------
4	72.000	4.17000	0.00	------	------
5	72.000	0.00000	32.00	------	------
6	558.000	0.00000	32.00	------	------
7	558.000	4.17000	0.00	------	------
8	618.000	4.17000	0.00	------	------
9	618.000	0.00000	32.00	------	------
10	720.000	0.00000	32.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 7168.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 40000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 19547.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 40000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 7168.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 40000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.330007	7.9322E-08	7168.0000	-0.0043759	277.7778	0.0000	0.0000

7.200	0.298501	52869.8485	7020.9882	-0.0043502	461.3536	-40.8366	985.0002
14.400	0.267365	103608.	6579.3056	-0.0042741	637.5275	-81.8530	2204.2610
21.600	0.236954	150074.	5871.9611	-0.0041508	798.8672	-114.6315	3483.1590
28.800	0.207593	190555.	5140.6226	-0.0039853	939.4273	-88.5180	3070.0975
36.000	0.179565	226394.	4482.4407	-0.0037827	1063.8689	-94.3103	3781.5426
43.200	0.153122	257281.	3785.7544	-0.0035476	1171.1146	-99.2137	4665.1498
50.400	0.128480	282953.	3057.1822	-0.0032851	1260.2518	-103.1675	5781.4985
57.600	0.105817	303197.	2303.8130	-0.0030002	1330.5439	-106.1017	7219.3440
64.800	0.085277	317856.	1533.2767	-0.0026984	1381.4429	-107.9361	9113.1385
72.000	0.066961	326830.	570.5027	-0.0023851	1412.6044	-159.5011	17150.4546
79.200	0.050932	327445.	-556.7166	-0.0020671	1414.7382	-153.6154	21715.8923
86.400	0.037194	320004.	-1647.7884	-0.0017525	1388.9028	-149.4601	28932.0543
93.600	0.025697	304726.	-2685.0559	-0.0014488	1335.8536	-138.6698	38854.3659
100.800	0.016331	282174.	-3619.4832	-0.0011636	1257.5477	-120.8934	53298.9890
108.000	0.008940	253276.	-4317.1417	-0.0009034	1157.2067	-72.9007	58709.2526
115.200	0.003322	220527.	-4684.8550	-0.0006731	1043.4974	-29.2419	63374.8526
122.400	-0.000753	186201.	-4764.5162	-0.0004755	924.3102	7.1138	68040.4526
129.600	-0.003525	152192.	-4610.7744	-0.0003110	806.2226	35.5922	72706.0526
136.800	-0.005231	119985.	-4280.2587	-0.0001787	694.3936	56.2177	77371.6526
144.000	-0.006099	90659.3327	-3827.7189	-7.6376E-05	592.5671	69.4878	82037.2526
151.200	-0.006331	64910.1877	-3303.0929	-7.7108E-07	503.1604	76.2416	86702.8526
158.400	-0.006110	43095.2386	-2749.5061	5.1718E-05	427.4140	77.5325	91368.4526
165.600	-0.005587	25287.5104	-2202.1402	8.4951E-05	365.5816	74.5136	96034.0526
172.800	-0.004886	11335.4882	-1687.8615	0.0001027	317.1371	68.3416	100700.
180.000	-0.004107	923.1215	-1225.4668	0.0001087	280.9831	60.1014	105365.
187.200	-0.003321	-6373.8492	-826.3940	0.0001061	299.9092	50.7522	110031.
194.400	-0.002580	-11038.0413	-495.7438	9.7596E-05	316.1043	41.0951	114696.
201.600	-0.001916	-13568.7750	-233.4735	8.5637E-05	324.8916	31.7578	119362.
208.800	-0.001347	-14449.3864	-35.6412	7.2021E-05	327.9493	23.1956	124028.
216.000	-0.000879	-14123.4924	104.3948	5.8135E-05	326.8177	15.7033	128693.
223.200	-0.000509	-12979.5866	194.8931	4.4963E-05	322.8458	9.4351	133359.
230.400	-0.000231	-11342.9299	244.8071	3.3143E-05	317.1630	4.4299	

138024.							
237.600	-3.21E-05	-9473.4542	263.0479	2.3026E-05	310.6717	0.6370331	
142690.							
244.800	0.000100	-7568.3028	257.9369	1.4744E-05	304.0566	-2.0568	
147356.							
252.000	0.000180	-5767.6561	236.8374	8.2632E-06	297.8044	-3.8042	
152021.							
259.200	0.000219	-4162.6044	205.9469	3.4372E-06	292.2313	-4.7765	
156687.							
266.400	0.000230	-2804.0007	170.2226	5.1573E-08	287.5139	-5.1469	
161352.							
273.600	0.000220	-1711.4281	133.4127	-2.1429E-06	283.7202	-5.0781	
166018.							
280.800	0.000199	-881.6235	98.1646	-3.4030E-06	280.8390	-4.7131	
170684.							
288.000	0.000171	-295.8974	66.1854	-3.9753E-06	278.8052	-4.1700	
175349.							
295.200	0.000142	73.7365	42.6785	-4.0833E-06	278.0338	-2.3597	
120010.							
302.400	0.000112	321.0246	27.2627	-3.8914E-06	278.8924	-1.9225	
123120.							
309.600	8.55E-05	468.5603	14.9433	-3.5077E-06	279.4047	-1.4995	
126231.							
316.800	6.19E-05	538.2282	5.5408	-3.0184E-06	279.6466	-1.1123	
129341.							
324.000	4.21E-05	550.0859	-1.2493	-2.4895E-06	279.6878	-0.7738619	
132452.							
331.200	2.61E-05	521.6726	-5.8020	-1.9686E-06	279.5891	-0.4907931	
135562.							
338.400	1.37E-05	467.6705	-8.5201	-1.4878E-06	279.4016	-0.2642144	
138672.							
345.600	4.64E-06	399.8407	-9.8003	-1.0662E-06	279.1661	-0.0914153	
141783.							
352.800	-1.64E-06	327.1599	-10.0109	-7.1293E-07	278.9137	0.0329152	
144893.							
360.000	-5.62E-06	256.0939	-9.4763	-4.2948E-07	278.6670	0.1156062	
148004.							
367.200	-7.82E-06	190.9493	-8.4692	-2.1222E-07	278.4408	0.1641284	
151114.							
374.400	-8.68E-06	134.2596	-7.2090	-5.4175E-08	278.2440	0.1859246	
154224.							
381.600	-8.60E-06	87.1706	-5.8631	5.3437E-08	278.0805	0.1879321	
157335.							
388.800	-7.91E-06	49.7997	-4.5520	1.2000E-07	277.9507	0.1762766	
160445.							
396.000	-6.87E-06	21.5529	-3.3554	1.5468E-07	277.8526	0.1561084	
163556.							
403.200	-5.68E-06	1.3928	-2.3198	1.6583E-07	277.7826	0.1315517	
166666.							
410.400	-4.48E-06	-11.9480	-1.4656	1.6070E-07	277.8193	0.1057378	
169776.							
417.600	-3.37E-06	-19.8040	-0.7936966	1.4527E-07	277.8465	0.0808959	
172887.							
424.800	-2.39E-06	-23.4609	-0.2919502	1.2424E-07	277.8592	0.0584781	
175997.							
432.000	-1.58E-06	-24.0797	0.0600538	1.0114E-07	277.8614	0.0393008	
179108.							
439.200	-9.36E-07	-22.6544	0.2868069	7.8427E-08	277.8564	0.0236862	
182218.							
446.400	-4.51E-07	-19.9948	0.4138232	5.7701E-08	277.8472	0.0115961	
185328.							
453.600	-1.05E-07	-16.7286	0.4654649	3.9854E-08	277.8359	0.0027488	
188439.							

460.800	1.23E-07	-13.3151	0.4635437	2.5253E-08	277.8240	-0.0032825	191549.
468.000	2.59E-07	-10.0681	0.4265561	1.3889E-08	277.8127	-0.0069918	194660.
475.200	3.23E-07	-7.1807	0.3694078	5.5062E-09	277.8027	-0.0088827	197770.
482.400	3.38E-07	-4.7518	0.3034913	-2.9277E-10	277.7943	-0.0094275	200880.
489.600	3.19E-07	-2.8103	0.2369988	-3.9678E-09	277.7875	-0.0090426	203991.
496.800	2.81E-07	-1.3367	0.1753720	-5.9832E-09	277.7824	-0.0080759	207101.
504.000	2.33E-07	-0.2814532	0.1218080	-6.7696E-09	277.7788	-0.0068029	210212.
511.200	1.83E-07	0.4212212	0.0777683	-6.7017E-09	277.7792	-0.0054303	213322.
518.400	1.37E-07	0.8422699	0.0434471	-6.0876E-09	277.7807	-0.0041033	216432.
525.600	9.56E-08	1.0504	0.0181785	-5.1678E-09	277.7814	-0.0029157	219543.
532.800	6.21E-08	1.1070	0.0007699	-4.1194E-09	277.7816	-0.0019200	222653.
540.000	3.63E-08	1.0638	-0.0102400	-3.0644E-09	277.7815	-0.0011383	225764.
547.200	1.80E-08	0.9613259	-0.0163934	-2.0802E-09	277.7811	-0.0005710	228874.
554.400	6.35E-09	0.8289590	-0.0191851	-1.2101E-09	277.7807	-0.0002045	231984.
561.600	5.36E-10	0.6857573	-0.0452166	-4.7400E-10	277.7802	-0.0070264	9.4462E+07
568.800	-4.78E-10	0.1781134	-0.0479469	-5.4170E-11	277.7784	0.0062680	9.4475E+07
576.000	-2.44E-10	-0.0046462	-0.0138319	3.0133E-11	277.7778	0.0032084	9.4488E+07
583.200	-4.38E-11	-0.0210835	-0.0002132	1.7629E-11	277.7779	0.0005746	9.4501E+07
590.400	9.37E-12	-0.0077270	0.0014125	3.6270E-12	277.7778	-0.0001230	9.4513E+07
597.600	8.45E-12	-0.0007461	0.0005702	-4.9077E-13	277.7778	-0.0001109	9.4526E+07
604.800	2.31E-12	0.0004843	6.1888E-05	-6.1802E-13	277.7778	-3.0269E-05	9.4539E+07
612.000	-4.50E-13	0.0001454	-2.5805E-05	-3.1200E-13	277.7778	5.9095E-06	9.4552E+07
619.200	-2.19E-12	0.0001129	-4.3328E-06	-1.8647E-13	277.7778	5.4878E-08	180624.
626.400	-3.14E-12	8.3138E-05	-3.8472E-06	-9.1209E-14	277.7778	8.0005E-08	183735.
633.600	-3.50E-12	5.7526E-05	-3.2321E-06	-2.2848E-14	277.7778	9.0852E-08	186845.
640.800	-3.46E-12	3.6609E-05	-2.5760E-06	2.2900E-14	277.7778	9.1394E-08	189955.
648.000	-3.17E-12	2.0418E-05	-1.9409E-06	5.0614E-14	277.7778	8.5034E-08	193066.
655.200	-2.74E-12	8.6303E-06	-1.3665E-06	6.4731E-14	277.7778	7.4528E-08	196176.
662.400	-2.24E-12	7.0350E-07	-8.7508E-07	6.9267E-14	277.7778	6.1974E-08	199287.
669.600	-1.74E-12	-4.0108E-06	-4.7611E-07	6.7660E-14	277.7778	4.8852E-08	202397.
676.800	-1.26E-12	-6.1914E-06	-1.7028E-07	6.2702E-14	277.7778	3.6099E-08	205507.
684.000	-8.35E-13	-6.4989E-06	4.6766E-08	5.6535E-14	277.7778	2.4192E-08	

```
208618.
 691.200 -4.51E-13 -5.5505E-06  1.8156E-07  5.0679E-14    277.7778  1.3252E-08
211728.
 698.400 -1.05E-13 -3.9136E-06  2.4057E-07  4.6079E-14    277.7778  3.1380E-09
214839.
 705.600  2.13E-13 -2.1129E-06  2.2866E-07  4.3151E-14    277.7778 -6.4450E-09
217949.
 712.800  5.16E-13 -6.4575E-07  1.4840E-07  4.1810E-14    277.7778 -1.5849E-08
221059.
 720.000  8.15E-13      0.0000      0.0000  4.1496E-14    277.7778 -2.5374E-08
112085.
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.33000721 in
Computed slope at pile head      =    -0.00437586
Maximum bending moment           =   327444.58891 lbs-in
Maximum shear force              =     7168.00000 lbs
Depth of maximum bending moment  =    79.20000000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             17
Number of zero deflection points =              8
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Slope (Pile-head Condition Type 2)
Specified shear force at pile head = 19547.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 40000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

```
  Depth   Deflect.    Moment      Shear       Slope      Total       Soil Res.
Es*h
    X        y          M           V           S        Stress          p
F/L
    in       in        lbs-in        lbs         Rad.   lbs/in**2    lbs/in
lbs/in
-------- --------- ----------- ----------- ----------- ----------- -----------
-----------
   0.000  0.379803   -1032603.  19547.0000  1.9275E-17   3863.2035      0.0000
0.0000
   7.200  0.376189    -891720.  19385.6625  -0.0009352   3374.0267    -44.8160
857.7460
  14.400  0.366336    -752910.  18889.8564  -0.0017345   2892.0500    -92.9080
1826.0223
  21.600  0.351213    -618707.  18071.6610  -0.0024010   2426.0649   -134.3685
2754.6039
  28.800  0.331761    -491295.  17229.6422  -0.0029405   1983.6648    -99.5256
2159.9429
  36.000  0.308870    -368906.  16482.5291  -0.0033585   1558.7018   -108.0058
2517.6978
```

43.200	0.283398	-252013.	15677.1141	-0.0036603	1152.8213	-115.7206	2939.9948
50.400	0.256162	-141047.	14819.1886	-0.0038513	767.5256	-122.5920	3445.7198
57.600	0.227939	-36397.8681	13915.1147	-0.0039375	404.1593	-128.5396	4060.2324
64.800	0.199461	61598.3186	12971.8368	-0.0039253	491.6608	-133.4820	4818.3296
72.000	0.171415	152658.	11496.1674	-0.0038212	807.8387	-276.4262	11610.8396
79.200	0.144436	229344.	9458.7876	-0.0036355	1074.1115	-289.5127	14431.8969
86.400	0.119063	290958.	7324.9811	-0.0033827	1288.0492	-303.2114	18335.8420
93.600	0.095726	336772.	5122.8532	-0.0030776	1447.1259	-308.4908	23203.0461
100.800	0.074746	366500.	2914.9794	-0.0027358	1550.3470	-304.8075	29361.0990
108.000	0.056330	380324.	766.8974	-0.0023729	1598.3466	-291.8820	37307.7496
115.200	0.040576	378910.	-1254.6406	-0.0020039	1593.4377	-269.6563	47848.8631
122.400	0.027474	363411.	-3082.8312	-0.0016431	1539.6223	-238.1744	62417.4624
129.600	0.016915	335464.	-4555.1689	-0.0013035	1442.5824	-170.8083	72706.0526
136.800	0.008704	298568.	-5506.7837	-0.0009954	1314.4709	-93.5292	77371.6526
144.000	0.002582	256739.	-5949.3836	-0.0007255	1169.2339	-29.4152	82037.2526
151.200	-0.001744	213314.	-5979.6905	-0.0004971	1018.4527	20.9967	86702.8526
158.400	-0.004576	170918.	-5695.0499	-0.0003103	871.2435	58.0702	91368.4526
165.600	-0.006212	131484.	-5187.6992	-0.0001634	734.3209	82.8606	96034.0526
172.800	-0.006928	96309.3662	-4540.5525	-5.2661E-05	612.1853	96.9024	100700.
180.000	-0.006971	66130.7847	-3824.4712	2.6282E-05	507.3986	102.0091	105365.
187.200	-0.006550	41221.8420	-3096.8859	7.8454E-05	420.9092	100.0979	110031.
194.400	-0.005841	21490.4379	-2401.5670	0.0001089	352.3974	93.0462	114696.
201.600	-0.004981	6576.5333	-1769.3046	0.0001226	300.6130	82.5822	119362.
208.800	-0.004076	-4058.1503	-1219.2473	0.0001238	291.8686	70.2115	124028.
216.000	-0.003199	-11051.9340	-760.6565	0.0001165	316.1525	57.1748	128693.
223.200	-0.002399	-15078.6807	-394.8648	0.0001038	330.1343	44.4340	133359.
230.400	-0.001705	-16797.7494	-117.2564	8.8262E-05	336.1033	32.6795	138024.
237.600	-0.001128	-16818.0118	80.8674	7.1925E-05	336.1737	22.3549	142690.
244.800	-0.000669	-15674.6874	210.6352	5.6134E-05	332.2038	13.6917	147356.
252.000	-0.000320	-13817.1975	284.2243	4.1801E-05	325.7542	6.7497	152021.
259.200	-6.71E-05	-11605.9349	313.7767	2.9446E-05	318.0762	1.4593	156687.
266.400	0.000104	-9315.7742	310.6119	1.9278E-05	310.1242	-2.3384	

161352.							
273.600	0.000211	-7144.2274	284.7160	1.1279E-05	302.5841	-4.8549	
166018.							
280.800	0.000267	-5222.3611	244.4720	5.2691E-06	295.9110	-6.3239	
170684.							
288.000	0.000286	-3626.8655	196.5934	9.6854E-07	290.3711	-6.9757	
175349.							
295.200	0.000281	-2391.9747	154.6368	-1.9565E-06	286.0832	-4.6789	
120010.							
302.400	0.000258	-1398.9688	121.8945	-3.7989E-06	282.6353	-4.4162	
123120.							
309.600	0.000226	-634.5052	91.7318	-4.7871E-06	279.9809	-3.9624	
126231.							
316.800	0.000189	-75.2733	65.2238	-5.1321E-06	278.0391	-3.4010	
129341.							
324.000	0.000152	307.6742	42.9071	-5.0191E-06	278.8461	-2.7981	
132452.							
331.200	0.000117	545.4797	24.9003	-4.6045E-06	279.6718	-2.2037	
135562.							
338.400	8.58E-05	668.8914	11.0178	-4.0143E-06	280.1003	-1.6525	
138672.							
345.600	5.92E-05	706.4483	0.8691660	-3.3459E-06	280.2307	-1.1665	
141783.							
352.800	3.76E-05	683.3346	-6.0558	-2.6705E-06	280.1505	-0.7570644	
144893.							
360.000	2.08E-05	620.7834	-10.3192	-2.0367E-06	279.9333	-0.4272214	
148004.							
367.200	8.29E-06	535.9113	-12.4836	-1.4746E-06	279.6386	-0.1740111	
151114.							
374.400	-4.51E-07	441.8684	-13.0753	-9.9941E-07	279.3120	0.0096587	
154224.							
381.600	-6.10E-06	348.2025	-12.5606	-6.1545E-07	278.9868	0.1333089	
157335.							
388.800	-9.31E-06	261.3499	-11.3336	-3.1921E-07	278.6852	0.2075389	
160445.							
396.000	-1.07E-05	185.1829	-9.7116	-1.0220E-07	278.4208	0.2429977	
163556.							
403.200	-1.08E-05	121.5611	-7.9381	4.6869E-08	278.1999	0.2496536	
166666.							
410.400	-1.00E-05	70.8473	-6.1886	1.4038E-07	278.0238	0.2363257	
169776.							
417.600	-8.76E-06	32.3648	-4.5802	1.9054E-07	277.8902	0.2104335	
172887.							
424.800	-7.28E-06	4.7821	-3.1822	2.0859E-07	277.7944	0.1779174	
175997.							
432.000	-5.76E-06	-13.5787	-2.0258	2.0431E-07	277.8249	0.1432856	
179108.							
439.200	-4.34E-06	-24.5077	-1.1149	1.8580E-07	277.8629	0.1097468	
182218.							
446.400	-3.08E-06	-29.7407	-0.4340264	1.5944E-07	277.8810	0.0793927	
185328.							
453.600	-2.04E-06	-30.8496	0.0440416	1.2999E-07	277.8849	0.0534040	
188439.							
460.800	-1.21E-06	-29.1814	0.3524211	1.0082E-07	277.8791	0.0322570	
191549.							
468.000	-5.89E-07	-25.8328	0.5258428	7.4084E-08	277.8675	0.0159157	
194660.							
475.200	-1.46E-07	-21.6519	0.5975440	5.1007E-08	277.8530	0.0040013	
197770.							
482.400	1.46E-07	-17.2575	0.5973023	3.2098E-08	277.8377	-0.0040684	
200880.							
489.600	3.17E-07	-13.0692	0.5503703	1.7360E-08	277.8232	-0.0089683	
203991.							

496.800	3.96E-07	-9.3422	0.4770992	6.4681E-09	277.8102	-0.0113848	207101.
504.000	4.10E-07	-6.2027	0.3930539	-1.0865E-09	277.7993	-0.0119611	210212.
511.200	3.80E-07	-3.6816	0.3094463	-5.8901E-09	277.7906	-0.0112632	213322.
518.400	3.25E-07	-1.7433	0.2337431	-8.5265E-09	277.7838	-0.0097654	216432.
525.600	2.57E-07	-0.3107683	0.1703355	-9.5248E-09	277.7789	-0.0078478	219543.
532.800	1.88E-07	0.7150186	0.1211866	-9.3283E-09	277.7803	-0.0058046	222653.
540.000	1.23E-07	1.4397	0.0864004	-8.2812E-09	277.7828	-0.0038582	225764.
547.200	6.85E-08	1.9640	0.0646768	-6.6271E-09	277.7846	-0.0021761	228874.
554.400	2.76E-08	2.3749	0.0536396	-4.5185E-09	277.7860	-0.0008898	231984.
561.600	3.39E-09	2.7390	-0.1084190	-2.0332E-09	277.7873	-0.0441265	9.3667E+07
568.800	-1.66E-09	0.8147943	-0.1887031	-3.0614E-10	277.7806	0.0218254	9.4475E+07
576.000	-1.02E-09	0.0218202	-0.0621087	1.0044E-10	277.7779	0.0133397	9.4488E+07
583.200	-2.17E-10	-0.0796293	-0.0038348	7.2349E-11	277.7781	0.0028475	9.4501E+07
590.400	2.53E-11	-0.0334419	0.0052192	1.7398E-11	277.7779	-0.0003325	9.4513E+07
597.600	3.36E-11	-0.0044823	0.0024352	-1.0327E-12	277.7778	-0.0004408	9.4526E+07
604.800	1.05E-11	0.0016252	0.0003537	-2.4213E-12	277.7778	-0.0001373	9.4539E+07
612.000	-1.29E-12	0.0006130	-7.9769E-05	-1.3335E-12	277.7778	1.6909E-05	9.4552E+07
619.200	-8.74E-12	0.0004773	-1.8106E-05	-8.0369E-13	277.7778	2.1936E-07	180624.
626.400	-1.29E-11	0.0003527	-1.6135E-05	-4.0031E-13	277.7778	3.2819E-07	183735.
633.600	-1.45E-11	0.0002451	-1.3598E-05	-1.0975E-13	277.7778	3.7651E-07	186845.
640.800	-1.44E-11	0.0001570	-1.0871E-05	8.5693E-14	277.7778	3.8099E-07	189955.
648.000	-1.33E-11	8.8556E-05	-8.2181E-06	2.0503E-13	277.7778	3.5596E-07	193066.
655.200	-1.15E-11	3.8541E-05	-5.8097E-06	2.6680E-13	277.7778	3.1303E-07	196176.
662.400	-9.43E-12	4.7428E-06	-3.7429E-06	2.8783E-13	277.7778	2.6109E-07	199287.
669.600	-7.34E-12	-1.5522E-05	-2.0598E-06	2.8259E-13	277.7778	2.0644E-07	202397.
676.800	-5.36E-12	-2.5081E-05	-7.6549E-07	2.6286E-13	277.7778	1.5309E-07	205507.
684.000	-3.56E-12	-2.6697E-05	1.5682E-07	2.3770E-13	277.7778	1.0311E-07	208618.
691.200	-1.94E-12	-2.2960E-05	7.3346E-07	2.1357E-13	277.7778	5.7067E-08	211728.
698.400	-4.83E-13	-1.6258E-05	9.9082E-07	1.9451E-13	277.7778	1.4421E-08	214839.
705.600	8.60E-13	-8.8040E-06	9.4898E-07	1.8233E-13	277.7778	-2.6041E-08	217949.
712.800	2.14E-12	-2.6976E-06	6.1846E-07	1.7674E-13	277.7778	-6.5772E-08	221059.
720.000	3.41E-12	0.0000	0.0000	1.7543E-13	277.7778	-1.0602E-07	

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

```
Pile-head deflection            =     0.37980258 in
Computed slope at pile head     =   1.927471E-17
Maximum bending moment          =      -1032603. lbs-in
Maximum shear force             =    19547.00000 lbs
Depth of maximum bending moment =        0.00000 in
Depth of maximum shear force    =        0.00000 in
Number of iterations            =             14
Number of zero deflection points =             8
```

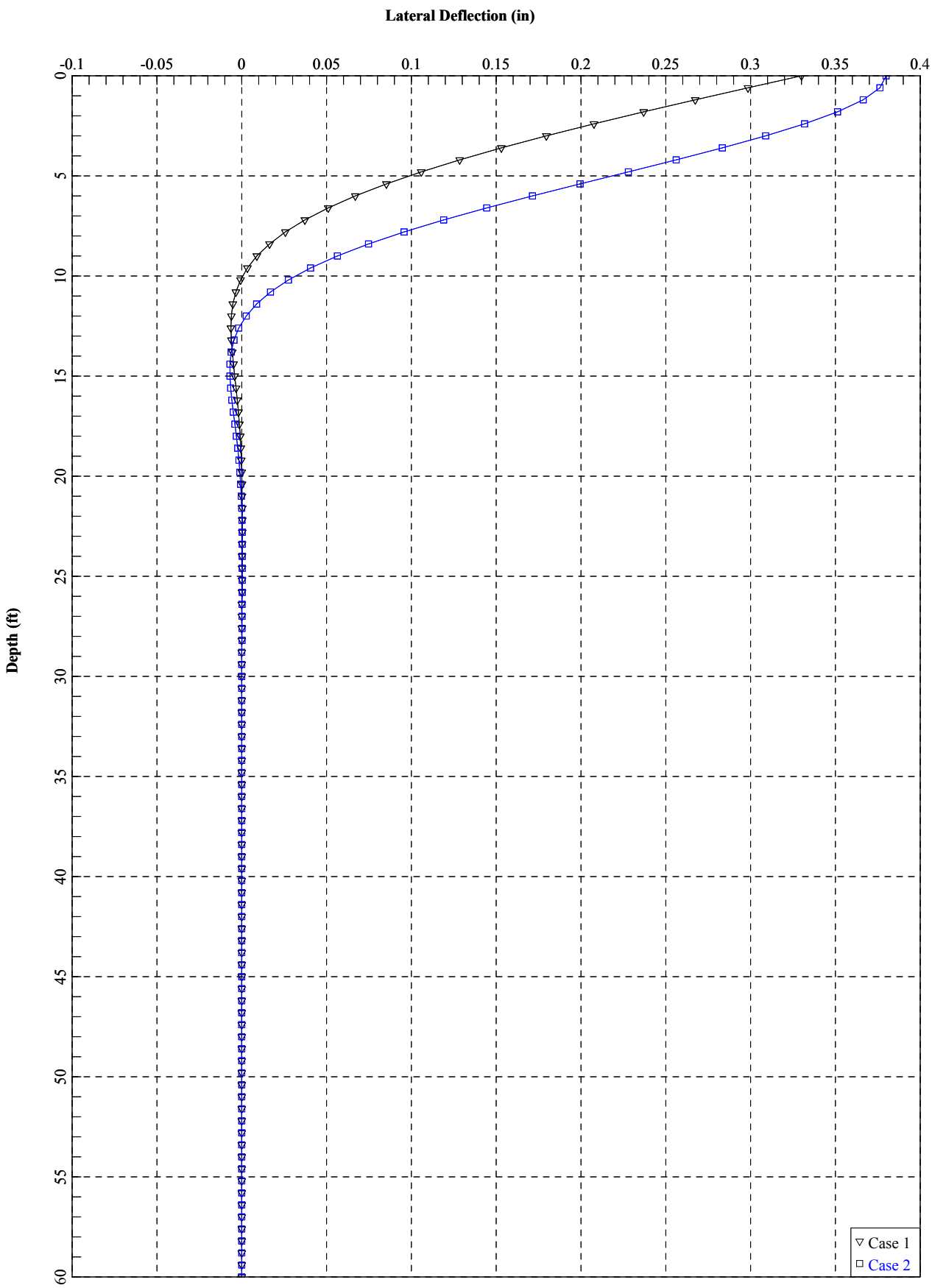
Summary of Pile Response(s)

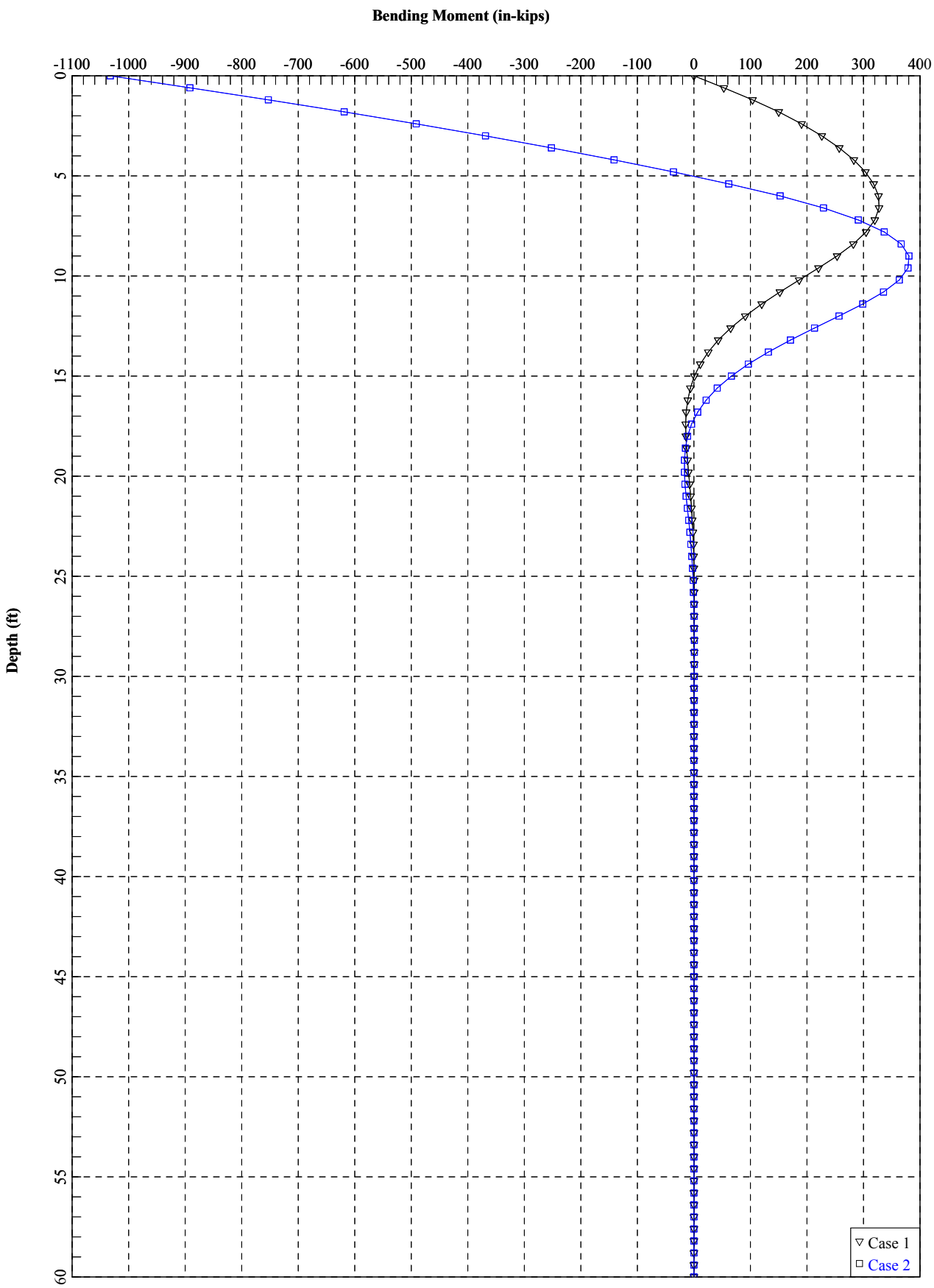
Definition of Symbols for Pile-Head Loading Conditions:

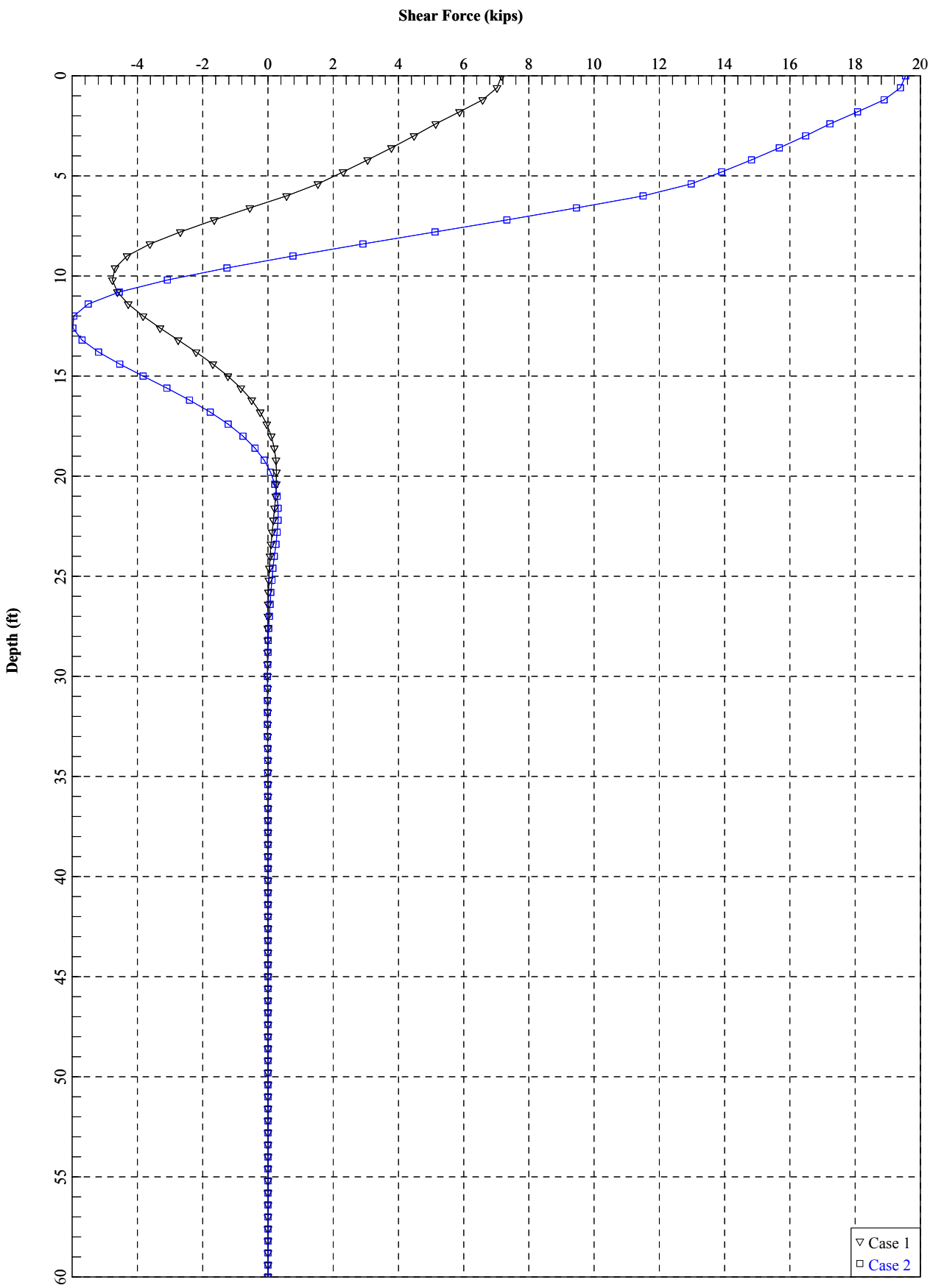
```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

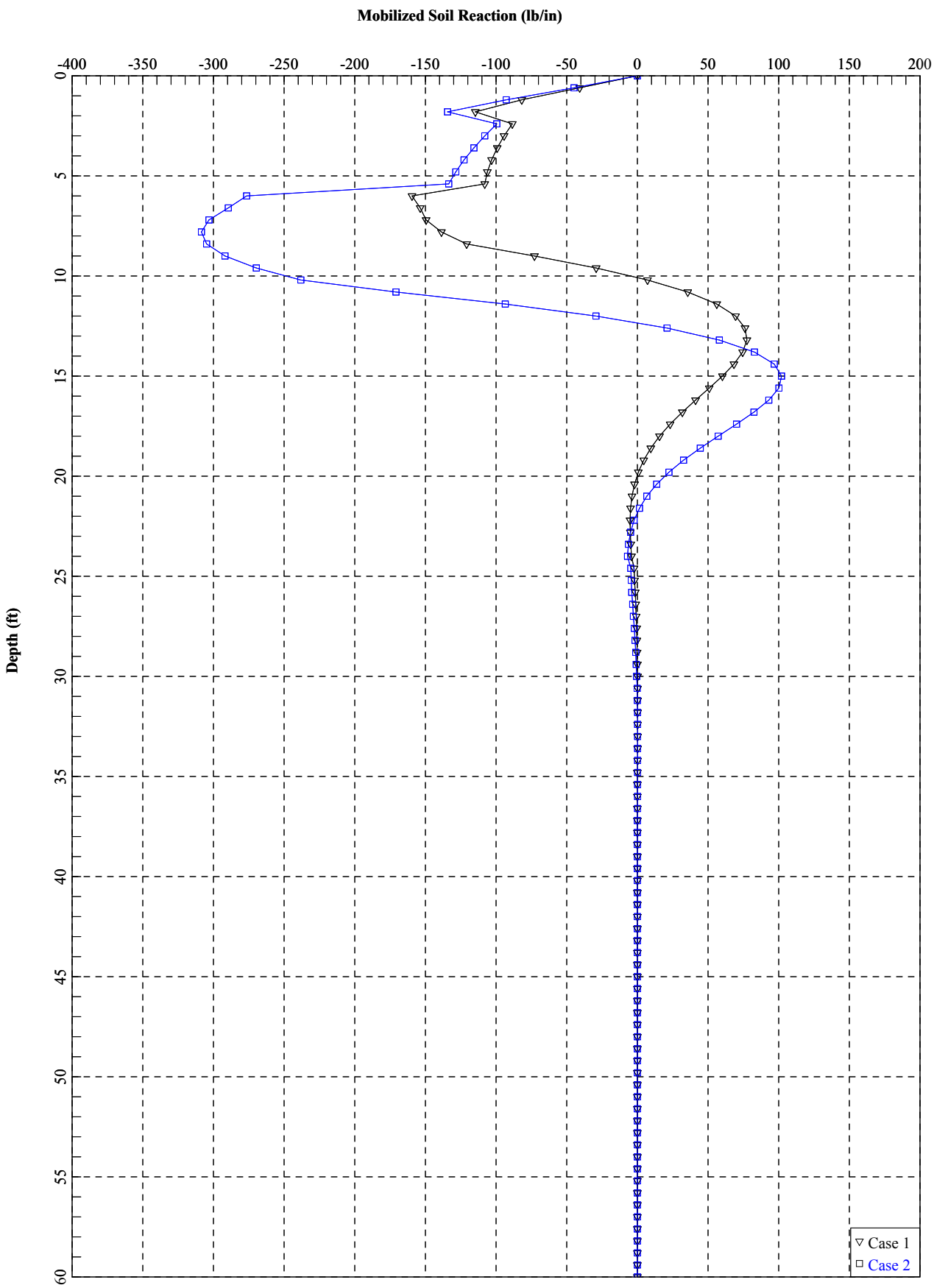
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 7168.000	M= 0.000	40000.0000	0.3300072	327445.	7168.0000
2	V= 19547.	S= 0.000	40000.0000	0.3798026	-1032603.	19547.0000

The analysis ended normally.


Lateral Deflection (in)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2


Bending Moment (in-kips)
-1100
-1000
-900
-800
-700
-600
-500
-400
-300
-200
-100
0
100
200
300
400
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2


Shear Force (kips)
-4
-2
0
2
4
6
8
10
12
14
16
18
20
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2


Mobilized Soil Reaction (lb/in)
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2

==========

LPILE Plus for Windows, Version 5.0 (5.0.46)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

[redacted] (b) (6)
get solutions inc.

Files Used for Analysis

Path to file locations: G:\documents\GET W\geotech\2011 GEO\WM11-175G Measurement Sciences Laboratory Bldgs\Calculations\14-in SPPC\L-Pile for Total Load\
Name of input data file: 60-ft piles with total load.lpd
Name of output file: 60-ft piles with total load.lpo
Name of plot output file: 60-ft piles with total load.lpp
Name of runtime file: 60-ft piles with total load.lpr

Time and Date of Analysis

Date: July 18, 2014 Time: 14:36:24

Problem Title

14" SPPC for Measurement Systems Laboratory - NASA Langley Research Center

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Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 720.00 in

Depth of ground surface below top of pile = 0.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	14.00000000	3201.0000	196.0000	4286825.
2	720.0000	14.00000000	3201.0000	196.0000	4286825.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 0.000 in
Distance from top of pile to bottom of layer = 24.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 24.000 in
Distance from top of pile to bottom of layer = 72.000 in

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 558.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 4 is stiff clay with water-induced erosion
Distance from top of pile to top of layer = 558.000 in

Distance from top of pile to bottom of layer = 618.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 618.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

(Depth of lowest layer extends 0.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 10 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.06940
2	24.00	0.06940
3	24.00	0.06650
4	72.00	0.06650
5	72.00	0.03760
6	558.00	0.03760
7	558.00	0.03647
8	618.00	0.03647
9	618.00	0.03760
10	720.00	0.03760

Shear Strength of Soils

Shear strength parameters with depth defined using 10 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	0.00000	28.00	------	------
2	24.000	0.00000	28.00	------	------
3	24.000	4.17000	0.00	------	------
4	72.000	4.17000	0.00	------	------
5	72.000	0.00000	32.00	------	------
6	558.000	0.00000	32.00	------	------
7	558.000	4.17000	0.00	------	------
8	618.000	4.17000	0.00	------	------
9	618.000	0.00000	32.00	------	------
10	720.000	0.00000	32.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 9769.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 40000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 26445.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 40000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 9769.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 40000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.341739	-5.8776E-08	9769.0000	-0.0040413	204.0816	0.0000	0.0000

7.200	0.312642	71500.7079	9606.4165	-0.0040226	360.4406	-45.1621	1040.0631
14.400	0.283814	140649.	9112.5453	-0.0039669	511.6561	-92.0244	2334.5421
21.600	0.255518	205006.	8306.7034	-0.0038762	652.3928	-131.8206	3714.4520
28.800	0.227996	262499.	7474.6837	-0.0037536	778.1181	-99.2960	3135.7181
36.000	0.201466	314804.	6737.2689	-0.0036021	892.4999	-105.5415	3771.8474
43.200	0.176125	361590.	5957.6998	-0.0034247	994.8130	-111.0055	4537.9092
50.400	0.152150	402567.	5141.7670	-0.0032242	1084.4226	-115.6425	5472.3889
57.600	0.129696	437489.	4295.6128	-0.0030038	1160.7893	-119.4003	6628.4216
64.800	0.108895	466154.	3425.7749	-0.0027668	1223.4757	-122.2213	8081.1005
72.000	0.089855	488414.	2261.9593	-0.0025163	1272.1525	-201.0608	16110.7929
79.200	0.072660	500176.	854.4092	-0.0022570	1297.8748	-189.9254	18819.9720
86.400	0.057355	502017.	-486.1180	-0.0019940	1301.9009	-182.4433	22902.9054
93.600	0.043946	494324.	-1781.5133	-0.0017327	1285.0785	-177.3887	29062.9303
100.800	0.032405	477361.	-3028.9652	-0.0014777	1247.9832	-169.1257	37578.1203
108.000	0.022667	451559.	-4194.5854	-0.0012340	1191.5573	-154.6577	49126.5836
115.200	0.014635	417670.	-5212.2855	-0.0010060	1117.4495	-128.0367	62992.0407
122.400	0.008180	377081.	-5949.9532	-0.0007975	1028.6887	-76.8710	67657.6407
129.600	0.003151	332450.	-6340.6290	-0.0006113	931.0890	-31.6501	72323.2407
136.800	-0.000623	286128.	-6430.5951	-0.0004491	829.7914	6.6595	76988.8407
144.000	-0.003316	240108.	-6271.2580	-0.0003110	729.1542	37.6008	81654.4407
151.200	-0.005101	196001.	-5915.7301	-0.0001966	632.7002	61.1569	86320.0407
158.400	-0.006146	155035.	-5415.9532	-0.0001045	543.1145	77.6700	90985.6407
165.600	-0.006606	118072.	-4820.4167	-3.2838E-05	462.2826	87.7568	95651.2407
172.800	-0.006619	85639.7965	-4172.4856	2.0605E-05	391.3602	92.2241	100317.
180.000	-0.006309	57975.9439	-3509.3097	5.8283E-05	330.8644	91.9914	104982.
187.200	-0.005780	35072.1658	-2861.2638	8.2694E-05	280.7780	88.0213	109648.
194.400	-0.005118	16726.1135	-2251.8445	9.6283E-05	240.6586	81.2618	114314.
201.600	-0.004393	2590.1460	-1697.9397	0.0001014	209.7458	72.6006	118979.
208.800	-0.003659	-7782.5967	-1210.3823	9.9989E-05	221.1007	62.8320	123645.
216.000	-0.002954	-14896.9522	-794.7000	9.4039E-05	236.6585	52.6353	128310.
223.200	-0.002305	-19280.4436	-451.9827	8.5072E-05	246.2444	42.5640	132976.
230.400	-0.001729	-21454.5042	-179.7935	7.4386E-05	250.9987	33.0441	

137642.							
237.600	-0.001233	-21912.3157	26.9319	6.3008E-05	251.9998	24.3796	
142307.							
244.800	-0.000821	-21102.9774	175.0463	5.1723E-05	250.2300	16.7633	
146973.							
252.000	-0.000489	-19421.4408	272.4445	4.1092E-05	246.5528	10.2917	
151638.							
259.200	-0.000229	-17203.4451	327.4301	3.1483E-05	241.7024	4.9820	
156304.							
266.400	-3.53E-05	-14724.5815	348.2074	2.3107E-05	236.2816	0.7894323	
160970.							
273.600	0.000103	-12202.5686	342.4989	1.6042E-05	230.7664	-2.3751	
165635.							
280.800	0.000196	-9801.8382	317.2845	1.0270E-05	225.5165	-4.6289	
170301.							
288.000	0.000251	-7639.5873	278.6513	5.6938E-06	220.7880	-6.1026	
174966.							
295.200	0.000278	-5792.5396	240.0546	2.1699E-06	216.7489	-4.6187	
119755.							
302.400	0.000282	-4184.0504	206.0805	-4.4750E-07	213.2314	-4.8186	
122865.							
309.600	0.000271	-2824.7230	171.6485	-2.2863E-06	210.2588	-4.7459	
125975.							
316.800	0.000249	-1710.9954	138.4631	-3.4762E-06	207.8233	-4.4723	
129086.							
324.000	0.000221	-828.8522	107.7427	-4.1425E-06	205.8942	-4.0612	
132196.							
331.200	0.000190	-157.1143	80.2821	-4.4012E-06	204.4252	-3.5668	
135307.							
338.400	0.000158	329.7455	56.5198	-4.3559E-06	204.8027	-3.0339	
138417.							
345.600	0.000127	659.2798	36.6058	-4.0964E-06	205.5234	-2.4978	
141527.							
352.800	9.88E-05	859.2285	20.4669	-3.6981E-06	205.9606	-1.9852	
144638.							
360.000	7.38E-05	956.1338	7.8668	-3.2218E-06	206.1725	-1.5148	
147748.							
367.200	5.24E-05	974.3659	-1.5413	-2.7153E-06	206.2124	-1.0985	
150859.							
374.400	3.47E-05	935.5031	-8.1688	-2.2143E-06	206.1274	-0.7424561	
153969.							
381.600	2.05E-05	858.0101	-12.4552	-1.7437E-06	205.9579	-0.4481893	
157079.							
388.800	9.61E-06	757.1533	-14.8383	-1.3200E-06	205.7374	-0.2137919	
160190.							
396.000	1.54E-06	645.0991	-15.7333	-9.5213E-07	205.4923	-0.0348229	
163300.							
403.200	-4.10E-06	531.1422	-15.5174	-6.4354E-07	205.2431	0.0947946	
166411.							
410.400	-7.73E-06	422.0192	-14.5208	-3.9348E-07	205.0045	0.1820383	
169521.							
417.600	-9.77E-06	322.2693	-13.0224	-1.9822E-07	204.7864	0.2341923	
172631.							
424.800	-1.06E-05	234.6112	-11.2491	-5.2118E-08	204.5947	0.2583882	
175742.							
432.000	-1.05E-05	160.3125	-9.3783	5.1490E-08	204.4322	0.2612744	
178852.							
439.200	-9.84E-06	99.5340	-7.5420	1.1966E-07	204.2993	0.2487959	
181963.							
446.400	-8.79E-06	51.6381	-5.8325	1.5932E-07	204.1946	0.2260700	
185073.							
453.600	-7.55E-06	15.4538	-4.3083	1.7692E-07	204.1154	0.1973386	
188183.							

460.800	-6.25E-06	-10.5027	-3.0003	1.7822E-07	204.1046	0.1659806	191294.
468.000	-4.98E-06	-27.8533	-1.9183	1.6816E-07	204.1425	0.1345681	194404.
475.200	-3.83E-06	-38.2236	-1.0561	1.5082E-07	204.1652	0.1049507	197515.
482.400	-2.81E-06	-43.1475	-0.3961604	1.2948E-07	204.1760	0.0783564	200625.
489.600	-1.96E-06	-44.0029	0.0857177	1.0661E-07	204.1779	0.0554987	203735.
496.800	-1.28E-06	-41.9746	0.4175670	8.4055E-08	204.1734	0.0366817	206846.
504.000	-7.51E-07	-38.0383	0.6284514	6.3064E-08	204.1648	0.0218974	209956.
511.200	-3.69E-07	-32.9612	0.7465622	4.4437E-08	204.1537	0.0109112	213067.
518.400	-1.11E-07	-27.3134	0.7978433	2.8624E-08	204.1414	0.0033335	216177.
525.600	4.35E-08	-21.4887	0.8050773	1.5821E-08	204.1286	-0.0013241	219287.
532.800	1.17E-07	-15.7294	0.7873232	6.0567E-09	204.1160	-0.0036076	222398.
540.000	1.31E-07	-10.1548	0.7595998	-7.3399E-10	204.1038	-0.0040933	225508.
547.200	1.06E-07	-4.7908	0.7327213	-4.6550E-09	204.0921	-0.0033729	228619.
554.400	6.37E-08	0.3990920	0.7132028	-5.8071E-09	204.0825	-0.0020489	231729.
561.600	2.26E-08	5.4827	0.2629801	-4.2640E-09	204.0936	-0.1230130	3.9186E+07
568.800	2.26E-09	4.1885	-0.2845668	-1.7268E-09	204.0908	-0.0290834	9.2740E+07
576.000	-2.26E-09	1.3859	-0.2842987	-2.6436E-10	204.0847	0.0291578	9.2753E+07
583.200	-1.55E-09	0.0947121	-0.1074869	1.2408E-10	204.0818	0.0199566	9.2766E+07
590.400	-4.77E-10	-0.1619620	-0.0135318	1.0644E-10	204.0820	0.0061421	9.2779E+07
597.600	-1.62E-11	-0.1002074	0.0093329	3.7656E-11	204.0819	0.0002093	9.2792E+07
604.800	6.56E-11	-0.0275895	0.0070421	4.1288E-12	204.0817	-0.0008456	9.2805E+07
612.000	4.32E-11	0.0011961	0.0019922	-2.7955E-12	204.0816	-0.0005571	9.2818E+07
619.200	2.53E-11	0.0010998	-1.5864E-05	-2.1932E-12	204.0816	-6.6402E-07	188602.
626.400	1.16E-11	0.0009689	-1.9370E-05	-1.6504E-12	204.0816	-3.0983E-07	191713.
633.600	1.58E-12	0.0008218	-2.0640E-05	-1.1806E-12	204.0816	-4.2839E-08	194823.
640.800	-5.36E-12	0.0006724	-2.0263E-05	-7.8861E-13	204.0816	1.4748E-07	197933.
648.000	-9.77E-12	0.0005305	-1.8750E-05	-4.7303E-13	204.0816	2.7288E-07	201044.
655.200	-1.22E-11	0.0004027	-1.6525E-05	-2.2822E-13	204.0816	3.4526E-07	204154.
662.400	-1.31E-11	0.0002927	-1.3928E-05	-4.5798E-14	204.0816	3.7593E-07	207265.
669.600	-1.28E-11	0.0002021	-1.1225E-05	8.4012E-14	204.0816	3.7505E-07	210375.
676.800	-1.18E-11	0.0001310	-8.6097E-06	1.7140E-13	204.0816	3.5134E-07	213485.
684.000	-1.04E-11	7.8044E-05	-6.2221E-06	2.2624E-13	204.0816	3.1189E-07	

```
216596.
 691.200 -8.59E-12  4.1259E-05 -4.1554E-06  2.5754E-13    204.0816  2.6217E-07
219706.
 698.400 -6.66E-12  1.8058E-05 -2.4698E-06  2.7310E-13    204.0816  2.0608E-07
222817.
 705.600 -4.66E-12  5.5370E-06 -1.2016E-06  2.7929E-13    204.0816  1.4619E-07
225927.
 712.800 -2.64E-12  5.9392E-07 -3.7328E-07  2.8090E-13    204.0816  8.3898E-08
229037.
 720.000 -6.14E-13      0.0000      0.0000  2.8106E-13    204.0816  1.9791E-08
116074.
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.34173921 in
Computed slope at pile head      =    -0.00404135
Maximum bending moment           =   502017.07093 lbs-in
Maximum shear force              =     9769.00000 lbs
Depth of maximum bending moment  =    86.40000000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             16
Number of zero deflection points =              8
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Slope (Pile-head Condition Type 2)

```
Specified shear force at pile head  =       26445.000 lbs
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =       40000.000 lbs
```

(Zero slope for this load indicates fixed-head conditions)

```
  Depth   Deflect.    Moment      Shear       Slope      Total       Soil Res.
Es*h
    X        y          M           V           S        Stress          p
F/L
    in       in        lbs-in        lbs         Rad.   lbs/in**2    lbs/in
lbs/in
-------- --------- ----------- ----------- ----------- ----------- -----------
-----------
   0.000  0.385996   -1559553.  26445.0000  2.3130E-17   3614.5381      0.0000
0.0000
   7.200  0.383050   -1369031.  26269.6933  -0.0007683   3197.9018    -48.6963
915.3200
  14.400  0.374932   -1180827.  25727.0324  -0.0014373   2786.3335   -102.0428
1959.5763
  21.600  0.362353    -997734.  24819.6940  -0.0020088   2385.9431   -149.9956
2980.4281
  28.800  0.346005    -822266.  23882.9574  -0.0024863   2002.2271   -110.2090
2293.3309
  36.000  0.326551    -652387.  23057.4994  -0.0028732   1630.7332   -119.0849
2625.6594
```

43.200	0.304632	-488583.	22170.5131	-0.0031725	1272.5237	-127.3002	3008.7520
50.400	0.280867	-331305.	21226.9747	-0.0033876	928.5841	-134.7938	3455.4297
57.600	0.255850	-180964.	20232.3062	-0.0035220	599.8159	-141.5030	3982.0993
64.800	0.230150	-37930.7551	19192.3837	-0.0035794	287.0292	-147.3644	4610.1376
72.000	0.204307	97468.4603	17544.4260	-0.0035638	417.2273	-310.4016	10938.9062
79.200	0.178831	216762.	15278.0880	-0.0034814	678.0998	-319.1367	12848.8856
86.400	0.154175	319478.	12937.9899	-0.0033407	902.7219	-330.8905	15452.6380
93.600	0.130726	404993.	10507.7671	-0.0031506	1089.7271	-344.1714	18955.9886
100.800	0.108806	472605.	7997.1690	-0.0029204	1237.5816	-353.2170	23373.3118
108.000	0.088672	521834.	5449.5958	-0.0026595	1345.2377	-354.4423	28779.9668
115.200	0.070510	552611.	2922.6169	-0.0023776	1412.5402	-347.4963	35484.1229
122.400	0.054435	565290.	475.6872	-0.0020843	1440.2663	-332.2064	43940.4231
129.600	0.040495	560661.	-1831.0010	-0.0017889	1430.1451	-308.5403	54857.8305
136.800	0.028674	539954.	-3937.2102	-0.0015002	1384.8611	-276.5178	69432.8117
144.000	0.018893	504830.	-5704.0137	-0.0012261	1308.0513	-214.2610	81654.4407
151.200	0.011019	458522.	-6950.9140	-0.0009733	1206.7852	-132.1002	86320.0407
158.400	0.004877	405297.	-7648.3228	-0.0007467	1090.3920	-61.6244	90985.6407
165.600	0.000266	348816.	-7882.8778	-0.0005489	966.8788	-3.5297	95651.2407
172.800	-0.003027	292100.	-7743.7358	-0.0003807	842.8503	42.1803	100317.
180.000	-0.005217	237526.	-7318.0420	-0.0002418	723.5070	76.0680	104982.
187.200	-0.006509	186859.	-6687.3363	-0.0001305	612.7085	99.1280	109648.
194.400	-0.007096	141303.	-5924.9180	-4.4362E-05	513.0860	112.6549	114314.
201.600	-0.007148	101566.	-5094.1275	1.9355E-05	426.1878	118.1203	118979.
208.800	-0.006817	67936.6930	-4247.4626	6.3824E-05	352.6467	117.0644	123645.
216.000	-0.006229	40365.7585	-3426.4105	9.2237E-05	292.3541	111.0056	128310.
223.200	-0.005489	18543.2540	-2661.8639	0.0001077	244.6323	101.3684	132976.
230.400	-0.004678	1972.8876	-1974.9801	0.0001131	208.3960	89.4326	137642.
237.600	-0.003860	-9961.5909	-1378.3458	0.0001110	225.8658	76.2992	142307.
244.800	-0.003080	-17939.2156	-877.3225	0.0001037	243.3114	62.8740	146973.
252.000	-0.002368	-22654.7428	-471.4625	9.3009E-05	253.6234	49.8649	151638.
259.200	-0.001741	-24781.8480	-155.9027	8.0564E-05	258.2750	37.7905	156304.
266.400	-0.001208	-24946.1466	77.3318	6.7518E-05	258.6343	26.9968	

160970.							
273.600	-0.000769	-23707.1605	238.1685	5.4753E-05	255.9248	17.6800	
165635.							
280.800	-0.000419	-21548.0583	337.5024	4.2881E-05	251.2033	9.9127	
170301.							
288.000	-0.000151	-18871.8247	386.4028	3.2276E-05	245.3509	3.6707	
174966.							
295.200	4.57E-05	-16002.4485	396.8817	2.3127E-05	239.0761	-0.7599392	
119755.							
302.400	0.000182	-13170.0495	382.9665	1.5474E-05	232.8821	-3.1054	
122865.							
309.600	0.000269	-10496.6433	354.8742	9.2648E-06	227.0359	-4.6980	
125975.							
316.800	0.000315	-8065.1978	317.6049	4.3951E-06	221.7187	-5.6545	
129086.							
324.000	0.000332	-5925.6643	275.3171	7.2462E-07	217.0400	-6.0921	
132196.							
331.200	0.000326	-4101.0489	231.3424	-1.9059E-06	213.0499	-6.1231	
135307.							
338.400	0.000304	-2593.2362	188.2350	-3.6621E-06	209.7526	-5.8511	
138417.							
345.600	0.000273	-1388.3549	147.8460	-4.7067E-06	207.1177	-5.3680	
141527.							
352.800	0.000237	-461.5434	111.4117	-5.1920E-06	205.0909	-4.7526	
144638.							
360.000	0.000198	218.9645	79.6513	-5.2557E-06	204.5605	-4.0698	
147748.							
367.200	0.000161	688.4622	52.8636	-5.0176E-06	205.5872	-3.3713	
150859.							
374.400	0.000126	983.0902	31.0214	-4.5791E-06	206.2315	-2.6960	
153969.							
381.600	9.50E-05	1137.8081	13.8576	-4.0227E-06	206.5698	-2.0717	
157079.							
388.800	6.81E-05	1184.9565	0.9412204	-3.4133E-06	206.6729	-1.5162	
160190.							
396.000	4.58E-05	1153.3277	-8.2573	-2.7998E-06	206.6037	-1.0390	
163300.							
403.200	2.78E-05	1067.6639	-14.3132	-2.2171E-06	206.4164	-0.6432026	
166411.							
410.400	1.39E-05	948.4950	-17.8054	-1.6882E-06	206.1558	-0.3268544	
169521.							
417.600	3.52E-06	812.2388	-19.2858	-1.2263E-06	205.8578	-0.0843706	
172631.							
424.800	-3.78E-06	671.4860	-19.2577	-8.3703E-07	205.5500	0.0921692	
175742.							
432.000	-8.53E-06	535.4098	-18.1627	-5.2040E-07	205.2525	0.2119971	
178852.							
439.200	-1.13E-05	410.2426	-16.3742	-2.7230E-07	204.9788	0.2848174	
181963.							
446.400	-1.25E-05	299.7783	-14.1963	-8.6031E-08	204.7372	0.3201634	
185073.							
453.600	-1.25E-05	205.8660	-11.8667	4.6625E-08	204.5318	0.3269337	
188183.							
460.800	-1.18E-05	128.8709	-9.5626	1.3444E-07	204.3634	0.3130868	
191294.							
468.000	-1.06E-05	68.0867	-7.4078	1.8611E-07	204.2305	0.2854686	
194404.							
475.200	-9.10E-06	22.0909	-5.4811	2.0977E-07	204.1299	0.2497474	
197515.							
482.400	-7.55E-06	-10.9613	-3.8244	2.1269E-07	204.1056	0.2104319	
200625.							
489.600	-6.04E-06	-33.1031	-2.4514	2.0113E-07	204.1540	0.1709472	
203735.							

496.800	-4.66E-06	-46.3780	-1.3545	1.8028E-07	204.1831	0.1337499	206846.
504.000	-3.45E-06	-52.7123	-0.5113632	1.5428E-07	204.1969	0.1004647	209956.
511.200	-2.43E-06	-53.8305	0.1096059	1.2633E-07	204.1994	0.0720267	213067.
518.400	-1.63E-06	-51.2067	0.5446572	9.8776E-08	204.1936	0.0488209	216177.
525.600	-1.01E-06	-46.0443	0.8313243	7.3262E-08	204.1823	0.0308089	219287.
532.800	-5.71E-07	-39.2779	1.0057	5.0878E-08	204.1675	0.0176389	222398.
540.000	-2.79E-07	-31.5910	1.1007	3.2286E-08	204.1507	0.0087360	225508.
547.200	-1.06E-07	-23.4466	1.1443	1.7847E-08	204.1329	0.0033701	228619.
554.400	-2.19E-08	-15.1239	1.1589	7.7276E-09	204.1147	0.0007058	231729.
561.600	5.14E-09	-6.7623	0.9504408	1.9858E-09	204.0964	-0.0586226	8.2097E+07
568.800	6.67E-09	-1.4387	0.4989803	-1.6573E-10	204.0848	-0.0667831	7.2139E+07
576.000	2.75E-09	0.4231312	0.1308089	-4.3216E-10	204.0826	-0.0354867	9.2753E+07
583.200	4.42E-10	0.4452325	-0.0174623	-2.0434E-10	204.0826	-0.0056997	9.2766E+07
590.400	-1.88E-10	0.1717920	-0.0292652	-4.2468E-11	204.0820	0.0024212	9.2779E+07
597.600	-1.69E-10	0.0238380	-0.0127006	8.8551E-12	204.0817	0.0021801	9.2792E+07
604.800	-6.04E-11	-0.0111024	-0.0020506	1.2196E-11	204.0817	0.0007782	9.2805E+07
612.000	6.47E-12	-0.0056976	0.0004510	7.7888E-12	204.0816	-8.3344E-05	9.2818E+07
619.200	5.18E-11	-0.0046125	0.0001461	5.0840E-12	204.0816	-1.3564E-06	188602.
626.400	7.97E-11	-0.0035970	0.0001336	2.9302E-12	204.0816	-2.1215E-06	191713.
633.600	9.40E-11	-0.0026909	0.0001168	1.2806E-12	204.0816	-2.5429E-06	194823.
640.800	9.81E-11	-0.0019163	9.7902E-05	7.1869E-14	204.0816	-2.6972E-06	197933.
648.000	9.50E-11	-0.0012812	7.8641E-05	-7.6699E-13	204.0816	-2.6530E-06	201044.
655.200	8.71E-11	-0.0007834	6.0203E-05	-1.3086E-12	204.0816	-2.4688E-06	204154.
662.400	7.62E-11	-0.0004135	4.3421E-05	-1.6227E-12	204.0816	-2.1926E-06	207265.
669.600	6.37E-11	-0.0001572	2.8827E-05	-1.7724E-12	204.0816	-1.8613E-06	210375.
676.800	5.06E-11	2.6151E-06	1.6720E-05	-1.8129E-12	204.0816	-1.5017E-06	213485.
684.000	3.76E-11	8.4599E-05	7.2424E-06	-1.7901E-12	204.0816	-1.1310E-06	216596.
691.200	2.49E-11	0.0001079	4.3882E-07	-1.7396E-12	204.0816	-7.5886E-07	219706.
698.400	1.25E-11	9.1920E-05	-3.6910E-06	-1.6871E-12	204.0816	-3.8831E-07	222817.
705.600	5.74E-13	5.5759E-05	-5.1538E-06	-1.6484E-12	204.0816	-1.8014E-08	225927.
712.800	-1.12E-11	1.8655E-05	-3.9373E-06	-1.6289E-12	204.0816	3.5593E-07	229037.
720.000	-2.29E-11	0.0000	0.0000	-1.6240E-12	204.0816	7.3776E-07	

116074.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

```
Pile-head deflection            =     0.38599599 in
Computed slope at pile head     =   2.312965E-17
Maximum bending moment          =      -1559553. lbs-in
Maximum shear force             =    26445.00000 lbs
Depth of maximum bending moment =        0.00000 in
Depth of maximum shear force    =        0.00000 in
Number of iterations            =             14
Number of zero deflection points =             7
```

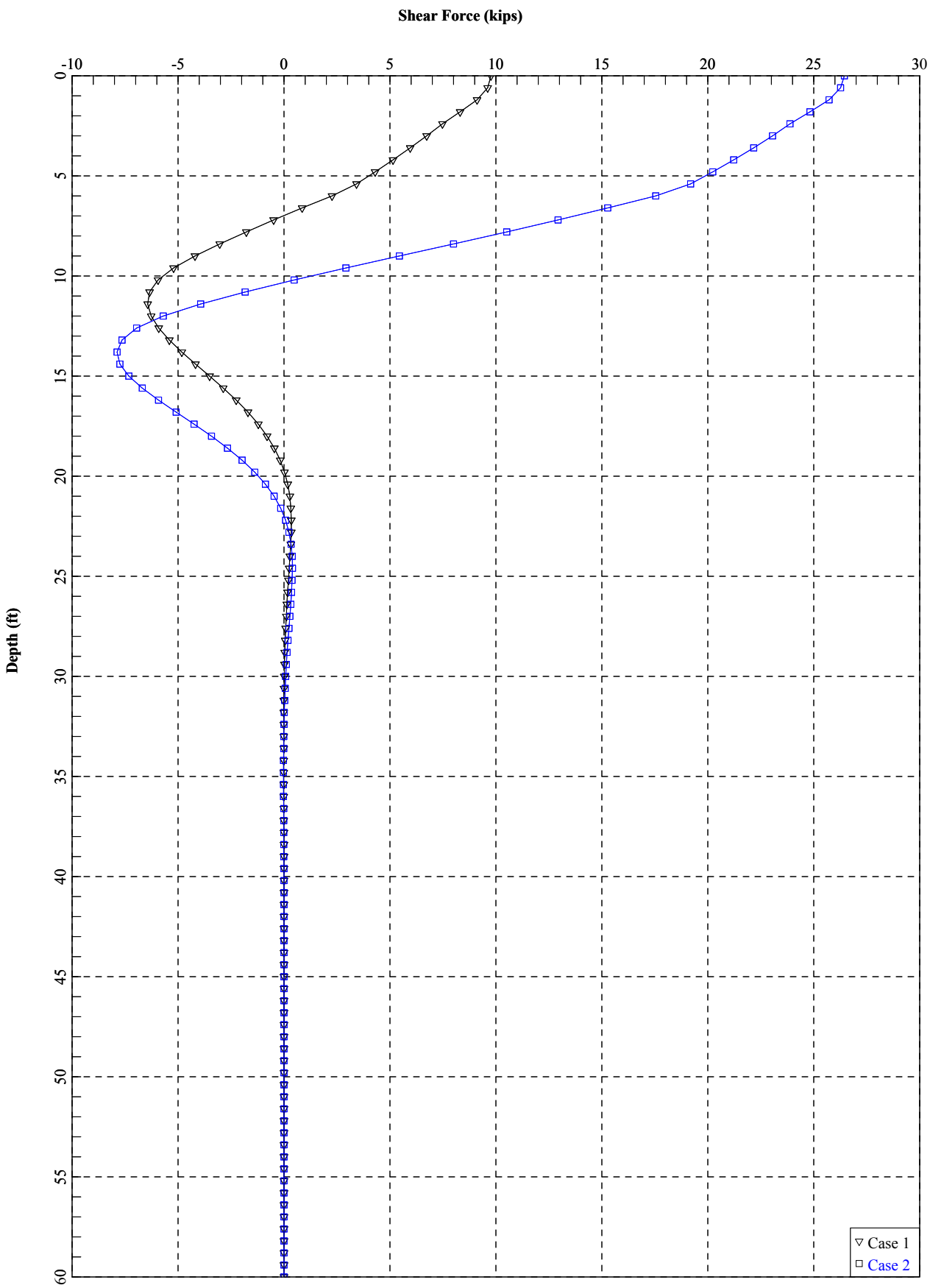
Summary of Pile Response(s)

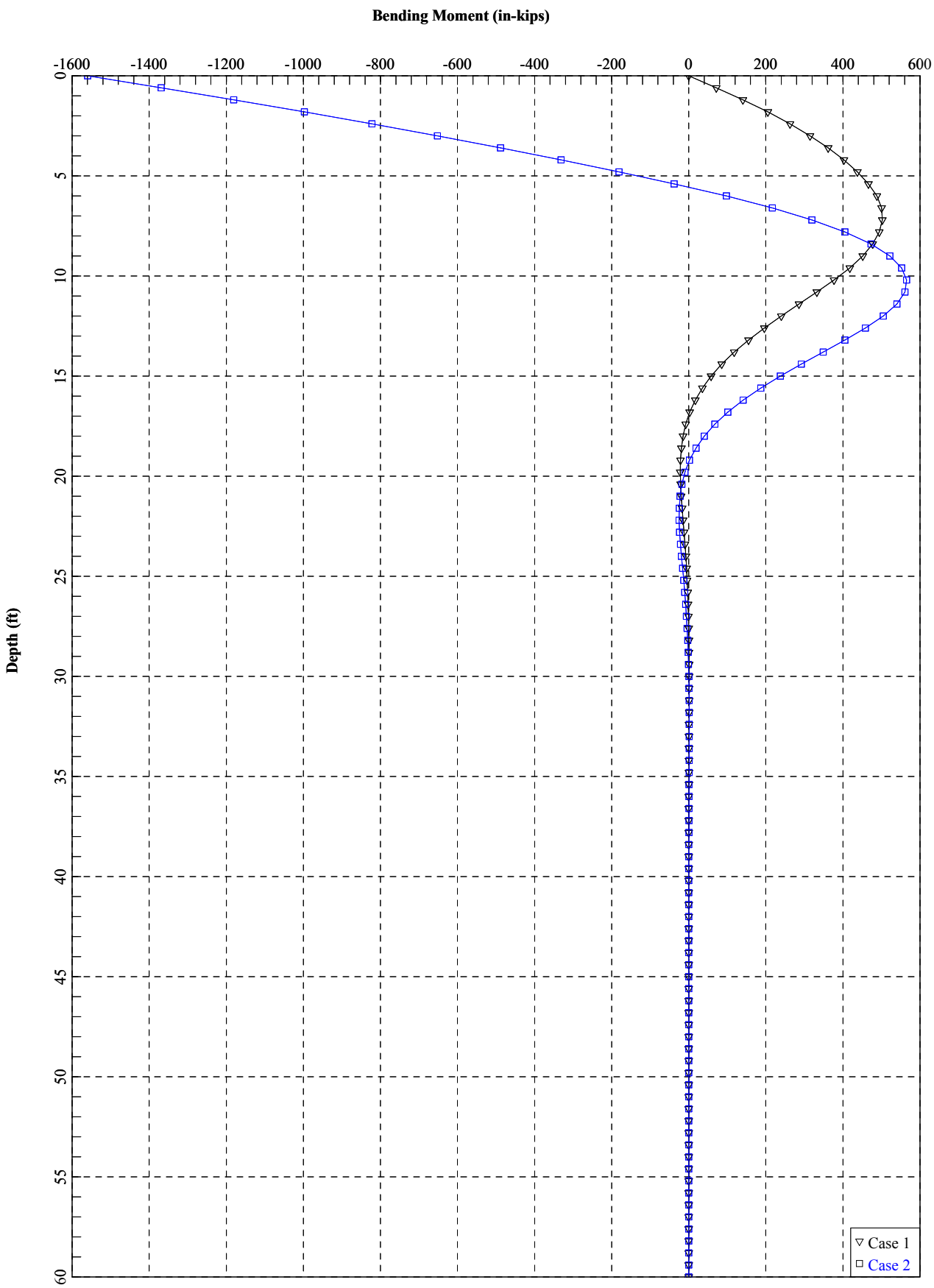
Definition of Symbols for Pile-Head Loading Conditions:

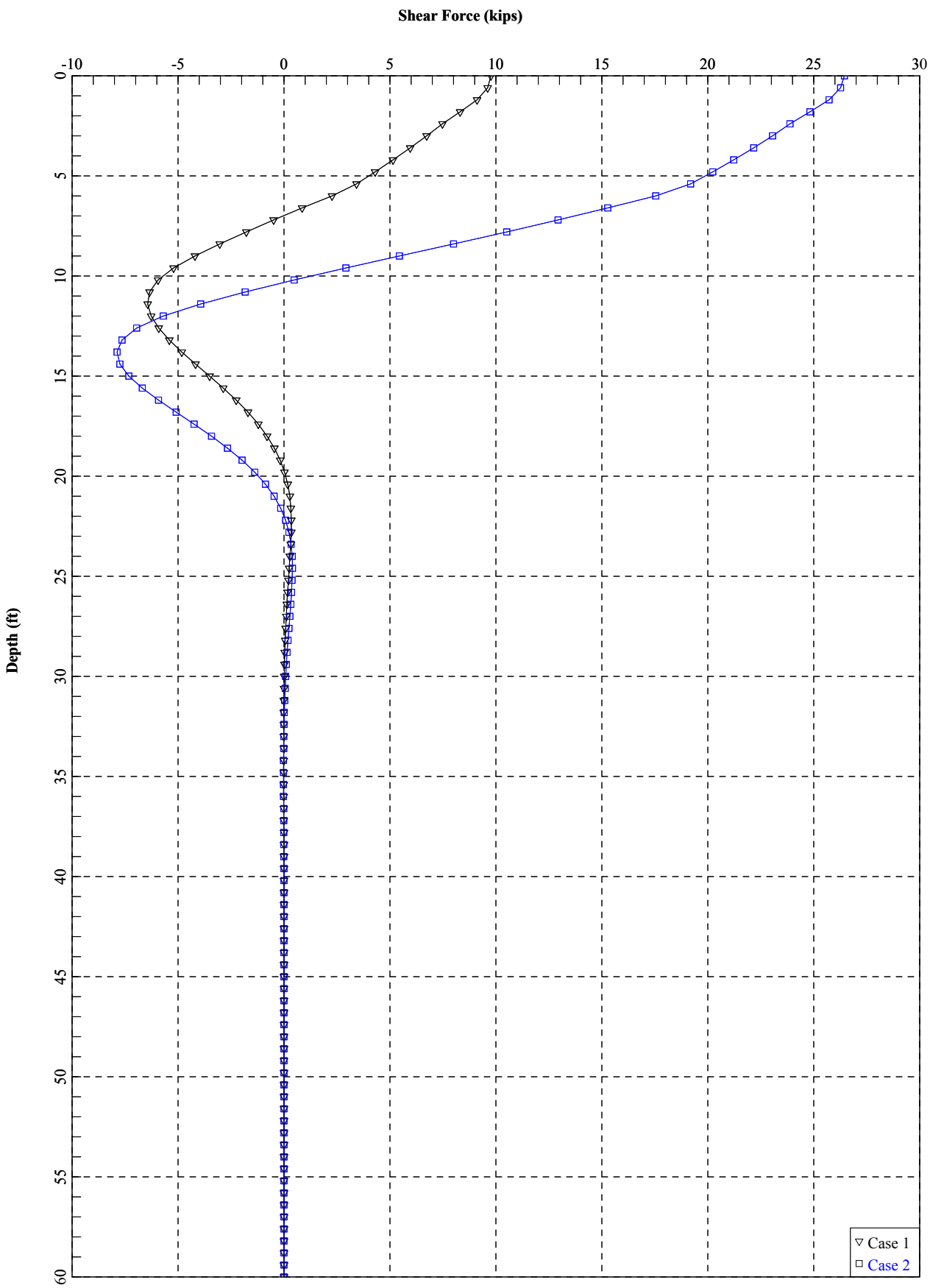
```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

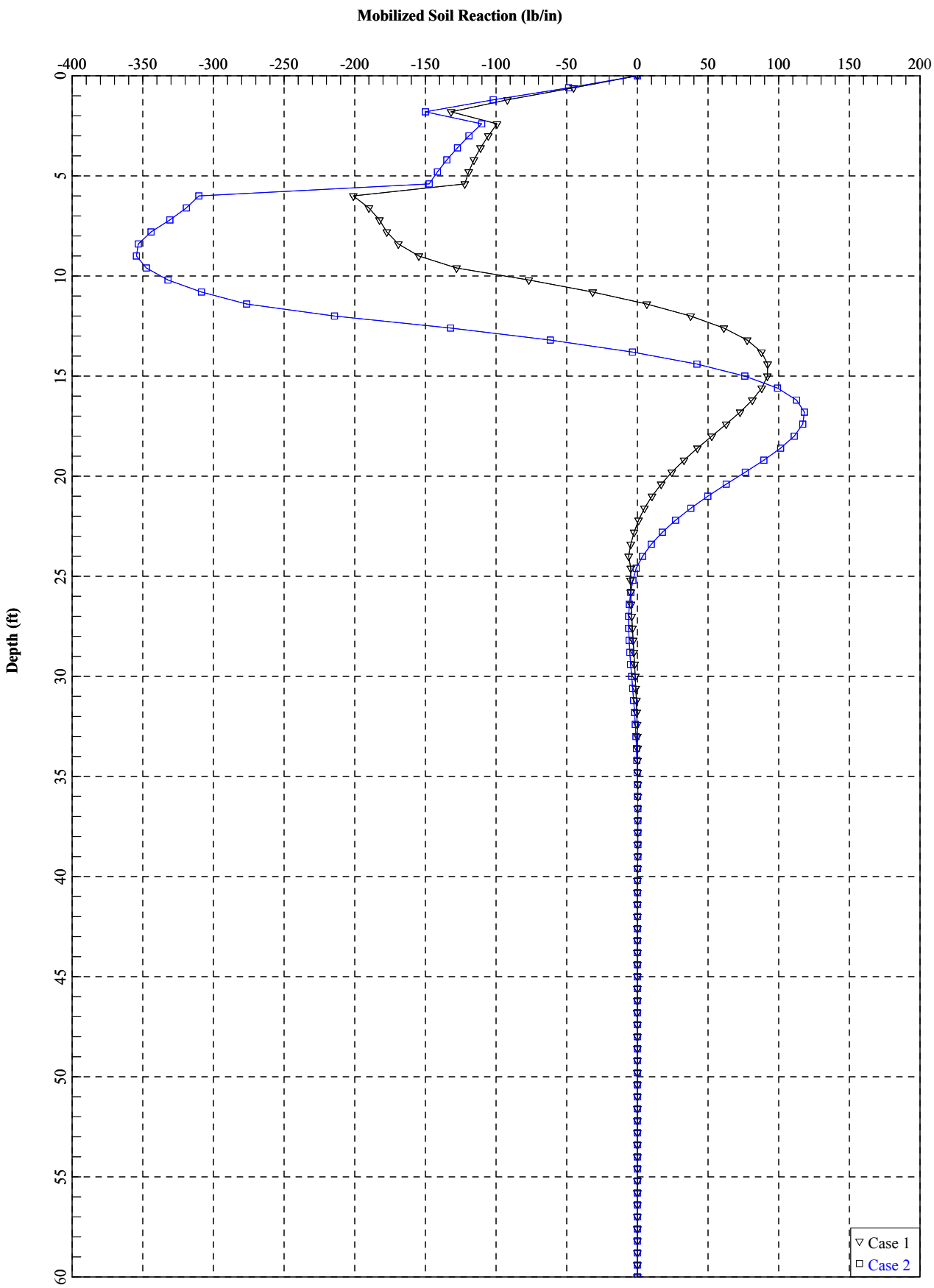
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 9769.000	M= 0.000	40000.0000	0.3417392	502017.	9769.0000
2	V= 26445.	S= 0.000	40000.0000	0.3859960	-1559553.	26445.0000

The analysis ended normally.


Shear Force (kips)
-10
-5
0
5
10
15
20
25
30
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2


Bending Moment (in-kips)
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2


Shear Force (kips)
-10
-5
0
5
10
15
20
25
30
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2


Mobilized Soil Reaction (lb/in)
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Case 1
Case 2

APPENDIX VI

SUMMARY OF CBR TEST RESULTS

SUMMARY OF CBR TEST RESULTS

Project: Measurement Systems Laboratory - NASA Langley Research Center

Project Location: Hampton, Virginia

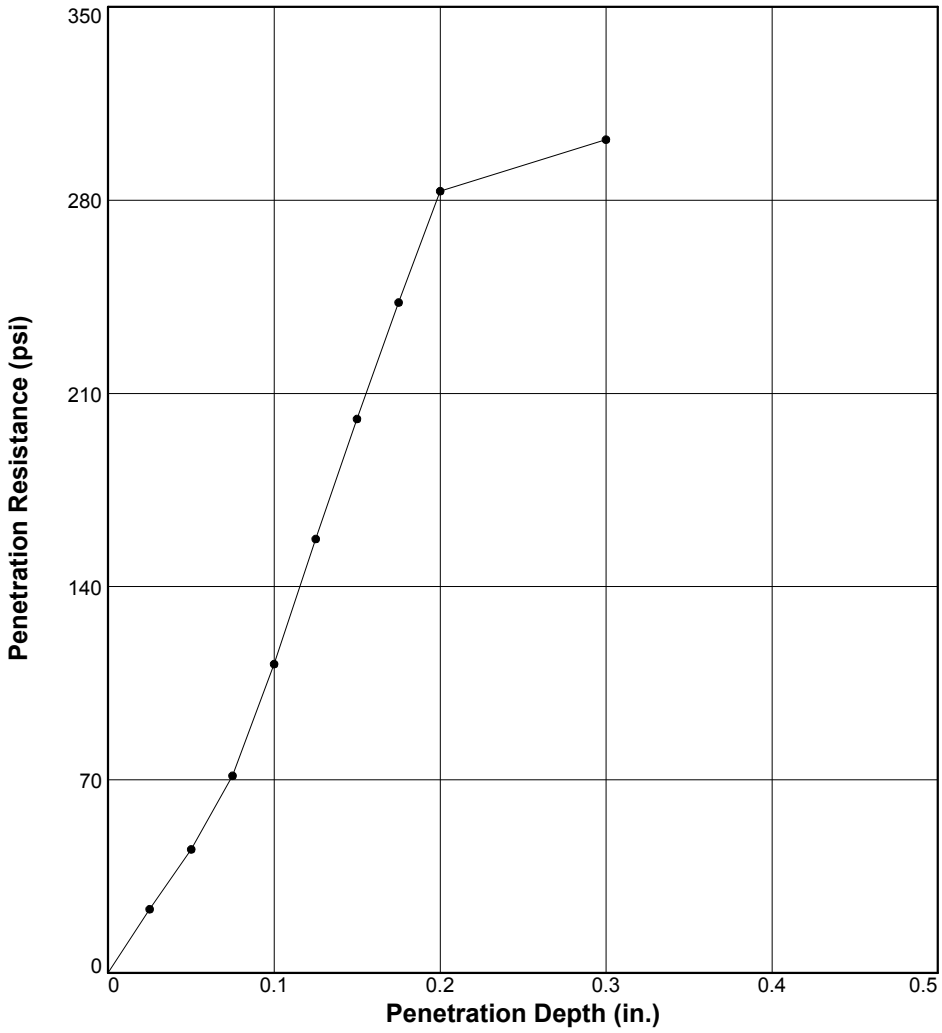
Client: AECOM

Project Number: WM11-175G

Sample Number	Sample Location	Sample Depth (ft)	USCS Symbol	Natural Moisture Content (%)	Atterberg Limits (LL/PL/PI)	Passing #200 Sieve (%)	Maximum Dry Density (pcf)	Optimum Moisture (%)	Soaked CBR Value	Resiliency Factor	Swell (%)
CBR-1	CBR-1	1-2	SC	25	34/16/18	48.0	120.5	14.3	18.9	2.5	0.6
CBR-2	CBR-2	1-2	SC	9	26/19/7	36.9	122.7	11.7	20.7	3.0	0.3
CBR-3	CBR-3	1-2	SC	23	21/15/6	42.3	123.5	11.9	20.5	2.5	0.4
CBR-4	CBR-4	1.8-2.5	SC	17	29/16/13	46.1	122.6	13.5	17.0	2.5	0.4
CBR-5	CBR-5	1.2-2	SC	20	26/16/10	39.5	123.0	12.4	17.4	2.5	0.3

GET Solutions, Inc.
Geotechnical • Environmental • Testing
1592 Penniman Road, Suite E
Williamsburg, Virginia 23185
Tel: 757-564-6452 Fax: 757-564-6453

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	120.5	100	13.8	119.9	99.5	17.9	11.2	18.9	0.000	10	0.6
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Grayish brown, Clayey, fine to medium SAND (SC)	SC	120.5	14.3	34	18

Project No: WM11-175G

Project: Measurement Systems Laboratory - NASA Langley Research Center

Location: CBR #1 - See Attached Boring Location Plan

Sample Number: CBR #1 **Depth:** 1-2 Ft Below G.

Date: 2/25/2012

Test Description/Remarks:

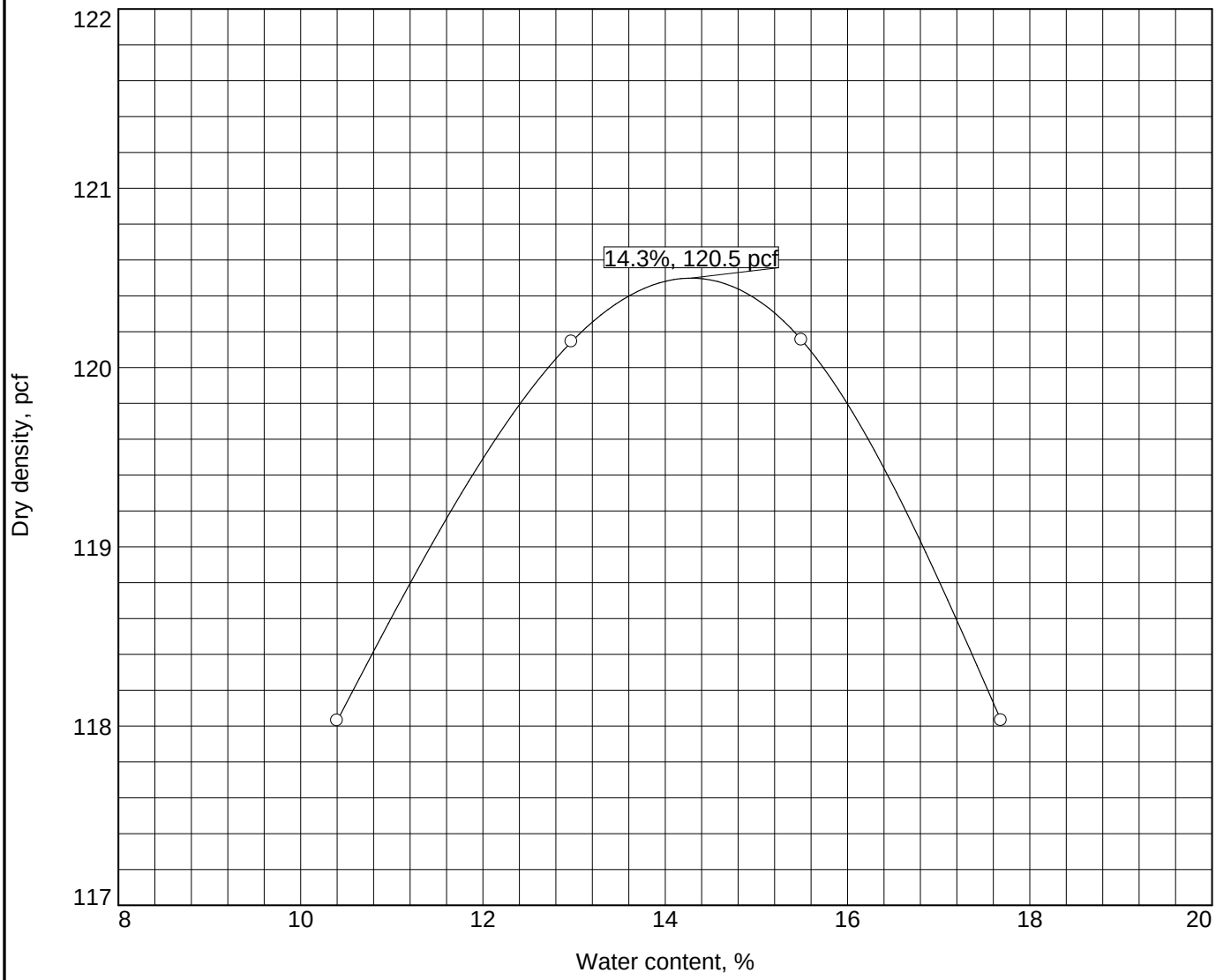
CBR #1
Sample Obtained: 2/25/2012
Sample Tested: 3/6/2012

BEARING RATIO TEST REPORT

GET Solutions, Inc.

Figure 1

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 1557-91 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 Ft Below G.	SC	A-6(5)		Estimated	35	19	0.0	48.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 120.5 pcf Optimum moisture = 14.3 %	Grayish brown, Clayey, fine to medium SAND (SC)

Project No. WM11-175 **Client:** AECOM

Project: Measurement Systems Laboratory - NASA Langley Research Center

○**Loc.:** CBR #1A - See Attached Boring Loaction Plan **Sample No.:** CBR #1A

GET Solutions, Inc.

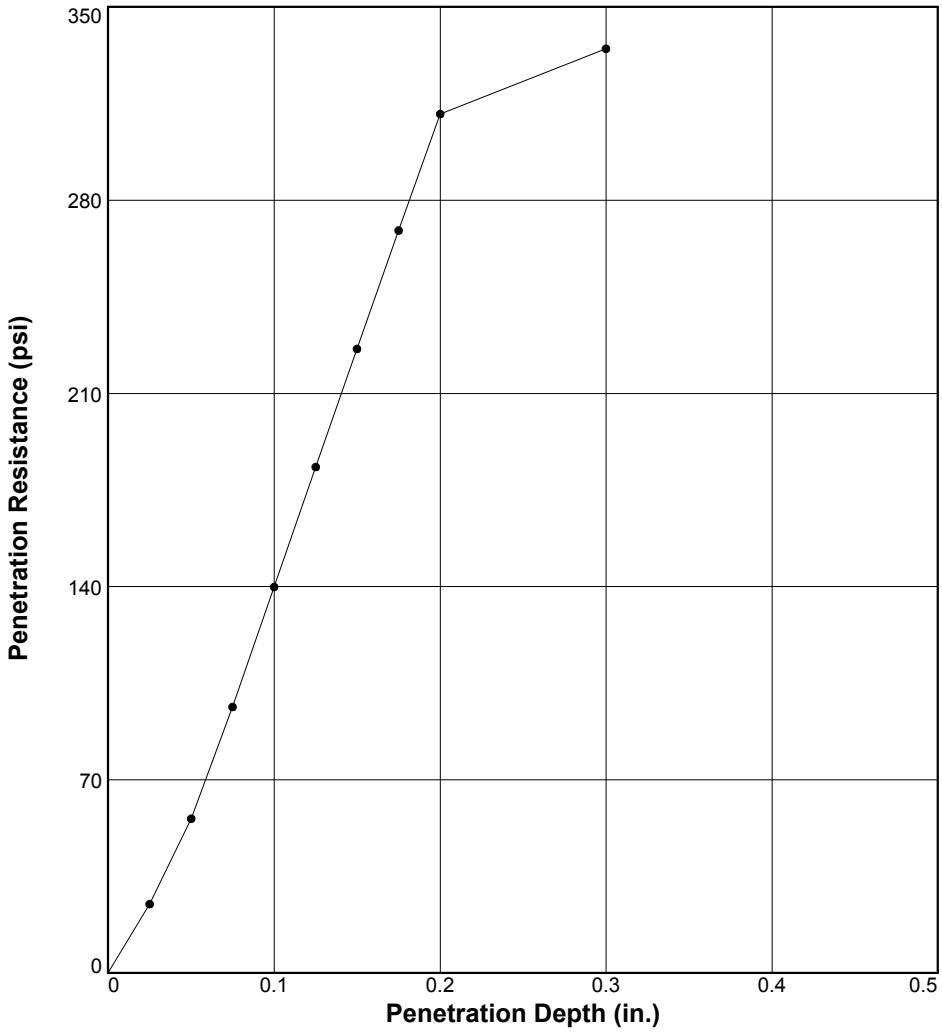
Williamsburg, VA

Remarks:

CBR #1A
Sample Obtained: 2/25/12
Sample Tested: 3/6/12

Figure 1a

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	122.7	100	11.2	122.3	99.7	15.4	14.0	20.7	0.000	10	0.3
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Dark brown and gray, Clayey, fine to medium SAND (SC) with trace Gravel and organics	SC	122.7	11.7	26	7

Project No: WM11-175G

Project: Measurement Systems Laboratory - NASA Langley Research Center

Location: CBR #2 - See Attached Boring Location Plan

Sample Number: CBR #2 **Depth:** 1-2 Ft Below G.

Date: 2/25/2012

Test Description/Remarks:

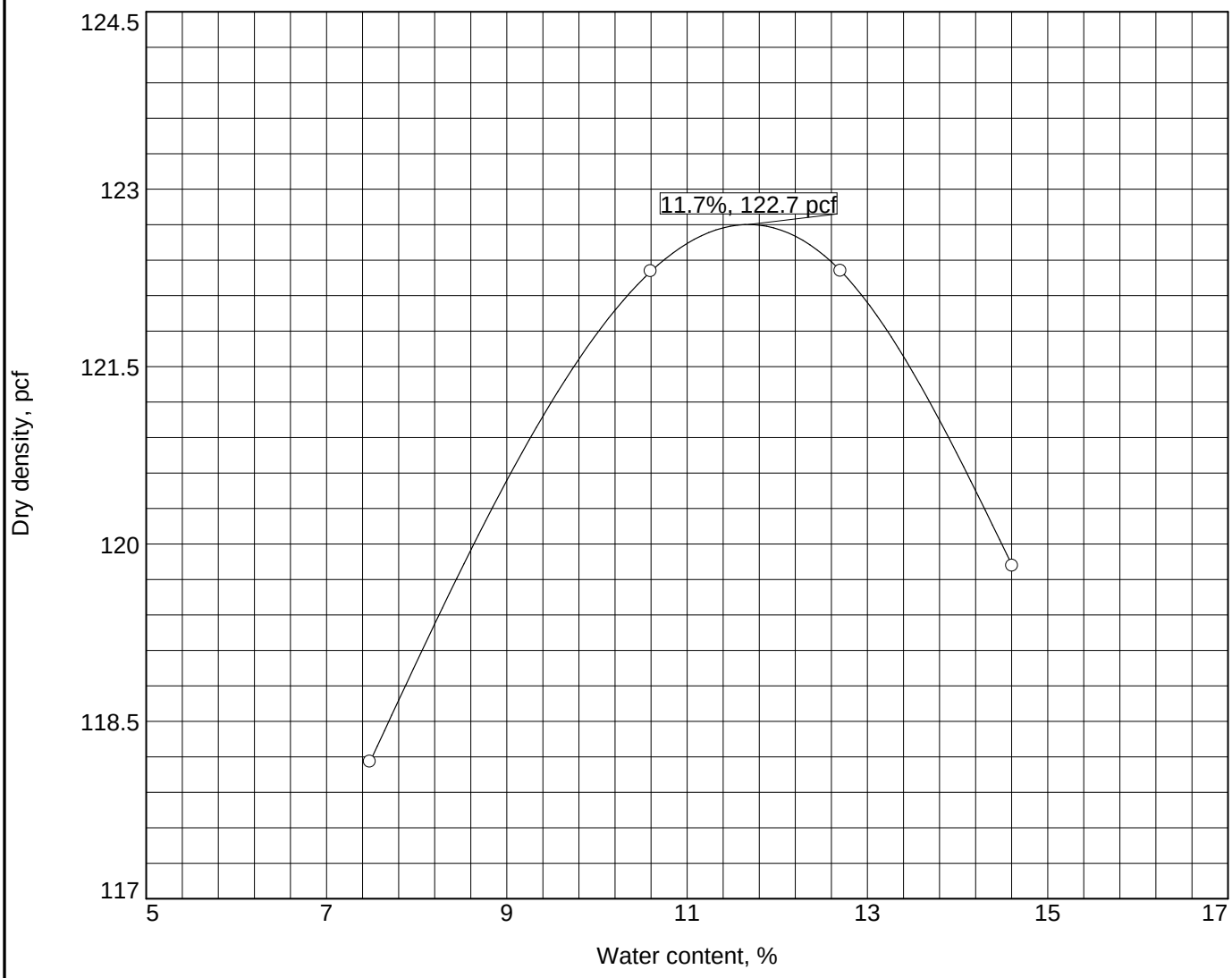
CBR #2
Sample Obtained: 2/25/2012
Sample Tested: 3/6/2012

BEARING RATIO TEST REPORT

GET Solutions, Inc.

Figure 2

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 1557-91 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 Ft Below G.	SC	A-4(0)		Estimated	27	8	1.5	36.9

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 122.7 pcf Optimum moisture = 11.7 %	Dark brown and gray, Clayey, fine to medium SAND (SC) with trace Gravel and organics

Project No. WM11-175 **Client:** AECOM

Project: Measurement Systems Laboratory - NASA Langley Research Center

○**Location:** CBR #2 - See Attached Boring Loaction Plan

Remarks:

CBR #2
Sample Obtained: 2/25/12
Sample Tested: 3/6/12

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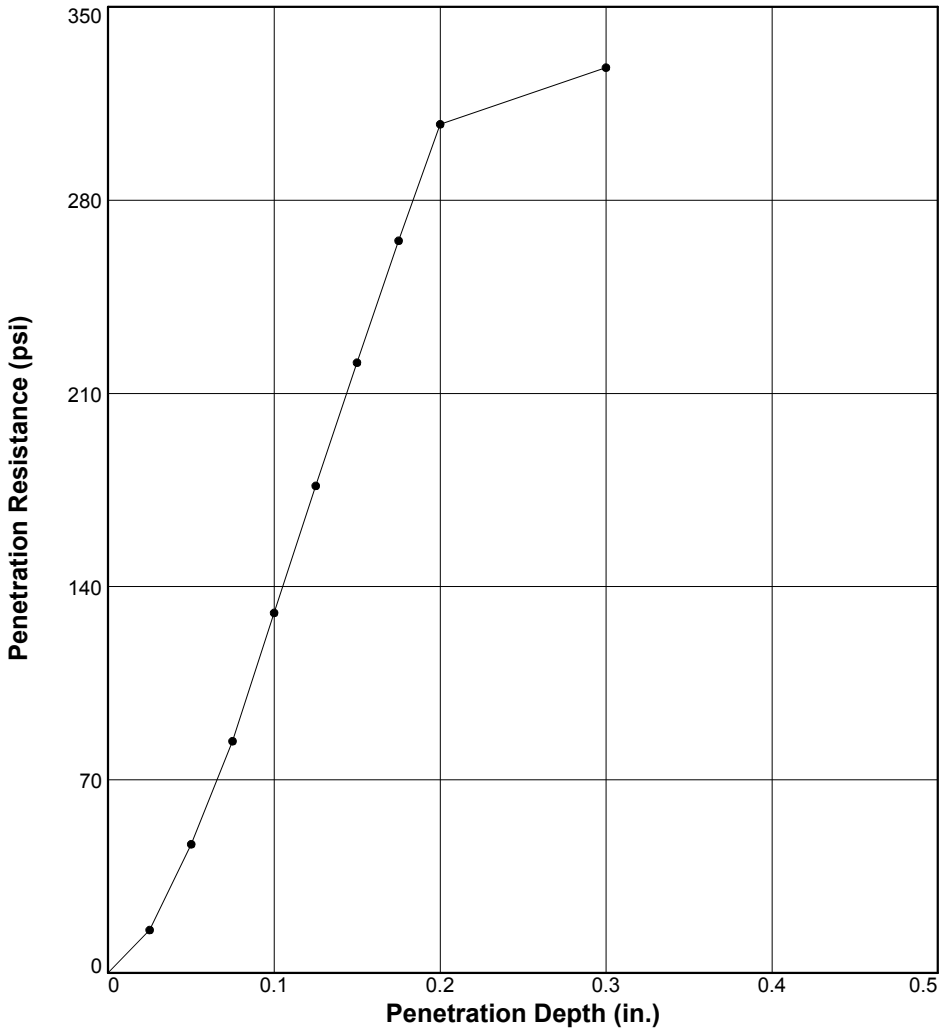
Figure 2a

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	123.5	100	11.4	122.9	99.5	15.7	13.0	20.5	0.000	10	0.4
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Gray, Clayey, fine to medium SAND (SC) with trace Gravel and organics	SC	123.5	11.9	21	6

Project No: WM11-175G

Project: Measurement Systems Laboratory - NASA Langley Research Center

Location: CBR #3 - See Attached Boring Location Plan

Sample Number: CBR #3 **Depth:** 1-2 Ft Below G.

Date: 2/25/2012

Test Description/Remarks:

CBR #3
Sample Obtained: 2/25/2012
Sample Tested: 3/6/2012

BEARING RATIO TEST REPORT

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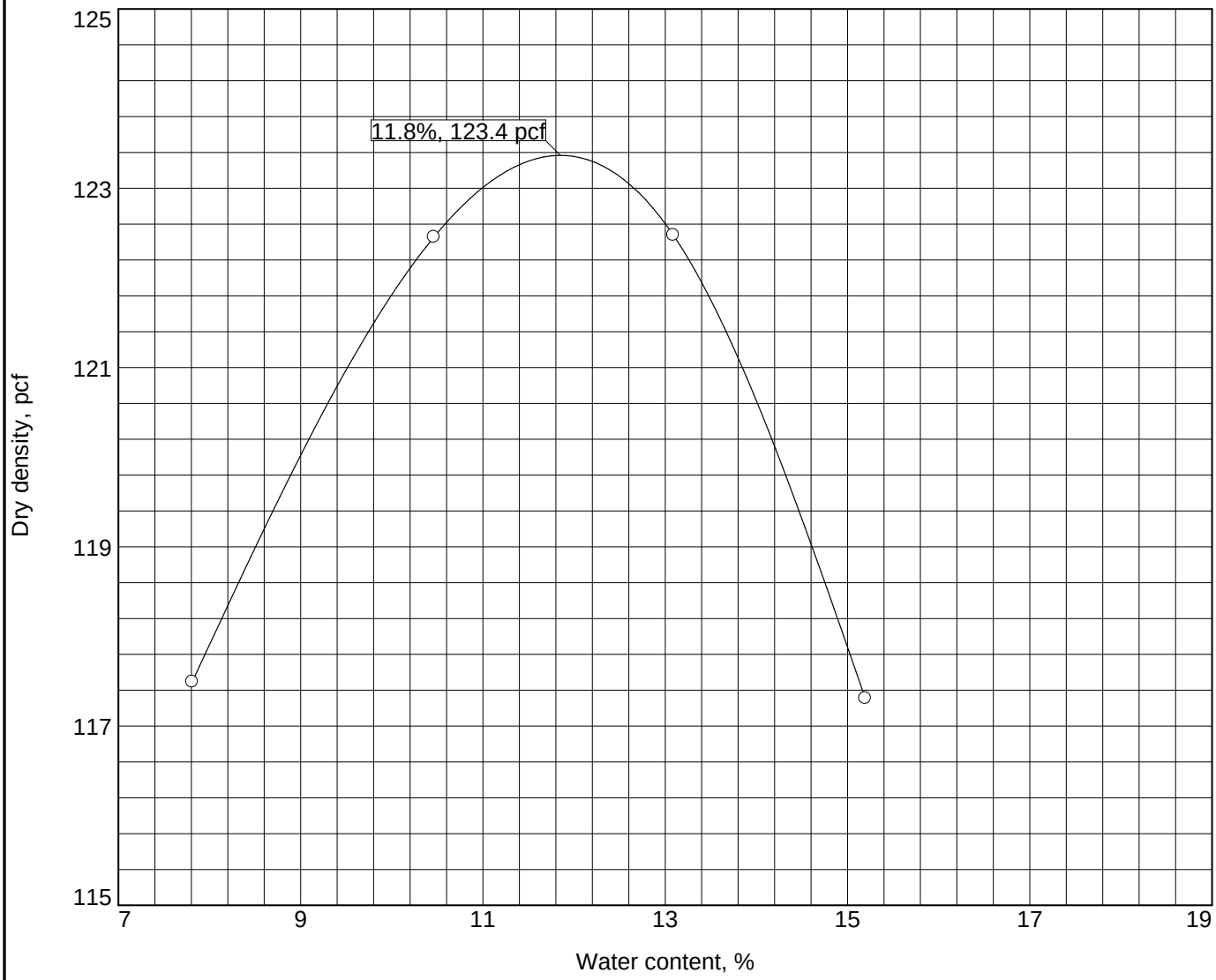
Figure 3

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 1557-91 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 Ft Below G.	SC-SM	A-4(0)		Estimated	22	7	2.2	42.3

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 123.4 pcf Optimum moisture = 11.8 %	Gray, Clayey, fine to medium SAND (SC) with trace Gravel and organics

Project No. WM11-175 **Client:** AECOM

Project: Measurement Systems Laboratory - NASA Langley Research Center

○**Location:** CBR #3 - See Attached Boring Loaction Plan

Remarks:

CBR #3
Sample Obtained: 2/25/12
Sample Tested: 3/6/12

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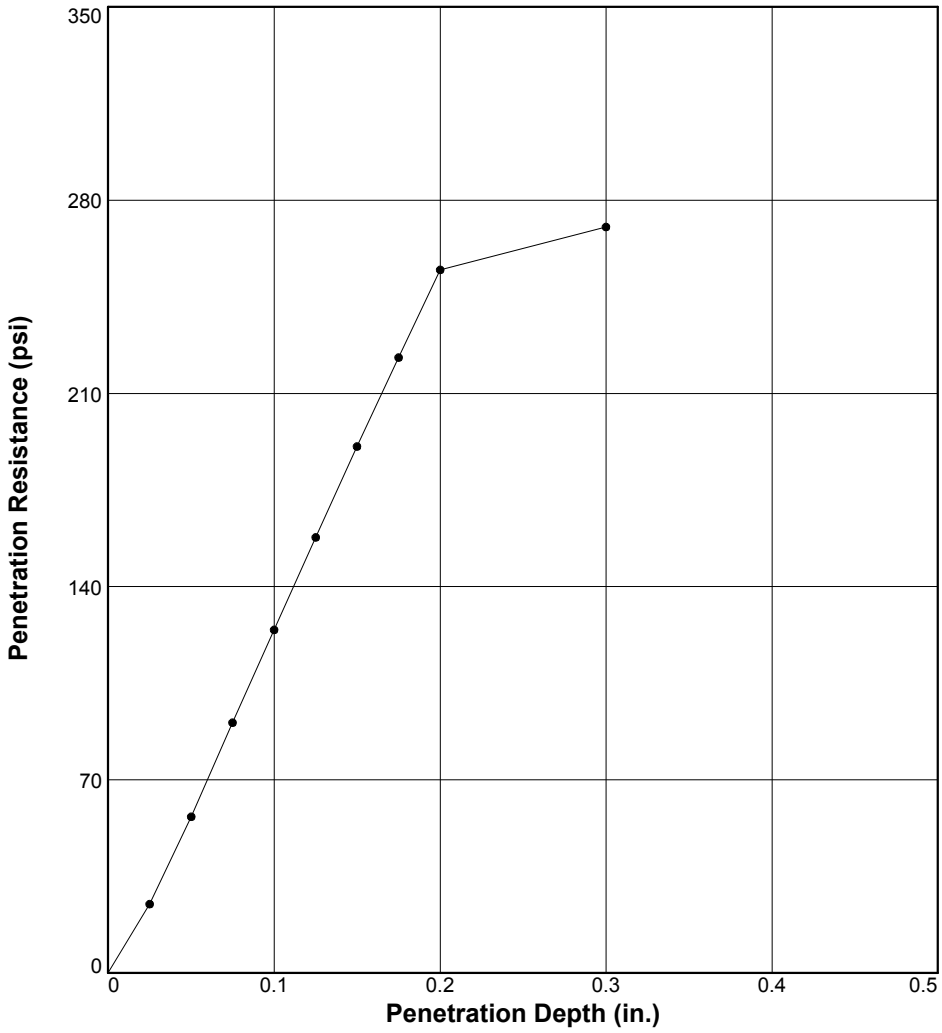
Figure

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	122.6	100	13.0	122.0	99.6	17.6	12.4	17.0	0.000	10	0.4
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Gray, Clayey, fine to medium SAND (SC) with trace Gravel	SC	122.6	13.5	29	13

Project No: WM11-175G

Project: Measurement Systems Laboratory - NASA Langley Research Center

Location: CBR #4 - See Attached Boring Location Plan

Sample Number: CBR #4 **Depth:** 1.8-2.5 Ft Below G.

Date: 2/25/2012

Test Description/Remarks:

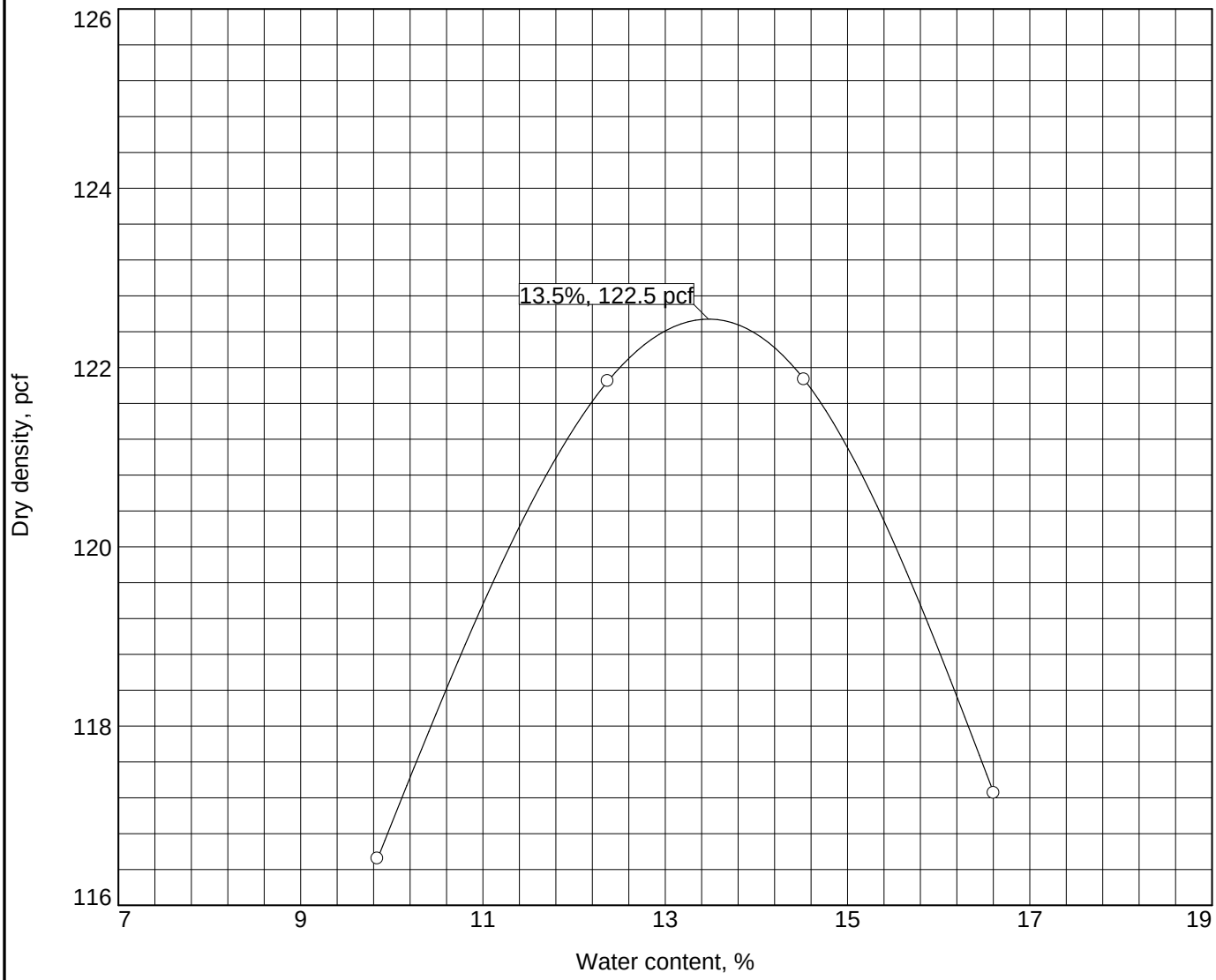
CBR #4
Sample Obtained: 2/25/2012
Sample Tested: 3/6/2012

BEARING RATIO TEST REPORT

GET Solutions, Inc.

Figure 4

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 1557-91 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1.8-2.5 Ft Below G.	SC	A-6(3)		Estimated	28	12	2.7	46.1

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 122.5 pcf Optimum moisture = 13.5 %	Gray, Clayey, fine to medium SAND (SC) with trace Gravel

Project No. WM11-175 **Client:** AECOM

Project: Measurement Systems Laboratory - NASA Langley Research Center

○**Location:** CBR #4 - See Attached Boring Loaction Plan

Remarks:

CBR #4
Sample Obtained: 2/25/12
Sample Tested: 3/6/12

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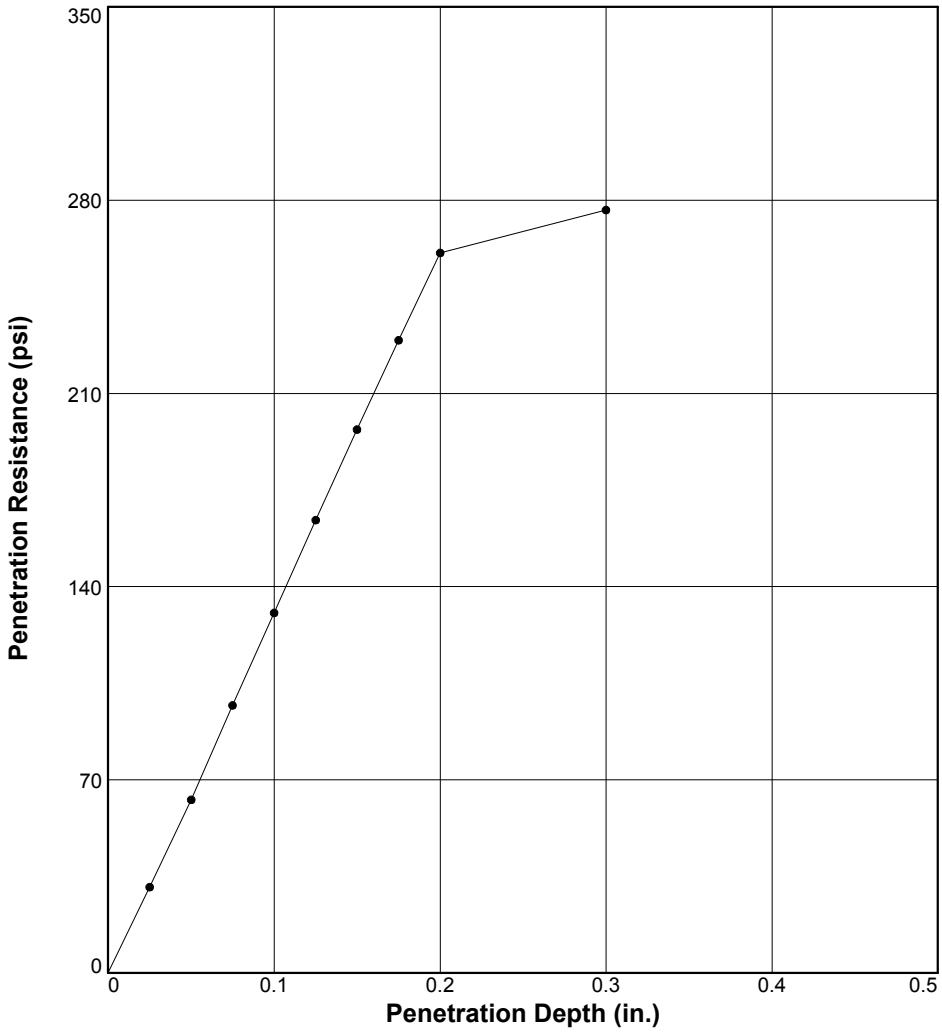
Figure 4a

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	123.0	100	11.9	122.6	99.7	16.4	13.0	17.4	0.000	10	0.3
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Dark gray, Clayey, fine to medium SAND (SC) with trace Gravel and organics	SC	123.0	12.4	26	10

Project No: WM11-175G

Project: Measurement Systems Laboratory - NASA Langley Research Center

Location: CBR #5 - See Attached Boring Location Plan

Sample Number: CBR #5 **Depth:** 1.2-2 Ft Below G.

Date: 2/25/2012

Test Description/Remarks:

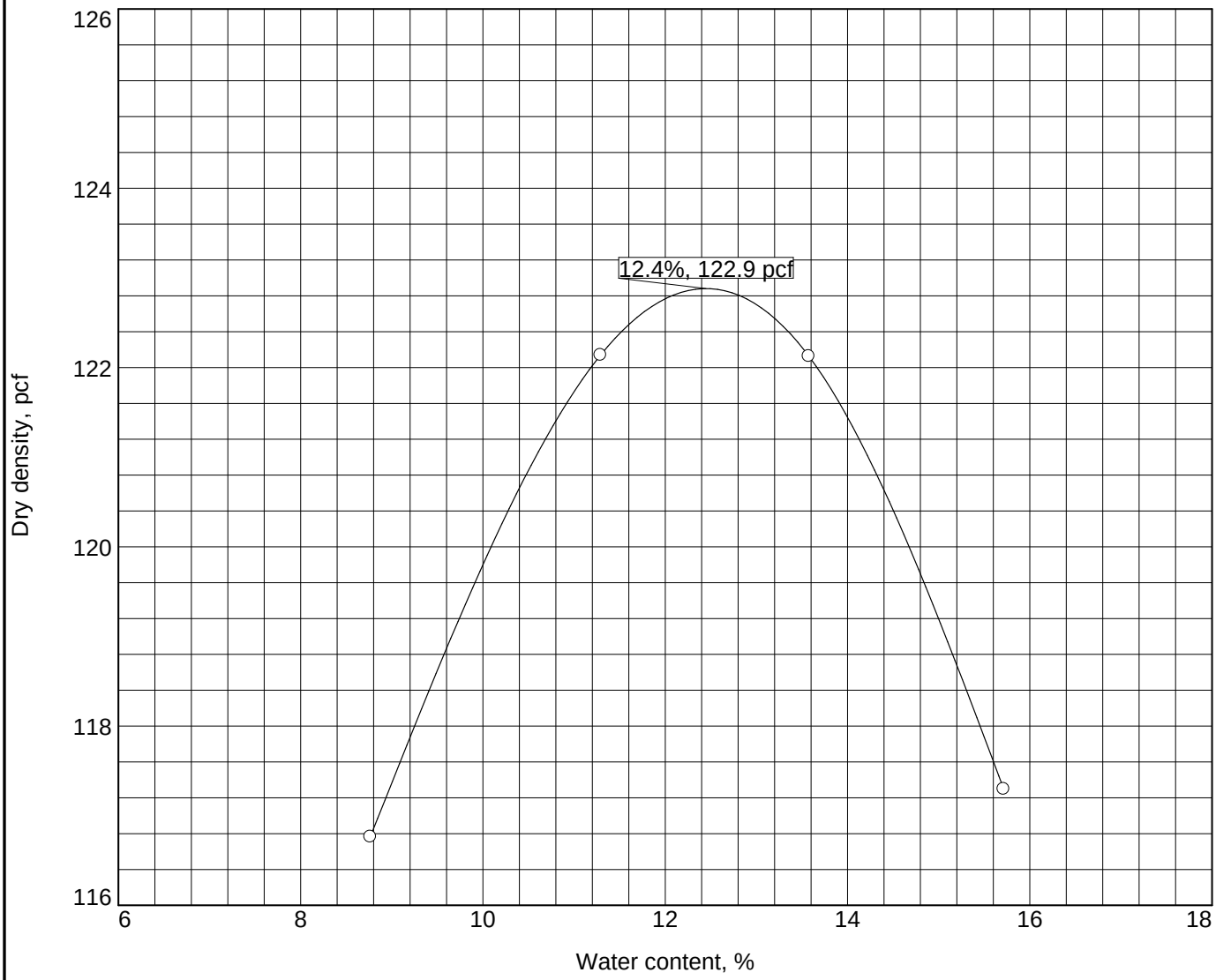
CBR #5
Sample Obtained: 2/25/2012
Sample Tested: 3/6/2012

BEARING RATIO TEST REPORT

GET Solutions, Inc.

Figure 5

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 1557-91 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1.2-2 Ft Below G.	SC	A-4(1)	20	Estimated	26	10	1.8	39.5

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 122.9 pcf Optimum moisture = 12.4 %	Dark gray, Clayey, fine to medium SAND (SC) with trace Gravel and organics

Project No. WM11-175 **Client:** AECOM

Project: Measurement Systems Laboratory - NASA Langley Research Center

○**Location:** CBR #5 - See Attached Boring Loaction Plan

Remarks:

CBR #5
Sample Obtained: 2/25/12
Sample Tested: 3/6/12

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Figure 5a

APPENDIX VII

INFILTRATION TEST RESULTS

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name……:	Measurement Systems Laboratory	**Project No……:**	WM11-175G
Boring No……:	INF-1	**Proj. Location…:**	Hampton, VA
Investigators……:	(b) (6)	**Date……:**	4/29/14
Boring Depth……:	2.5 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r…:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** ……:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
105		1:06:16 PM								
95	10	1:08:42 PM	0:02:26	2.43	4.11	0.002	3.93E-05	3.391	0.056	0.111
85	10	1:11:22 PM	0:02:40	2.67	3.75	0.002	3.58E-05	3.095	0.051	0.102
75	10	1:14:46 PM	0:03:24	3.40	2.94	0.002	2.81E-05	2.427	0.040	0.080
65	10	1:16:08 PM	0:01:22	1.37	7.32	0.004	6.99E-05	6.038	0.099	0.198
55	10	1:19:02 PM	0:02:54	2.90	3.45	0.002	3.29E-05	2.846	0.047	0.093
45	10	1:22:43 PM	0:03:41	3.68	2.71	0.002	2.59E-05	2.240	0.037	0.074
35	10	1:25:32 PM	0:02:49	2.82	3.55	0.002	3.39E-05	2.930	0.048	0.096
25	10	1:28:28 PM	0:02:56	2.93	3.41	0.002	3.26E-05	2.813	0.046	0.092
15	10	1:31:39 PM	0:03:11	3.18	3.14	0.002	3.00E-05	2.592	0.043	0.085
Field-Estimated Ksat:						0.002	4.12E-05	**3.559**	0.058	0.117

Natural Moisture……:	11	**Consistency……:**	
USDA Txt./USCS Class:	CL	**Water Table Depth…:**	4 ft
Struct./% Pass. #200.:	67	**Init. Saturation Time.:**	12:50:00 PM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well.**H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Measurement Systems Laboratory	**Project No.....:**	WM11-175G
Boring No.....:	INF-2	**Proj. Location...:**	Hampton, VA
Investigators.....:	(b) (6)	**Date.....:**	5/15/14
Boring Depth.....:	3 ft (m, cm, ft, in)	**WCU Base Ht. h:**	15.0 cm
Boring Diameter..:	8.3 cm	**WCU Susp. Ht. S:**	6.4 cm
Boring Radius r...:	4.15 cm	**Const. Wtr. Ht. H:**	21.4 cm
Soil/Water Tmp. T:	11 °C	**H/r** .....:**	5.2
Dyn. Visc. @ T °C.:	0.001271 kg/m·s	**Dyn. Visc. @ T_B °C.:**	0.001170 kg/m·s

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
100		2:51:02 PM								
90	10	2:52:08 PM	0:01:06	1.10	9.09	0.005	8.68E-05	7.502	0.123	0.246
80	10	2:53:17 PM	0:01:09	1.15	8.70	0.005	8.31E-05	7.176	0.118	0.235
70	10	2:54:24 PM	0:01:07	1.12	8.96	0.005	8.55E-05	7.390	0.121	0.242
60	10	2:55:50 PM	0:01:26	1.43	6.98	0.004	6.66E-05	5.758	0.094	0.189
50	10	2:57:20 PM	0:01:30	1.50	6.67	0.004	6.37E-05	5.502	0.090	0.181
40	10	2:58:38 PM	0:01:18	1.30	7.69	0.004	7.35E-05	6.348	0.104	0.208
30	10	2:59:49 PM	0:01:11	1.18	8.45	0.005	8.07E-05	6.974	0.114	0.229
20	10	3:01:03 PM	0:01:14	1.23	8.11	0.005	7.74E-05	6.691	0.110	0.220
10	10	3:02:22 PM	0:01:19	1.32	7.59	0.004	7.25E-05	6.268	0.103	0.206
Field-Estimated Ksat:						0.005	7.71E-05	**6.666**	0.109	0.219

Natural Moisture.....:	11	**Consistency.....:**	
USDA Txt./USCS Class:	SC	**Water Table Depth...:**	6 ft
Struct./% Pass. #200.:	30	**Init. Saturation Time.:**	2:30:00 PM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name……:	Measurement Systems Laboratory	**Project No……:**	WM11-175G
Boring No……:	INF-3	**Proj. Location…:**	Hampton, VA
Investigators……:	(b) (6)	**Date……:**	5/25/14
Boring Depth……:	3 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r…:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** ……:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
120		10:05:16 AM								
110	10	10:09:51 AM	0:04:35	4.58	2.18	0.001	2.08E-05	1.801	0.030	0.059
100	10	10:13:23 AM	0:03:32	3.53	2.83	0.002	2.70E-05	2.336	0.038	0.077
90	10	10:18:05 AM	0:04:42	4.70	2.13	0.001	2.03E-05	1.756	0.029	0.058
80	10	10:21:57 AM	0:03:52	3.87	2.59	0.001	2.47E-05	2.134	0.035	0.070
70	10	10:25:34 AM	0:03:37	3.62	2.76	0.002	2.64E-05	2.282	0.037	0.075
60	10	10:29:16 AM	0:03:42	3.70	2.70	0.002	2.58E-05	2.230	0.037	0.073
50	10	10:33:44 AM	0:04:28	4.47	2.24	0.001	2.14E-05	1.848	0.030	0.061
40	10	10:37:41 AM	0:03:57	3.95	2.53	0.001	2.42E-05	2.089	0.034	0.069
30	10	10:42:02 AM	0:04:21	4.35	2.30	0.001	2.20E-05	1.897	0.031	0.062
					Field-Estimated Ksat:	0.001	2.39E-05	**2.062**	0.034	0.068

Natural Moisture……:	42	**Consistency……:**	
USDA Txt./USCS Class:	CL	**Water Table Depth…:**	5.5 ft
Struct./% Pass. #200.:	56	**Init. Saturation Time.:**	9:45:00 AM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well.** H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Measurement Systems Laboratory	**Project No.....:**	WM11-175G
Boring No.....:	INF-4	**Proj. Location...:**	Hampton, VA
Investigators.....:	(b) (6)	**Date.....:**	4/29/14
Boring Depth.....:	3 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r...:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** .....:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
120		2:42:12 PM								
110	10	2:44:28 PM	0:02:16	2.27	4.41	0.003	4.21E-05	3.641	0.060	0.119
100	10	2:47:02 PM	0:02:34	2.57	3.90	0.002	3.72E-05	3.215	0.053	0.105
90	10	2:49:46 PM	0:02:44	2.73	3.66	0.002	3.49E-05	3.019	0.050	0.099
80	10	2:53:01 PM	0:03:15	3.25	3.08	0.002	2.94E-05	2.539	0.042	0.083
70	10	2:55:28 PM	0:02:27	2.45	4.08	0.002	3.90E-05	3.368	0.055	0.111
60	10	2:58:51 PM	0:03:23	3.38	2.96	0.002	2.82E-05	2.439	0.040	0.080
50	10	3:01:15 PM	0:02:24	2.40	4.17	0.002	3.98E-05	3.439	0.056	0.113
40	10	3:04:02 PM	0:02:47	2.78	3.59	0.002	3.43E-05	2.965	0.049	0.097
30	10	3:06:48 PM	0:02:46	2.77	3.61	0.002	3.45E-05	2.983	0.049	0.098
					Field-Estimated Ksat:	0.002	3.65E-05	**3.157**	0.052	0.104

Natural Moisture.....:	32	**Consistency.....:**	
USDA Txt./USCS Class:	CL	**Water Table Depth...:**	6 ft
Struct./% Pass. #200.:	56	**Init. Saturation Time.:**	2:20:00 PM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well.** H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Measurement Systems Laboratory	**Project No.....:**	WM11-175G
Boring No.....:	INF-5	**Proj. Location...:**	Hampton, VA
Investigators.....:	(b) (6)	**Date.....:**	5/15/14
Boring Depth.....:	2 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r...:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** .....:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		10:54:12 AM								
1,800	100	10:57:31 AM	0:03:19	3.32	30.15	0.017	2.88E-04	24.882	0.408	0.816
1,700	100	11:00:54 AM	0:03:23	3.38	29.56	0.017	2.82E-04	24.392	0.400	0.800
1,600	100	11:04:17 AM	0:03:23	3.38	29.56	0.017	2.82E-04	24.392	0.400	0.800
1,500	100	11:07:52 AM	0:03:35	3.58	27.91	0.016	2.67E-04	23.030	0.378	0.756
1,400	100	11:11:24 AM	0:03:32	3.53	28.30	0.016	2.70E-04	23.356	0.383	0.766
1,300	100	11:14:59 AM	0:03:35	3.58	27.91	0.016	2.67E-04	23.030	0.378	0.756
1,200	100	11:18:42 AM	0:03:43	3.72	26.91	0.015	2.57E-04	22.204	0.364	0.728
1,100	100	11:22:17 AM	0:03:35	3.58	27.91	0.016	2.67E-04	23.030	0.378	0.756
1,000	100	11:25:55 AM	0:03:38	3.63	27.52	0.016	2.63E-04	22.713	0.373	0.745
					Field-Estimated Ksat:	0.017	2.78E-04	**24.010**	0.394	0.788

Natural Moisture.....:	12	**Consistency.....:**	
USDA Txt./USCS Class:	SM	**Water Table Depth...:**	5 ft
Struct./% Pass. #200.:	22	**Init. Saturation Time.:**	10:30:00 AM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Measurement Systems Laboratory	**Project No.....:**	WM11-175G
Boring No.....:	INF-6	**Proj. Location...:**	Hampton, VA
Investigators.....:	(b) (6)	**Date.....:**	5/15/14
Boring Depth.....:	1.5 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r...:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** .....:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
100		2:07:09 PM								
90	10	2:09:10 PM	0:02:01	2.02	4.96	0.003	4.74E-05	4.092	0.067	0.134
80	10	2:11:10 PM	0:02:00	2.00	5.00	0.003	4.78E-05	4.126	0.068	0.135
70	10	2:13:13 PM	0:02:03	2.05	4.88	0.003	4.66E-05	4.026	0.066	0.132
60	10	2:15:13 PM	0:02:00	2.00	5.00	0.003	4.78E-05	4.126	0.068	0.135
50	10	2:17:09 PM	0:01:56	1.93	5.17	0.003	4.94E-05	4.269	0.070	0.140
40	10	2:19:32 PM	0:02:23	2.38	4.20	0.002	4.01E-05	3.463	0.057	0.114
30	10	2:21:51 PM	0:02:19	2.32	4.32	0.002	4.12E-05	3.562	0.058	0.117
20	10	2:24:14 PM	0:02:23	2.38	4.20	0.002	4.01E-05	3.463	0.057	0.114
10	10	2:26:41 PM	0:02:27	2.45	4.08	0.002	3.90E-05	3.368	0.055	0.111
Field-Estimated Ksat:						0.003	4.78E-05	**4.128**	0.068	0.135

Natural Moisture.....:	11	**Consistency.....:**	
USDA Txt./USCS Class:	SC	**Water Table Depth...:**	6 ft
Struct./% Pass. #200.:	44	**Init. Saturation Time.:**	1:45:00 PM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well.** H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name……:	Measurement Systems Laboratory	**Project No……:**	WM11-175G
Boring No……:	INF-7	**Proj. Location…:**	Hampton, VA
Investigators……:	(b) (6)	**Date……:**	5/15/14
Boring Depth……:	1.5 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r…:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** ……:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		11:51:38 AM								
1,800	100	11:53:18 AM	0:01:40	1.67	60.00	0.034	5.73E-04	49.515	0.812	1.625
1,700	100	11:55:01 AM	0:01:43	1.72	58.25	0.033	5.56E-04	48.073	0.789	1.577
1,600	100	11:56:41 AM	0:01:40	1.67	60.00	0.034	5.73E-04	49.515	0.812	1.625
1,500	100	11:58:26 AM	0:01:45	1.75	57.14	0.033	5.46E-04	47.157	0.774	1.547
1,400	100	12:00:14 PM	0:01:48	1.80	55.56	0.032	5.31E-04	45.847	0.752	1.504
1,300	100	12:01:58 PM	0:01:44	1.73	57.69	0.033	5.51E-04	47.610	0.781	1.562
1,200	100	12:03:45 PM	0:01:47	1.78	56.07	0.032	5.36E-04	46.276	0.759	1.518
1,100	100	12:05:35 PM	0:01:50	1.83	54.55	0.031	5.21E-04	45.014	0.738	1.477
1,000	100	12:07:30 PM	0:01:55	1.92	52.17	0.030	4.98E-04	43.056	0.706	1.413
					Field-Estimated Ksat:	0.033	5.56E-04	**48.021**	0.788	1.576

Natural Moisture……:	10	**Consistency……:**	
USDA Txt./USCS Class:	SM	**Water Table Depth…:**	5 ft
Struct./% Pass. #200.:	18	**Init. Saturation Time.:**	11:30:00 AM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well.** H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Measurement Systems Laboratory	**Project No.....:**	WM11-175G
Boring No.....:	INF-8	**Proj. Location...:**	Hampton, VA
Investigators.....:	(b) (6)	**Date.....:**	5/25/14
Boring Depth.....:	2 ft (m, cm, ft, in)	**WCU Base Ht. h:**	15.0 cm
Boring Diameter..:	8.3 cm	**WCU Susp. Ht. S:**	6.4 cm
Boring Radius r...:	4.15 cm	**Const. Wtr. Ht. H:**	21.4 cm
Soil/Water Tmp. T:	11 °C	**H/r**.....:**	5.2
Dyn. Visc. @ T °C.:	0.001271 kg/m·s	**Dyn. Visc. @ T_B °C.:**	0.001170 kg/m·s

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
120		8:32:01 AM								
110	10	8:35:12 AM	0:03:11	3.18	3.14	0.002	3.00E-05	2.592	0.043	0.085
100	10	8:38:40 AM	0:03:28	3.47	2.88	0.002	2.76E-05	2.381	0.039	0.078
90	10	8:42:02 AM	0:03:22	3.37	2.97	0.002	2.84E-05	2.451	0.040	0.080
80	10	8:45:27 AM	0:03:25	3.42	2.93	0.002	2.80E-05	2.415	0.040	0.079
70	10	8:48:33 AM	0:03:06	3.10	3.23	0.002	3.08E-05	2.662	0.044	0.087
60	10	8:51:09 AM	0:02:36	2.60	3.85	0.002	3.67E-05	3.174	0.052	0.104
50	10	8:54:41 AM	0:03:32	3.53	2.83	0.002	2.70E-05	2.336	0.038	0.077
40	10	8:57:17 AM	0:02:36	2.60	3.85	0.002	3.67E-05	3.174	0.052	0.104
30	10	9:00:51 AM	0:03:34	3.57	2.80	0.002	2.68E-05	2.314	0.038	0.076
Field-Estimated Ksat:						0.002	2.89E-05	**2.500**	0.041	0.082

Natural Moisture.....:	11	**Consistency.....:**	
USDA Txt./USCS Class:	SC	**Water Table Depth...:**	6 ft
Struct./% Pass. #200.:	45	**Init. Saturation Time.:**	8:05:00 AM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

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Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name……:	Measurement Systems Laboratory	**Project No……:**	WM11-175G
Boring No……:	INF-9	**Proj. Location…:**	Hampton, VA
Investigators……:	(b) (6)	**Date……:**	5/15/14
Boring Depth……:	3 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r…:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** ……:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		12:37:12 PM								
1,800	100	12:42:28 PM	0:05:16	5.27	18.99	0.011	1.81E-04	15.669	0.257	0.514
1,700	100	12:47:50 PM	0:05:22	5.37	18.63	0.011	1.78E-04	15.377	0.252	0.505
1,600	100	12:53:23 PM	0:05:33	5.55	18.02	0.010	1.72E-04	14.869	0.244	0.488
1,500	100	12:59:04 PM	0:05:41	5.68	17.60	0.010	1.68E-04	14.520	0.238	0.476
1,400	100	1:04:56 PM	0:05:52	5.87	17.05	0.010	1.63E-04	14.067	0.231	0.462
1,300	100	1:10:51 PM	0:05:55	5.92	16.90	0.010	1.61E-04	13.948	0.229	0.458
1,200	100	1:16:03 PM	0:05:12	5.20	19.23	0.011	1.84E-04	15.870	0.260	0.521
1,100	100	1:22:23 PM	0:06:20	6.33	15.79	0.009	1.51E-04	13.030	0.214	0.428
1,000	100	1:28:44 PM	0:06:21	6.35	15.75	0.009	1.50E-04	12.996	0.213	0.426
					Field-Estimated Ksat:	0.010	1.72E-04	**14.901**	0.244	0.489

Natural Moisture……:	13	**Consistency……:**	
USDA Txt./USCS Class:	SC	**Water Table Depth…:**	5 ft
Struct./% Pass. #200.:	39	**Init. Saturation Time.:**	12:15:00 PM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

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Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name……:	Measurement Systems Laboratory	**Project No……:**	WM11-175G
Boring No……:	INF-10	**Proj. Location…:**	Hampton, VA
Investigators……:	(b) (6)	**Date……:**	5/15/14
Boring Depth……:	1.5 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r…:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r** ……:**	**5.2**
Dyn. Visc. @ T °C.:	**0.001271 kg/m·s**	**Dyn. Visc. @ T_B °C.:**	**0.001170 kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		1:24:01 PM								
1,800	100	1:25:14 PM	0:01:13	1.22	82.19	0.047	7.85E-04	67.829	1.113	2.225
1,700	100	1:26:20 PM	0:01:06	1.10	90.91	0.052	8.68E-04	75.023	1.231	2.461
1,600	100	1:27:48 PM	0:01:28	1.47	68.18	0.039	6.51E-04	56.267	0.923	1.846
1,500	100	1:29:10 PM	0:01:22	1.37	73.17	0.042	6.99E-04	60.384	0.991	1.981
1,400	100	1:30:42 PM	0:01:32	1.53	65.22	0.037	6.23E-04	53.821	0.883	1.766
1,300	100	1:32:12 PM	0:01:30	1.50	66.67	0.038	6.37E-04	55.017	0.903	1.805
1,200	100	1:33:54 PM	0:01:42	1.70	58.82	0.034	5.62E-04	48.544	0.796	1.593
1,100	100	1:35:41 PM	0:01:47	1.78	56.07	0.032	5.36E-04	46.276	0.759	1.518
1,000	100	1:37:34 PM	0:01:53	1.88	53.10	0.030	5.07E-04	43.818	0.719	1.438
					Field-Estimated Ksat:	0.044	7.25E-04	**62.665**	1.028	2.056

Natural Moisture……:	9	**Consistency……:**	
USDA Txt./USCS Class:	SM	**Water Table Depth…:**	4.5 ft
Struct./% Pass. #200.:	27	**Init. Saturation Time.:**	1:05:00 PM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

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Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Measurement Systems Laboratory	**Project No.....:**	WM11-175G
Boring No.....:	INF-11	**Proj. Location...:**	Hampton, VA
Investigators.....:	(b) (6)	**Date.....:**	5/25/14
Boring Depth.....:	2 ft (m, cm, ft, in)	**WCU Base Ht. h:**	15.0 cm
Boring Diameter..:	8.3 cm	**WCU Susp. Ht. S:**	6.4 cm
Boring Radius r...:	4.15 cm	**Const. Wtr. Ht. H:**	21.4 cm
Soil/Water Tmp. T:	11 °C	**H/r**.....:**	5.2
Dyn. Visc. @ T °C.:	0.001271 kg/m·s	**Dyn. Visc. @ T_B °C.:**	0.001170 kg/m·s

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (ºC)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
120		11:52:05 AM								
110	10	11:55:32 AM	0:03:27	3.45	2.90	0.002	2.77E-05	2.392	0.039	0.078
100	10	11:58:30 AM	0:02:58	2.97	3.37	0.002	3.22E-05	2.782	0.046	0.091
90	10	12:02:41 PM	0:04:11	4.18	2.39	0.001	2.28E-05	1.973	0.032	0.065
80	10	12:06:10 PM	0:03:29	3.48	2.87	0.002	2.74E-05	2.369	0.039	0.078
70	10	12:10:00 PM	0:03:50	3.83	2.61	0.001	2.49E-05	2.153	0.035	0.071
60	10	12:13:56 PM	0:03:56	3.93	2.54	0.001	2.43E-05	2.098	0.034	0.069
50	10	12:17:41 PM	0:03:45	3.75	2.67	0.002	2.55E-05	2.201	0.036	0.072
40	10	12:20:31 PM	0:02:50	2.83	3.53	0.002	3.37E-05	2.913	0.048	0.096
30	10	12:24:18 PM	0:03:47	3.78	2.64	0.002	2.52E-05	2.181	0.036	0.072
					Field-Estimated Ksat:	0.002	2.70E-05	**2.334**	0.038	0.077

Natural Moisture.....:	8	**Consistency.....:**	
USDA Txt./USCS Class:	CL	**Water Table Depth...:**	5 ft
Struct./% Pass. #200.:	60	**Init. Saturation Time.:**	11:30:00 AM

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

(b) (6)

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0009	06/16/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED (SEE ITEM 11)
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0009

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 16 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0009.

2. In response to questions submitted to date the NASA MSL Project RFI logs are provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. The BIM Q207 Modeling Scope Definitions is incorporated in this amendment.

4. The due date for submission of project RFI's shall be extended to 24 June 2016 with all RFI's due by 4 PM EST.

5. The due date for submission of the technical proposal is extended to 30 June 2016 at1 PM EST. Please see Amendment 0008 for instructions.

6. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
130	230923.132	SF-11 / 12 Damper interlock note M-101B Call out to 36x36 damper connected to duct serving SF-11 indicates this damper to be interlocked with SF-12. Please indicate if this damper is actually to be interlocked to SF-11 and not SF-12	The southern one of the two 36"x36" outdoor air dampers should read "interlock to SF-12".
131	230923.132	CT-1/2 Basin level controls Div. 236500 2.5.1.6 (page 6) States: "Cold Water Basin Equipment. Include sump with removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. Provide float valves with adjustable arms. Valve sizes larger than 1/2 inch pipe size shall be the balanced piston type. Valve seats and disks shall be replaceable. Provide electric water level control." However M-601 Sequence of Operation paragraph 4 states: "COOLING TOWER BASIN LEVEL CONTROL SHALL BE MAINTAINED THROUGH DUAL ELECTRONIC PROBE WATER LEVEL CONTROLLER LOCATED IN EACH CELL. BAS SHALL [redacted] (b) (5) [redacted] (b) (5) 1. Please indicate the following: a. Which basin water level control type shall be required? b. Which division shall provide the level controller? c. We are unable to locate a specification for a "Dual Electronic Probe Water Level Controller in the contract documents, if this type of controller is required, please provide specifications or indicate where this system is specified.	a. The basin water level control shall be type dual electronic liquid-sensing probe type, one set for the high level alarm, one set of the low level alarm, one set for high level cutoff, one set for low level cutoff, one set for make-up control. b. The Div 23, the cooling tower manufacturer, shall provide the level controller, including the high water alarm, the low water alarm, high water cutoff, low level cutoff and make-up control. The Div 23, the BAS manufacturer, shall provide [redacted] (b) (5) [redacted] (b) (5) c. The specification for the cooling tower 23 65 00 shall include: "water level controller, including dual electronic liquid-sensing probe type, one set for the high level alarm, one set of the low level alarm, one set for high level cutoff, one set for low level cutoff, one set for make-up control".

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
132	230923.132	CT-1/2 Basin heater controls 1. Div. 236500 2.5.3.12 Electric Basin Heater states: "Heater shall be the electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 40 degrees F at an ambient temperature of zero degrees F. Heater shall be complete with control thermostat, transformer, contactor, and low water level heater protection." However M-601 Sequence of Operation paragraph 4 states" THE COOLING TOWER BASIN TEMPERATURE SHALL BE CONTROLLED BY TEMPERATURE SENSORS. INDIVIDUAL BASIN HEATERS SHALL ENERGIZE WHEN WATER TEMPERATURE DROPS TO 38°F AND DE-ENERGIZE THE HEATERS WHEN WATER TEMPERATURE RISES TO 40°F. THE BAS SHALL [redacted] (b) (5) [redacted] (b) (5) 1. Please indicate the following: a. Which basin water heater type shall be required? b. Which division shall provide the heating controller? c. Will the required basin water heater be controlled by thermostats or controllers with temperature sensors?	a. The basin water heater shall be electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 40 degrees F at ambient temperature of zero degrees F. Heater shall be complete with control thermostat, transformer, contactor, and low water level heater protection. b. The Div 23, the cooling tower manufacturer shall provide the basin heater. The Div 23, the BMS manufacturer shall provide [redacted] (b) (5) [redacted] (b) (5) [redacted] c. The control shall be by a thermostat provided by the cooling tower manufacturer.
133	230923.132	CT-1/2 Auto Bleed off valve M-601 Condenser and Chilled Water Control System Diagram indicates an automatic bleed off to drain valve, however the sequence of operations does not appear to address the operation of this valve. Please indicate the following: a. Is this valve required? b. Which division is to provide this valve? c. What is the control sequence for this valve?	a. The cooling tower automatic bleed-off valve is required. b. The cooling tower automatic bleed-off valve shall be provided by Div 23, by the cooling tower manufacturer. c. The bleed-off valve shall be controlled by the cooling tower manufacturer. [redacted] (b) (5) [redacted]

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
134	230923.132	Vib-Accelerometers Which Division Provides? Div. 23 05 48 00 40 Page 7 states: "Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers. Provide pressure switches on each set of filter banks. Provide vibration accelerometers with breakout boxes. Provide vibration accelerometers with signal conditioners. Provide quantity per table below." However SECTION 23 09 23.13 20 Page 30 Part 2 2.2.9 Vibration Equipment Monitoring States: "Provide vibration-Accelerometers, per specification section 23 05 48.00 40, on equipment. Vibration Accelerometers [redacted] (b) (5) Both Sections appear to require that section to provide the same devices? Please indicate the following: a. Which division should provide these?	a. All vibration accelerometers shall be provided by Div 23, by the BMS manufacturer.
145	RFP	The Value Engineering Suggestions state "The Value amounts you provide are for comparison purposes only and will NOT be used to adjust your bid. Any VE suggestions the Government wishes to pursue will be addressed after the contract award as changes to the contract." Please clarify if the VE provided will be factored into the selection of the Contractor. Please confirm that the VE values provided are only estimates since the VE design will need to be finalized.	The Value Engineering suggestions offered by the Contractor will not be scored and are not part of the selection criteria. It is confirmed that the VE estimates provided by the Contractor are not considered final, fixed price offers. If the Government elects to pursue a VE suggestion, the Contractor will be expected to negotiate in good faith as it would with any other change to the contract..
146	01 33 00	Amendment 2 states "The Government and its representatives reserves two (2) weeks of review time for submittals...." This conflicts with specification 01 33 00 paragraph 1.10.e which states a review period of 30 working days. Please confirm that the submittal review period will be two weeks in accordance with amendment 2.	The timeframe specified in section 01 33 00, paragraph 1.10.e for submittal review by the Contracting Officer may be reduced from thirty (30) working days to fifteen (15) working days. Please note the that the time specified is working days and not calendar days, so the review time is closer to three weeks than the two weeks stated in the question.
147	01 33 00	Please advise if the QC Manager submittal review period can be shortened from 15 to 10 working days due to the project schedule.	The timeframe specified in section 01 33 00, paragraph 1.10.e for submittal review by the QC Manager may be reduced from fifteen (15) working days to ten (10) working days for critical submittals. Please note that the duration specified is in working days.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
148	Structural Dwgs	Reference response to RFI #38. The structural plans include building section references that do not provide the building section number or the sheet on which the section is drawn. For example, on S-101A there are approximately 50 section references missing information. There are approximately 300 incomplete section references throughout the structural drawings. Please provide this missing information or reissue the drawings to remove erroneous section references.	Please see the response to #65.
149	01 91 00.00 40	Per Amendment 2 and specification 01 91 00.00 40 paragraph 1.3, the Government and its representatives will retain an independent, 3rd party Commissioning Agent/Authority. Per specification 01 9100.00 40 paragraph 1.5.1, "the Commissioning Firm shall be a subcontractor of the prime Contractor...." Please confirm that the prime contractor is required to hire a Commissioning Firm in addition to the Commissioning Agent/Authority hired by the Government. Please also confirm that the Commissioning Team Supervisor and Commissioning Specialist roles cannot be performed by the prime contractor's own personnel.	Confirmed. The Commissioning Firm, including the Commissioniong Team Supervisor and Commissioning Specialist, shall be a subcontractor of the prime as stated in 01 91 00.40 paragraph 1.5.1.
150	Site Furnishings	Are alternative items of equal quality but different manufacturer permitted for site furnishings?	The specifications are intended to be non-proprietary, as this is not a sole-source product. The "Or equal" applies to any products that can meet the performance specifications, a standard approach for federal procurements.
151	Site Furnishings	Please specify location and quanitity of exterior waste receptacles, tables, and chairs.	Please see the response to #108
152	11 53 00-6, 2.2.1.2 / Drawing Q-403	The specification indicates fume hoods to have "double wall ends, not more than 4" wide . . . ". Typically hood wall thicknesses vary from 4-3/4" to 5" to provide adequate speace for plumbing service valves and associated piping. Please review and indicate if the minimum dimension can be increased.	Yes. 5" maximum double walls width is acceptable.
153	11 53 00-4, 2.1.6	The specification indicates filters however this is not indicated on the drawings. Please review and indicate the size and quantity of filters if they are required.	11 53 00 / 4 / 2.1.6 is the definition of HEPA filters, if they occur anywhere within the project, or if they are integral part of some equipment. The scrubber filter for the vented cabinet is self contained within the scrubber.
154	11 53 00-8, 2.2.1.10	Specifications indicate fume hood ceiling enclosure. The drawings indicate an exposed exhaust duct with no ceiling enclosure. Please review and provide details if ceiling enclosures are required.	Ceiling enclosure is not required. Delete paragraph 2.2.1.10 in its entirety.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
160	31 62 13.20	Specification Section 31 62 13.20 - 1.6.4 states that an independent Geotechnical Engineer is to be hired by the contractor to observe test pile installation and job pile installation. Would it be acceptable for the Geotechnical Engineer to be hired and retained by the subcontractor installing the precast / prestressed concrete piles scope of work?	No. The Contractor shall retain an independent Geotechnical Engineer in accordance with the referenced specification. The intent is to preserve objectivity and greater independence from the sub with production responsibility.
167	Dwg A503	The response to Master RFI #25 states that detail 10 indicates design intent and it is the responsibility for the GC to coordinate field conditions. Is it acceptable for the steel tube framing and associated drywall wrap shown in the detail to be moved off of the guide rail to provide sufficient clearance for the guide rail cover plate?	An RFI submitted with a proposed solution during construction will be reviewed for compliance with design intent.
168	Detail 2/Q-402	Detail 2 on Q-402 shows the bottom knuckle of the 60"L x 3" diameter extractor arms at 96" AFF. The connection to the bracket would be 10" above that. The basis of design product is the Terfu (MT/MV 1500-75) with a recommended mountgin height of 76" to 88" AFF. The specified height appears too high for the 60" arm. Please review and indicate if the mounting height should be lowered or a longer arm should be specified or both.	96" A.F.F. is be to the underside of bracket (86" to the top knuckle). When the snorkel is fully extended the metal hood shall be 36" A.F.F.
169	Detail 2D/Q-402	Detail 2D on Q-402 shows an extractor vented through the wall of a clean room. The arm will not function as intended if it is installed in this manner. The Movex arm has a 360 degree swivel joint where the arm meets the bracket allowing free rotation of the arm. The user will not be able to position the arm above the pivot joint without holding it in place as gravity will cause the arm to rotate down. A suggestion would be to mount an extended wall bracket to the structural wall and have it extend through the clean room wall with the arm attaching vertically (similar to Detail 2A on sheet Q-402). Please review and provide direction.	Detail 2D should be similar to Detail 2A. The support bracket shall be attached to the building wall beyond the clean room plenum. Provide a ductwork extension with an elbow from the top of the snorkel to the exhaust ductwork located inside the plenum as required.
170	13 20 00	Specification section 13 20 00 – 1.3 states, "Work under this section shall include all labor, services, materials, and equipment, and performance of all work, as necessary, to design, furnish, install and commission the cleanrooms as detailed in this specification section and the contract documents". Specification section 13 20 00 specifies products and methods that conflict with each other, e.g. plenum modules vs. component t-grid ceiling, ECM FFU's vs. 3-speed FFU's, structural wall systems vs. non-load bearing wall systems, fluorescent type luminaire housings with doors vs. sealed LED luminaires, etc., etc. Please confirm that the cleanrooms are to be built to a performance criteria meeting ISO Standards versus a line-by-line conformance to Section 13 20 00?	Cleanrooms shall be built to a performance criteria meeting ISO Standards with non-load bearing wall systems and laminar flow plenum with flush LED lighting, FFUs, and cooling coils .

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
171	13 20 00	Specification Section 13 20 00 – 1.1 references FED-STD- 209E. This standard was canceled on November 29, 2001 by the United States General Services Administration (GSA). The document was superseded by standards written for the International Organization for Standardization (ISO). Please confirm that the ISO Standards supersede FED STD 209E for Particulate Cleanliness and is acceptable?	Yes. ISO Standard shall be used.
172	13 20 00	Specification Section 13 20 00 – 1.6 indicates pre-manufactured ceiling plenums that is integral to the cleanroom ceiling grid. Drawing Q301A indicates an on-site plenum. Recommend using suspended ceiling with perimeter walls to deck (as shown on drawing Q301A) be utilized for the plenum. Please confirm this is acceptable.	Using a suspended ceiling with perimeter walls to deck to be utilized as the plenum is not acceptable. Provide laminar flow plenum with flush LED lighting, FFUs, and cooling coils as specified
173	01 23 60	Specification section 01 23 60 – 3.1 states, "If Add Alternate 2 is accepted it will maintain the capabilities of a Class 100 space within the MSL building while allowing for additional standard lab space. Rebalance AHU, rebalance FFUs, and rebalance the associated clean room chilled water coils if Add Alternate 2 is accepted. Please clarify how allowing for additional standard lab space is defined or to be achieved?	A separate Class 100 Cleanroom was removed from the project during design, and was replaced with a standard electronics laboratory. The following phrase will be removed from the 01 23 60 - 3.1: 'If Add Alternate 2 is accepted it will maintain the capabilities of a Class 100 space within the MSL building while allowing for additional standard lab space.'
174	13 20 00	Specification Section 13 20 00 - 1.4.2 indicates the installation of Digital Space Temperature Sensors, digital humidity sensors and localized positive pressure indicators. Recommend placing temperature and humidity sensors near return air grilles (even behind the grilles) to provide optimal control of the environment conditions. Please confirm this is acceptable to locate the sensors near or behind the grills?	Placing temperature and humidity sensors near return air grilles or behind grilles is acceptable. Local positive pressure indicators must be provided in the space.
175	13 20 00	Section 13 20 00 - 1.7 states, "Calculations; G": "Provide design Calculation for clean wall framing system". Per section 2.2, the wall system is indicated as non-load bearing. With this wall framing system being non-load bearing, please confirm that calculations will not be required?	Calculations for wall framing system is not required.
176	13 20 00	Section 13 20 00 – 1.7 states. "Samples: "Color samples of not less than ten (10) standard manufacturer's colors." There is only one standard color from cleanroom wall manufacturers – white. Custom colors are available for additional cost. Without knowing which color the Architect will choose, please confirm if pricing should include non-standard colors?	Standard white cleanroom walls are all that will be required. No custom colors.
178	13 20 00	Specification Section 13 20 00 - 2.1.1: NC is listed as 45. Most FFU's individually cannot meet NC 45. Placing multiple units in the same cleanroom space will definitely exceed NC 45. Recommend NC 60 with use of 'quiet' high-end FFU's. Please confirm?	Provide NC 55 max.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
179	13 20 00	Specification Section 13 20 00 - 2.1.1: Environmental setpoints are listed at 65°F +/- 1°F, 45%RH +/- 5%. Mechanical drawing M-101L lists RH as 40%. Please clarify which setpoints are required?	RH shall be 40% +/- 5, as listed on Mechanical Drawing M-101L.
180	13 20 00	Specification Section 13 20 00 - 2.1.1: FFU's are listed "w/ sensible cooling coil". Mechanical drawings show coils mounted in return air plenum. Mechanical cooling coil schedule shows that these coils are not sensible only, but also have a latent cooling capacity. It is possible that these coils could become 'wet' due to the low entering water temperature of 41°F. Coil locations on the mechanical drawings, drain pans and drain piping are not shown and wouldn't be accessible if installed. Recommend elimination of sensible cooling coils with additional make-up air flow rate (with returns) or rising the entering chilled water temperature above the room operating dew point to prevent condensation. Please confirm intent and if suggestions are acceptable?	It is possible that these coils could become 'wet'. The condensate drain lines for these coils are shown on sheet M-201A (See Note 2). Eliminating the sensible coils and replacing with additional make-up air would not be a cost effective solution and would reduce the overall building energy savings. Suggestions are not acceptable. Clean room manufacturer shall provide drain pans and drain lines as indicated on the plans.
181	13 20 00	Specification Section 13 20 00 - 2.1.1: MAU-1 is listed as a 4,000 CFM supply fan. Mechanical schedule lists MAU-1 as 2,940 CFM. Please clarify which size is required?	MAU-1 should be a minimum 2,940 CFM.
182	13 20 00	Specification Section 13 20 00 - 2.2.2: Section indicates to provide door automatic operated swing types, however door schedule or Q drawings do not indicate which doors are to receive the auto operators. Please indicate which rooms are required to receive auto operators?	All doors into and within the cleanrooms require automatic operators. Door into the cleanrooms shall be part of the cleanroom package as specified in section 13 20 00.
183	13 20 00	Specification Section 13 20 00 - 2.1: This section does not indicate which cleanroom doors are to receive half-glass or which doors require UV blocking amber filter film? Review of the hardware schedule and Q drawings do not indicate these items. Please provide which doors are to receive glazing and UV blocking?	All doors into and within the cleanrooms shall be the solid type as shown on the Q drawings.
184	13 20 00	Specification Section 13 20 00 – 2.2.2 indicates that UV blocking is to be installed on half-glass doors. Please provide what criteria or specifications to meet for the film?	UV is not required. All doors into and within cleanrooms are solid as indicated in response #183.
185	13 20 00	Specification Section 13 20 00 - 2.5 states, "Fan filter units shall be provided with ECM motors for variable speed control." Section 2.5.2 indicates FFU's to be 3-speed. Please clarify which is required or if either option is acceptable?	FFUs shall be provided with ECM motors for balancing, control and energy efficiency. Typical operation will be 3 stages: occupied, unoccupied, and off.
186	13 20 00	Section 13 20 00 - 2.6: A plenum divider would be required to ensure that the cleanroom recirculation air diverts through the cooling coils. This is neither specified nor shown on the drawings. This plenum divider would interfere with all the ductwork, electrical, and miscellaneous utility work above the ceiling. Recommend eliminating cooling coils and increasing air flow (including return air) from MAU-1 to provide the room cooling. Please confirm if this is acceptable?	Plenum dividers are required. Clean room walls that must go to the deck are identified in the Q drawings. Eliminating cooling coils is not acceptable.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
187	13 20 00	Specification Section 13 20 00 - 2.6 indicates cooling coils are sensible cooling and therefore drain piping would not be required. Please confirm no drain piping is acceptable?	Cooling coils are deigned to condition the sensible load, however they may become 'wet' and therefore require drain piping as indicated on sheet M-201A (See Note 2). Clean room manufacturer must provide these drains and drip pans.
188	13 20 00	Specification Section 13 20 00 - 2.6.1: Locating prefilters at cooling coils would make them inaccessible. Recommend locating filters in low wall-mounted return air grilles. Please confirm if this is acceptable?	The design intent is to locate the filters in the low wall-mounted return air grilles as indicated by note 5 on sheet M-101A
189	13 20 00	Section 13 20 00 - 2.7.1: Type of luminaire housing defined is for a fluorescent type fixture while LED is specified in paragraph 2.7.2. Please confirm which is correct?	LED light fixtures shall be incorporated into the flush light ceiling system.
190	13 20 00	Specification Section 13 20 00 - 2.7.2: IES standard does not specify a lighting level. What lighting level is desired by the end users? Typical cleanroom light levels are 70-90 footcandles. Please confirm lighting levels required for the cleanrooms?	Lighting level required is 80 foot-candles.
191	13 20 00	Section 13 20 00 - 2.10: Specification calls for a local control panel for each cleanroom. Recommend combining the two groups of cleanrooms into a single panel for each group with the panel located in or just outside each Gowning room which is the entry point for each group. This would centralize, simplify, and improve accessibility to the controls for each group. Please confirm if this is acceptable?	Provide local control panel for each cleanroom as specified.
192	13 20 00	Specification Section 13 20 00 - 2.10: Please clarify the need to exhaust the make-up air from the cleanroom. Without process exhaust this is wasted energy that needs to be conditioned from outside air make-up. Please confirm if eliminating the exhaust from the make-up air is acceptable?	Eliminating the exhaust is not acceptable. The clean room requires ventilation air. Without exhaust, the space would become too pressurized.
193	13 20 00	Specification Section 13 20 00 – 2.10: Since the make-up air unit is dedicated to the cleanroom, environmental control would be more repeatable and consistent without LAB VAV TU's. We recommend deletion of the exhaust system and the terminal units along with the associated controls. Cleanroom would control better with constant volume system with zone reheats and humidifiers. Please confirm this is acceptable?	MAU-1 provides outdoor ventilation air to the clean room. The terminal units control the amount of air delivered to the space and the exhaust system regulates the pressure. Reheat is not required because the FFU will generate a substantial amount of heat. This solution is not acceptable.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
194	13 20 00	Specification Section 13 20 00 – 3.6.3.4: Since most FFU's come in either a single piece construction with both HEPA filter and fan module factory assembled or two piece where the fan module is set on the HEPA filter and then both elevated into the ceiling as an assembly, the specified procedure to install the HEPA filters after all other components (including the fan modules) are in the ceiling would require an expensive option to go with 'room side replaceable' HEPA filters. Each HEPA filter would have to be smaller to accommodate an adaptor frame in the ceiling grid to mount the filter. Please confirm which method is acceptable?	The HEPA filters must be "Room Side Replaceable"
195	Amendment 6,7	Amendments 6 and 7 both include the following statement "Questions left unanswered are due to the fact that information is either unavailable, not releasable, or is already identifiable in the solicitation package." Please confirm that each RFI submitted will receive a specific answer to that RFI in lieu of this general statement.	Confirmed.
196	Price Proposal Form	Amendment 2 provide a Base Bid GC Price Proposal Form broken down by Specification sections. Item 13b, Drawings RQ (ETS-Lindgren) and Spec 13754 (Allowance) has a note that this will be an allowance – "Note that this work will be sole sourced and the allowance will cover the for the sole source". Please confirm GSA will be providing allowance to Contractors to include in base bid?	The allowance shown on the Base Bid tab of the Bid Form should be included in the Contractor's bid.
200	10 22 43	Reference response to RFI #47. Please confirm that 1) panels shall be 4' wide, 2) panels shall be full height, and 3) drop pins, closers, pivots, floor quides, and handles are not required. Additionally, please clarify if the panel count provided in the response to RFI #47 is total panels per floor or panels per double track section. Floors 1 through 4 have two double track sections per floor.	1. Confirmed, panels are to be 4' wide. 2. Confirmed, panels are to be full height. 3. Not confirmed. Drop pins are to be provided per 10 00 43 - 2.3 #9. Confirmed - response to # 47 indicates the total number of panels per floor, not per double track section.
221	Drawing Q-001	Drawing Q-001 indicates Tables T01 and T02 to have ESD Bench Top. The Laboratory Casework General Information indicates modified epoxy resin for tops. Epoxy resin in not available in ESD. There are some laminates that are available in ESD. Please review and clarify the top material of T01 and T02.	Per Q-403, ESD tables are not to be provided as a part of this contract.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
226	01 23 60, 27 51 19	Specification 27 51 19 - Sound Masking Systems is not referenced in the description for Add Alternate No. 4. Plese confirm that complete sound masking systems shall be installed in accordance with specification 27 51 19 as part of the base bid.	Confirmed. A Sound Masking System is to be installed in accordance with 27 51 19 as a part of the base bid.
227	10 14 02	Many of the sign types do not appear to be ADA compliant due to the location of the braille text. Per ADA requirements, braille shall be placed below the text. If the text is multiline, braille shall be placed below the entire text. Please advise.	Documents indicate design intent. Signage to meet all ADA requirements. Submittal will be reviewed for compliance with design intent and ADA requirements.
228	General	Standard Form SF 1442, line 11 states that the contractor shall begin within 1 calendar days and complete within 730 calendar days after receiving award / notice to proceed. Neither check box adjacent to "award" or "notice to proceed" is checked. Confirm that performance of the contract shall be within 730 calendar days after receiving notice to proceed.	Confirmed.
229	27 41 16	Specification section 27 41 16, Integrated Audiovisual Systems and Equipment, indicates "for the Control system and software, a single manufacturer shall be provided" (2.2 B.) The section for the control system interface (2.2 H, I, J) indicates only AMX as an acceptable manufacturer. The section for Matrix Switchers (2.3 D), System Switchers (2.3 E), Video Scalers (2.3 F), and Twisted Pair Receivers and Transmitters (2.3H) indicate AMX, Extron, and Crestron. The control system interface and these other components must be by the same manufacturer so are Extron and Crestron also acceptable manufacturers for the control system interface?	No, AMX is the Government's standard for the Control System and Software.
239	RAC RFI #12	Our RFI #12 was not responded to in Amendment 0006 or Amendment 0007. We are not sure if it is because it is similar to GSA RFI #38. However, we did provide Structural Sheet number where Section designations are missing. Please review and respond.	See response 004 which was issued with Amendment 0008.
241	01 91 00.00 40	Paragraph 1.3 (Page 3) – The Government is going to retain a third party CxA for QA purposes. At this time, is GSA able to disclose who they are using, or intend to use?	The GSA intends to use ONIX II, Inc. to provide commissioning oversight.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
242	01 91 00.00 40	The electrical commissioning requirements are very general. Can the government confirm if commissioning is required for the following electrical systems and components: 1) automatic transfer switches, 2) manual transfer switches and portable gensets, 3) switchboards, 4) secondary unit substations, 5) existing (b) (5) generator at IESB, and 6) utility substation commissioning.	Commissioning is required for the followings systems: ATS, manual transfer switches, switchgears, switchboards, transformers, secondary electrical service systems, circuit breakers, conductors, grounding, panelboars, power monitoring /metering system, emergency power system, UPS modules and systems, batteries, lighting and lighting control systems, emergency and egress lighting operation, interior and exterior lighting controls lightning protection systems, and existing (b) (5) Emergency Generator. The integral Loss Power Test is also required to verify the emergency power operation.
245	01 91 00.00 40	Paragraph 1.4 (Page 3,4) – One of the required submittals is "Start-up Plans". Is this re referring to the manufacturer / vendor equipment startup forms typically provided and completed by the respective trade contractors or a separate distinct start up plan?	The manufacturers' start-up forms and proposed start-up schedules are sufficient. The contractor may also develop a separate start-up plan in lieu of manufacturer /vender forms.
246	01 91 00.00 40	Paragraph 1.5.3.3 a.(3) (Page 6) – Requires the [redacted] (b) (5)	The MSL BAS [redacted] (b) (5)
247	01 91 00.00 40	Paragraph 2.6 – Are the Functional Performance Test Plans referred to a separate document for each discipline (i.e.: mechanical / electrical / plumbing), or is the required information to be incorporated into each individual functional performance test for each discipline?	The information should be incorporated into each individual functional test based on equipment /system approach. For example, the test of AHU should include mechanical, electrical, Tab and control contractors.
248	01 91 00.00 40	Paragraph 3.2.4 (Page 11) – A sampling strategy is noted for testing multiple identical pieces of "non-life safety or non-critical" equipment. What equipment is defined as "non-life safety or non-critical"?	VAV Boxes, FCUs or similar identical (type and function) units that serve non-critical or non-life safety spaces. For example, offices or conference rooms are not-critical and non-life safety spaces.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
249	01 91 00.00 40	Specification Section 01 91 00 part 1.5.3.3 a(6) includes Reliability Centered Acceptance for Facility Shells (01 83 00.07 40), Mechanical Systems (01 86 12.07 40) and Electrical Systems (01 86 26.07 40) under systems to be commissioned, in addition to the specific Mechanical and electrical systems listed under parts (1) and (2) respectively. Please confirm that responsibility for compliance and execution of Reliability Centered Acceptance for Facility Shells (01 83 00.07 40), Mechanical Systems (01 86 12.07 40) and Electrical Systems (01 86 26.07 40) is the responsibility of the General Contractor and their associated specialty trade contractors and certified testing firms and not the responsibility of the Commissioning Specialist.	Compliance and execution of Reliability Centered Acceptance for Facility Shells (01 83 00.07 40), Mechanical Systems (01 86 12.07 40) and Electrical Systems (01 86 26.07 40) is the responsibility of the General Contractor and their associated specialty trade contractors. The responsibility of the Commissioning Specialist is the verification and documentation of compliance.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
202	01 78 25	Specification Section 01 78 25, 1.1 states that Autodesk Revit and AutoCAD Civil 3D are required software platforms for modeling. This may limit the prequalified subcontractors who can participate in coordination. Many BIM mature mechanical subcontractors are still using 3D CAD applications to fabricate from. Additionally, most steel and concrete subs use Tekla as a fabrication tool. This may require subcontractors to use a 3RD party modeler to convert their fabrication models to a record Revit model at the end of the job. Will coordination drawings in either 3D CAD or Tekla be acceptable or will conversion Autodesk Revit and AutoCAD Civil 3D be required? If Autodesk Revit and AutoCAD Civil 3D are required is conversion by a 3rd party modeler acceptable?	The Contractor is required to submit AutoCAD Civil 3D for items outside of the building. Contractor is required to submit Autodesk Revit for all other building elements at 30% and 60% fiscal completion milestones, then at Substantial Completion and Project Closeout milestones as specified in 01 78 25, the NASA BIM Execution Plan, NASA Level of Development Specification for Building Models, and the NASA LOI Level Of Information Specification. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.
203	01 78 25	Specification Section 01 78 25, 1.3.1 requires a Revit certification of the BIM manager which is an unusual requirement. You can be qualified to use these software platforms without paying Autodesk for a certificate. The test is a written exam which does not prove a person's BIM competency. Can this requirement be removed from the specifications?	No the requirement can not be removed.
204	01 78 25	Please provide further clarification / specifics on what must be demonstrated as part of the BIM demonstration stated in Specification 01 78 25 1.3.3.	The detailed means and methods by which the required BIM uses will be accomplished as described in the Government approved BEP will be demonstrated. Live BIM models and BIM tools shall be used. Pre-recorded demos or still screenshots are not acceptable. Key personnel, hardware, and software solutions documented in the Government accepted BEP shall demonstrate their abilities to accomplish the described means and methods as described in the Government approved BEP. For instance, the Contractor must actually perform a clash detection analysis of a federated coordination model to demonstrate their ability to accomplish this BIM use. All BIM uses shall be demonstrated in the same manner. The Contractor may use non-MSL model content as long as it complies with the BIM requirements specifications of the contract.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
205	01 78 25	Specification Section 01 78 25, 1.4 states that the Government will provide a 100% Design BIM, but that the contractor is not relieved of coordination requirements. Please provide information regarding what will be provided by the design team in terms of model deliverables. Specifically what will be provided by the design team?	Per response to RFI 207, please refer to the LOD Matrix that outlines each major model component category of the Design BIMs, and what LOD they have been modeled to. This LOD matrix shall be for information only, as a guideline and not as a specification and shall not be relied upon by the contractor as such. Per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the design BIMs. The Contractor is also fully at risk if they decide to rely upon the LOD Matrix provided in response to this RFI.
206	01 78 25	Will the contractor receive a Revit model for all major design disciplines (A, S, MEPF, security, communications, fire alarm, lab equipment) and any additional consultants? Specifications reference trades like security, communication, Fire Alarm, Pneumatic Tubing, and Equipment.	Yes. Architectural, Civil, Electrical, Fire Protection, Mechanical, Plumbing, Labaratory Equipment, Structural, Telecom, Audio Visual, Auxilary Systems (Security). See Design BIM Model Element Matrix attachment to RFI response for detailed description of model element types included. Note, per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the design BIMs.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
207	01 78 25	What LOD can the contractor expect the design models to be constructed? Please provide a Model Development Specification (LOD Table) which outlines each major model component category and what Level of Development they will be modeled to for each milestone phase of the project. This will help gauge which subcontractors be required to provide modeling and coordination. If A/E design model is not adequately constructed to assist with coordination, the contractor will have to supplement with a 3rd party modeler which will add cost to the BIM effort. The LOD specification attachment details what is expected from the record model, but what is required from the AE team in the production of the design model?	An LOD Matrix that outlines each major model component category of the Design BIMs, and what LOD they have been modeled to will be provided but shall be for information only, as a guideline and not as a specification and shall not be relied upon by the contractor as such. Per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the design BIMs. The Contractor is also fully at risk if they decide to rely upon the LOD Matrix provided in response to this RFI. A Model Development Specification (LOD Table) which outlines each major model component category and the as-built LOD they are required to be modeled to for construction is already provided; see the NASA Level of Development Specification for Building Models in section 01 78 25. Per section 01 78 25 the Contractor shall submit an as-built record model for all work that, up to the milestone dates specified, has been installed/constructed compliant to the NASA Level of Development Specification for Building Models, and the NASA LOI Level Of Information Specification. Per section 01 78 25 these milestone dates are 30% Fiscal Completion, 60% Fiscal Completion, Substantial Completion and Project Close Out. Nothing is required from the AE team in the production of the Design BIMs. Per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the Design BIMs.
208	01 78 25	How often will the contractor be transmitted design models? Confirm new models will be transmitted within 10 days of a receipt of any Bulletins/ ASIs/ Revision Packages.	Changes will not be provided in BIM format. Only 2D, non-CAD format drawings shall be provided. The Contractor is responsible for incorporating these changes into Coordination BIMs and into all BIM deliverable requirements as specified in sections 01 78 25, 01 79 00, and ammendment 0007 NASA Level Of Information.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
209	01 78 25	Will the contractor be provided CAD backgrounds for every major project milestone to supply to subcontractors? Will updates be provided for all Bulletins/ ASIs/ Revision Packages? The contractor can create these backgrounds from the design models, but if there is a contractual requirement for the A/E to provide them, it would assist coordination efforts if they were transmitted to the contractor as well. Please confirm this will occur.	Changes will not be provided in CAD format. Only 2D, non-CAD format drawings shall be provided. The Contractor is responsible for incorporating these changes into Coordination BIMs and into all BIM deliverable requirements as specified in sections 01 78 25, 01 79 00, and ammendment 0007 NASA Level Of Information.
210	01 78 25	It will be required to conduct file sharing through a secured buffalo drive or a cloud based systems like Google drive and Box acceptable? Is the use of a file sharing cloud base system acceptable? Box is the primary means for transmitting model files usually.	Any file transfer solution must be compliant to GSA policy and procedure 3490.2 Public Buildings Service document security for Sensitive But Unclassified building information and US Government computer security standard, the Federal Information Processing Standard (FIPS) publication 140-2, (FIPS PUB 140-2). Box.com is FedRAMP certified and should be acceptable, however this will need to be confirmed with the GSA Contracting Officer.
211	01 78 25	Are the trades listed in Specification Section 01 78 25, 3.1.1 required to produce fabrication models? Are there additional trades that must participate in the coordination process? It is noted that trades like communications, Equipment, FA and Security are not always as BIM mature as our traditional MEP or FP subcontractors. They may not be able to develop a Revit model deliverable in-house. This may require additional 3rd party modeling. Is the development of a Revit model by a 3rd party modeler acceptable?	All trades traditionally required to participate in the coordination process are required to participate in the BIM coordination process and to produce models sufficient enough to represent the exact geometry of elements and element clearances to prevent coordination errors in the field. The intent of the BIM record model is to show the as-built conditions. This must be in accordance with the section 01 78 25, NASA BIM Execution Plan, NASA Level Of Development and Amendment 0007 NASA Level Of Information. Any shop drawing requirement must be compatible with updating the deliverable record models. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
213	01 78 25	Specification Section 01 78 25, 3.3 states that we are "encouraged" to submit a 4D schedule before payment and defines the minimum object categories that should be reflected. Provide additional clarification on what is contractually required. Please provide a better understanding of the following: What does the Government hope to gain from 4D scheduling (i.e. site logistics and initial phasing, concrete pour sequence, steel erection sequence, exterior skin phasing, etc.)? How often does the Government want the 4D model updated? With each payment would imply bi-monthly or weekly updates. This would require dynamic connection to the project schedule and will add additional time to the BIM Manager's job description to maintain. This will add additional cost to the BIM effort requirements.	There is no 4D BIM contractual requirement. The 4D BIM specification section is recommended guidance. The intent is to utilize 4D BIM capabilities to better detect future site and construction sequencing errors that traditional GANNT chart CPM schedules could never show. If used properly, schedule delays and field rework could be minimized and the project team's understanding of the site and construction sequencing plan could be improved. It is possible to minimize crane moves and other strategic advantages to site logistics using 4D BIM tools.
214	01 78 25	What (if any) GIS data must be captured in the record BIM?	See section 01 78 25, NASA BEP, Section K, Item 6.
215	01 78 25	Specification Section 01 78 25, 3.8.3.2D states requirements for the design team in the production of construction documents. If the Contractor is required to deliver a record Revit model with all corresponding sheets from the contract documents, that would require the Contractor to take ownership and liability for their errors and omissions in the original creation of the model. The Contractor is not responsible or liable for the design. Can this section of the specifications be omitted? If not please clarify requirement regarding the production of construction documents.	No, this section cannot be omitted. The Contractor's requirement is not to deliver design 2D sheets, but to deliver as-built, record 2D sheets compliant to the BIM requirements specifications of section 01 78 25. The only 2D sheets that the Contractor would be responsible for or liable for are those which the Contractor designed themselves, per Section 01 78 25, 3.8.3. 2D, 2nd paragraph "If the contract requires the Contractor to design portions of the project and if, for the portion designed by the Contractor will be reviewed by inspection or permitting agencies, the Contractor must produce printed drawings from the model, signed and sealed by licensed professional architects and engineers, as required by the reviewing or permitting agency."
216	01 78 25	Does the Government want all subcontractor shop drawings created in Revit? This goes back to the software specific requirement in Specification Section 01 78 25, 1.1. Requiring subcontractors to comply with one software package, it may limit the amount of potential qualified bidders and significantly increase costs of the BIM effort.	The intent of the BIM record model is to show the as-built conditions. This must be in accordance with the BEP, LOD and LOI. Any shop drawing requirement must be compatible with updating the deliverable record models. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
217	01 78 25	The Contractor will need to walk through the model exchange that will need to take place with the A/E in order to meet the Revit deliverable that is required including as-built model with O&M and asset data link. Does the Government want all asset data kept internally within Revit, COBie, both, or an external O&M Database as described in 01 78 23? The contractor needs to know exactly what asset data will be tracked in each system in order to acquire BIM accurately from our subcontractors. The LOI requirement defines some attributes, but is the extent of the attributes that need to be tracked indicated in its entirety?	There will be no model exchange with the A/E beyond the single issuance of Design BIMs immediately following contract award. The data specified in Ammendment 0007, NASA LOI must be data located internally within the Revit Models except for documents which must be linked to the revit models. The links to the documents must be located internally within the revit model as specified in the LOI. The exact, entire asset data requirements are specified in ammendment 0007 the NASA LOI and is the responsibility of the contractor to deliver. However, per page 2 of the NASA LOI specification instructions "..the contractor is ultimately responsible for including any product asset types not currently highlighted in green, or components of this product asset types which become added to the project scope as the design and construction of the project progresses or as a result of a modification or amendment to the construction contract." The contractor would then be required to contact the Government who will specify the exact asset data requirements of the asset types or components added to the project scope.
218	01 78 23	Specification 01 78 23, 1.2.5 refers to an O&M database as a project requirement. Is this a separate deliverable from the COBie Database or can it be used in place of COBie as an alternate? Can the contractor choose between an eOMSI (Section 01 78 24.00 20) or COBie (Section 01 79 00)?	Specification 01 78 23 1.2.5 is a separate deliverable from the COBie database and cannot be used in place of COBie as an alternate. The Contractor cannot choose between Section 01 78 24.00 20 eOMSI or Section 01 79 00 COBie. These two sections are separate requirements. The Contractor may leverage or utilize the COBie database to more efficiently deliver the section 01 78 32, 1.2.5 requirement or the section 01 78 24.00 20 requirement.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
219	01 78 23	Would eOMSI an "or equal" to COBie? What CMMS/CAFM system does the Government use? With either COBie, or eOMSI, would it be expected to interface directly with your CMMS system prior to turnover?	eOMSI is not an equal to COBie. The COBie requirement specified in 01 79 00 and ammendment 007 the NASA LOI must be met regardles of the CMMS/CAFM system the Government uses. Currently the NASA CMMS system is IBM Maximo. COBie data is expected to be imported periodically throughout construction into the NASA CMMS prior to turnover. eOMSI would not interface directly with CMMS.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
136	230923.132	ACD Air Cooled Duct Seq of Ops There appears to be no sequence of operations or Flow diagrams or description of the equipment labelled ACD "Air Cooled Duct" Resolution of Problem: Please indicate if there is any scope of work for the BAS Control System.	[redacted] (b) (5)
138	230923.132	VAV Controls By Whom? Section 230000 Part 2 2.12.2 Variable Volume, Single Duct Air Terminal Units 2.12.5 States: [redacted] (b) (5) Please indicate Who provides these controls?	The Div 23 BMS manufacturer shall provide controls for the office VAV terminal units.
143	230923.132	EF-6 Refrigerant Purge Fan / Dampers EF-6 Refrigerant Purge Fan located on 3rd level roof above Chiller plant is shown on M-601 to have a Purge Damper. The Sequence indicates there is "a" damper, which appears to be at the end of the duct line drawing. M-102B shows this Ductwork as having 4 drops in the chiller plant all terminating at 8" AFF (refer to Notes 13 & 14) but does not indicate motorized damper/s? Please indicate is there only one damper, or are there 4 (one at each drop)? If there is only one where is it located?	There is only one refrigerant purge motorized damper (not 4). The refrigerant purge motorized damper shall be located in the main duct just upstream of the EF-6.
158	Civil Dwgs, Resource Dwgs	Removal Note 1 on Drawing RC-001 indicates that Building 1168 and foundation in its entirety is to be removed. This is in conflict with Drawing CD105 which indicates the extents of an existing underground foundation. Is it correct for the contractor to assume that all features including buildings, foundations, utilities, etc. on the RC drawings are to have been already removed under separate contract by others? Likewise, is it correct for the contractor to assume that all features specifically noted on the CD drawings are to be removed including buildings, foundations, utilities, etc. under the NASA MSL contract?	a. B1168 was removed prior to MSL design beginning and no as-built drawings were provided. See also NOTE on CD105 re: survey data. B. The features noted on the CD and S drawings are items that are known to exist below grade. It is the responsibility of the GC to either remove those items in their entirety or to coordinate new construction around them. Not all items will need to be fully removed in order to construct MSL.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
159	Civil Dwgs, Structural Dwgs, Resource Dwgs	Removal Note 1 on Drawing RC-003 indicates that Buildings 1192, 1192A, 1192B, 1192C, and 1192D and foundations in its entirety are to be removed. This is in conflict with Drawing CD105 and S040 which indicates the extents of an existing underground foundation. Is it correct for the contractor to assume that all features including buildings, foundations, utilities, piles, etc. shown on the RC drawings are to have been already removed under separate contract by others? Likewise, is it correct for the contractor to assume that all features specifically noted on the CD and S-040 drawings are to be removed including buildings, foundations, utilities, piles, etc. under the NASA MSL contract?	a. Confirmed. All features indicated to be removed on the RC drawings are assumed to have already been removed as a part of a separate contract by others. B. The features noted on the CD and S drawings are items that are known to exist below grade. It is the responsibility of the GC to either remove those items in their entirety or to coordinate new construction around them. Not all items will need to be fully removed in order to construct MSL.
177	13 20 00	Specification Section 13 20 00 - 2.1.1: "FFU's are indicated as 115 volt. Section 2.5.2 indicates 277 volt. Please clarify?	Per the Mechanical and Electrical Schedules, the FFUs are to be 277V/1Ph/60Hz. The voltage of the control panels associated with the FFUs is 120V
212	01 78 25	Specification Section 01 78 25, 3.2 states that design changes must be pre-clashed to determine extent of impact prior to approval of a change. This implies that the contractor would be directing subcontractors to proceed with a change prior to change order approval. Per the solicitation, the contractor cannot direct subcontractors to proceed with re-modeling until Government approval. Is the contractor to follow the RFP requirement or the specification requirement?	The intent is where appropriate, the Contractors shall utilize the BIM to assist in the development of cost proposals for change orders to improve proposal accuracy.
223	Architectural Dwgs	Window types W1 and W2 are shown on drawing A604, however, no information could be located regarding the frame type. Please provide. Additionally, Finish types GL-6 and GL-10 on A701 reference the window schedule. The window schedule could not be located. Please provide.	Window types W1 and W2 are to be hollow metal frames. The window types are as indicated on sheet A604.
230		1. The spec 074213 para 2.3 calls for Composite "Reynobond Panels for MPL-1 &MPL-2 and also 0.125 alum Plate or Metalwerks Arcwall 2510 in the next paragraph for the same panels. Please clarify that the Aluminum plate is an option in lieu of ACM at the contractor's choosing or if the Plate system is intended for a specific panel type.	Per 2.3 COMPOSITE METAL AND ALUMINUM PLATE PANEL SYSTEMS "At Contractor's option provide aluminum-faced composite panels or aluminum plate wall panels with mounting system."

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Master RFI #	Spec Reference	Bidder Question	GSA Response
236		3) Drawing T-111A note 2 states "OUTLETS IN CLEAN ROOMS TO BE INSTALLED BY CLEAN ROOM PREFAC INSTALLATION CONTRACTOR IN SURFACE MOUNTED BOXES." Please define "OUTLETS" for the purpose of this note. Is it just the raceways and surface mount boxes or would the clean room contractor also install the cabling, jacks, etc?	Installation of electric power, and conduit and wiring to points of connection in junction box, and installation of cabling, jacks, etc. shall be provided by the respective Division 26 and 27 Contractors. Coordinate with electrical and AV drawings.
240		Other equipment manufacturers can provide SqD/Schneider Electric meters in their equipment to meet project GSA requirements; however, spec section 260913 Power Monitoring System is extensive and will be a large portion of the project value. Is this section required to be provided by SqD/Schneider Electric or can independent vendors provide? Will the Power Monitoring System upgrade be part of the same bid /contract? If this section is a separate bid, it enables other manufactures beside Schneider to provide a competitive package. Paragraph 2.4 says: "Contractor shall provide the latest upgrade to the existing campus power monitoring system software." Unless 260913 is separated from the rest of the bid package – provided under a separate contract, this is essentially a sole-source project.	See response to #233
250	Architectural Dwgs	RFI No. 61 provides a response that is still not clear. Are door assembles that are not called out as STC door assembles on the Door Schedule to match the STC wall assemble rating? Is it the intent to provide STC 45 door assembles in all walls that are not specifically called out for a STC rating on the Door Schedule?	Per response #61 - All doors in STC rated partitions, even those not specifically called-out in the Door Schedule, are to have a minimum STC 45 rating per Door Schedule General Note #8.
251	Architectural Dwgs	Please note that some of the door hardware provided in the specifications are to be installed with door assembles in STC rated walls are missing hardware to achieve a STC rating. For example Office 227-A&B call for walls to meet a STC 49. The door hardware (Set 510) does not include any sound seals, thresholds, door sweeps, etc. How can we achieve a STC rating if the hardware schedule is missing the hardware to achieve this STC rating.	The doors mentioned in the example are not located in STC rated walls, but rather in glass storefront. That storefront is not an STC rated wall, therefore, the door is not required to meet the STC 49 noted in the question.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
252	08 34 73	In SECTION 08 34 73, 3.5 FIELD TESTING (Page 11) - Provide third party testing in accordance with ASTM E336. Verify in writing that installed product performs no less than five (5) FSTC or NIC rating points below the specified laboratory STC rating. Examine, adjust, and retest any installation not meeting that criteria until compliance is obtained. How can this test be achieved if the Door Schedule does not have the STC ratings for all the door assembles that are required in STC rated walls assembles. The Door Schedule, Note No. 8 calls for a minimum STC 45 door assembly to be provided. If this requirement is to be achieved, we request that a revised Door Schedule be provided with the correct door assemblies STC ratings and hardware.	See responses #61 and 250.
255	01 33 29	The LEED scorecard is showing construction credit Sustainable Site 7.1 Heat Island Effect – Non-roof to achieve 1 point. Please confirm that the design has incorporated the required high SRI hardscape, open-grid paving, and/or shading to achieve the point in this credit.	Within the LEED boundary concrete paving accounts for more than 50% of the site paving, and standard gray concrete when maintained (washed every other year) will have no issue meeting the required SRI value of 29 and therefore does not need to have additional instruction on how to make the product "high SRI."
256	01 33 29	The LEED scorecard is showing construction credit Energy & Atmosphere 3 Enhanced Commissioning to achieve 2 points. Please confirm that a commissioning agent has been involved throughout the design process to the extent needed to achieve the points in this credit.	Confirmed. A commissioning agent has been under contract and involved throughout the design process.
260	SF1442	Standard Form 1442 states that an offer guarantee is required, however, requirements for the bid bond are not provided. Please advise if bid bonds are required to utilize Standard Form 24. Please also provide the required amount of the bid bond.	28.101-2 – Solicitation Provision or Contract Clause.(b) The contracting officer shall determine the amount of the bid guarantee for insertion in the provision at 52.228-1 (see 28.102-2(a)). The amount shall be adequate to protect the Government from loss should the successful bidder fail to execute further contractual documents and bonds as required. The bid guarantee amount shall be at least 20 percent of the bid price but shall not exceed $3 million. When the penal sum is expressed as a percentage, a maximum dollar limitation may be stated.
261	Amendment 2, Preproposal presentation	Amendment 2 states "Please provide five (5) copies of the technical proposal and one (1) copy of the pricing proposal in an electronic format." The preproposal conference presentation states that all copies shall be submitted on CDs. Please clarify the required format/procedure for submitting proposals.	Please provide one copy of the techical proposal and one copy of the pricing proposal in an electronic format.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
262	Amendment 2, Preproposal presentation	Please confirm that no hard copies are required.	No hard copies of the pricing and technical proposal is required.
263	Amendment 2, Preproposal presentation	Please advise if the price proposal can be submitted via email.	The price proposal can be submitted via email to the attention of Raymond J Porter: raymondj.porter@gsa.gov
264	Amendment 2, Preproposal presentation	Please confirm that proposals shall be delivered to The Dow Building. Please confirm that bids will be received in the building lobby.	No hard copies of the pricing and technical proposal is required.
267	230923.132	Please confirm that Johnson Controls is an acceptable manufacturer and bidder for the specification section 230923.1320.	Confirmed unless Add Alternate 6 is accepted; Provide [redacted] (b) (5) BAS System for specification section 23 09 23.13 20 [redacted] (b) (5) [redacted] (b) (5) for HVAC.
269	Structural Dwgs	Structural Drawing S102A shows the overhead unistrut structural framing grid running through the cleanrooms. Drawings Q201A and Q301A do not show the unistrut framing system but a powder coated structural system in isolated areas. Please confirm the overhead unistrut framing grid is not required in the clean rooms. Please re-issue structural drawings clarifying.	S102A indicates the concrete insert system for the slab, not the grid. The insert system is required in the slab for the owner's future use. Any grids in the cleanrooms are to be coordinated and installed by the cleanroom manufacturer per 13 20 00/1.6. The cleanroom plenum grid system shall be capable of supporting 2,000 lb loads on the suspended grids per 13 20 00/2.4.1.1 and are as indicated in the Q drawings.

SECTION F: BIM MODELING SCOPE / ELEMENTS / LEVEL OF DEVELOPMENT (LOD)

BIM MODELING SCOPE DEFINITIONS

LOD definitions are aligned to the **US Army Corps of Engineers** document **Minimum Modeling Matrix (M3)**. *See USACE Minimum Modeling Matrix, Version 1.2 (Oct. 3, 2013) for a full description.*

Level of Model Development Definitions (Accuracy)			
	100	200	300
Level of BIM Content Guidelines			
Design & Coordination	Model Elements indicative of area, height, volume, location and orientation may be modeled geometrically or represented by other data	Model Elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements.	Model Elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location, and orientation. Non-geometric information may also be attached to model elements.
Example	(i.e., a pump would be a cube).	(i.e., a pump would be a generic pump of approximate size).	(i.e., a pump would be a generic pump of accurate size complete with connections and clearances for a complete system).

ELEMENT GRADE DEFINITIONS

Grade	Description
A	3D + Facility Data. 3D graphical representation with associated intelligent attribute data.
B	2D + Facility Data. 2D graphical representation with associated intelligent attribute data.
C	2D Only (Drafting, linework, text, and or part of an assembly). – 2D graphical representation without associated intelligent attribute data.
+	Original Grade (A, B, or C) adjusted for contract changes.
-	Not included or tied to the model (however is still required in the deliverable.
•	Refer to specific child element for appropriate Grade.

LEVEL OF DEVELOPMENT MATRIX

LEVEL OF DEVELOPMENT (LOD) AND MODEL COMPONENT AUTHOR (MCA)

MCA Legend:

A - Architectural (AECOM)
LB - Laboratory (SST)
C - Civil (BAMFORTH)
L – Landscape (AECOM)
S - Structural (E+M)
M - Mechanical (AECOM)
E - Electrical (AECOM)
P - Plumbing (AECOM)
T - Telecom/Security/A/V (AECOM)
F - Fire Protection (AECOM)

MODEL ELEMENT BREAKDOWN (BY ASTM UNIFORMAT IV CLASSIFICATION)				FINAL CONCEPT DESGN		DESIGN DEVELOPMENT		75% CONSTRUCTION DOCUMENTS		95% CONSTRUCTION DOCUMENTS		100% CONSTRUCTION DOCUMENTS		CONFORMED SET		PRIMARY DISCIPLINE
				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
A	Substructure															
		Column Grid		-		-		-		-		-		-		
	A10	Foundations		-	-											
	A1010	Standard Foundations		-	-											
		Standard Foundations	A1010100	NA	NA	200	B	300	A	300	A	300	A	300	A	S
		Strip Footings	A1010110	NA	NA	200	B	300	A	300	A	300	A	300	A	S
		Spread Footings	A1010120	NA	NA	200	B	300	A	300	A	300	A	300	A	S

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION				FINAL CONCEPT DESIGN		DESIGN DEVELOP-MENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFOR MED SET		PRIMARY DISCIPLINE
				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Foundation Walls	A1010200	NA	NA	200		300		300		300		300		S
		Foundation Walls - CIP	A1010210	NA	NA	200		300		300		300		300		S
		Perimeter Drainage	A1010300	NA	NA	NA	C	100	C	100	C	100	C	100	C	P
		Footing Drains	A1010310	NA	NA	NA	C	100	C	100	C	100	C	100	C	P
		Perimeter Insulation	A1010400	NA	NA	NA	C	100	C	100	C	100	C	100	C	A
	A1020	Special Foundations														
		Grade Beams	A1020200	NA	NA	200		300		300		300		300		S
		Grade Beams - CIP	A1020210	NA	NA	200		300		300		300		300		S
		Dewatering	A1020500	NA	NA	NA		100		100		100		100		S
		Raft Foundations	A1020600	NA	NA	200		300		300		300		300		S
	A1030	Slab on Grade														
		Standard Slab on Grade	A1030100	NA	NA	200		300		300		300		300		S
		SOG - Unreinforced	A1030120	NA	NA	200		300		300		300		300		S
		Inclined Slab on Grade	A1030300	NA	NA	200		300		300		300		300		S
		Trenches	A1030400	NA	NA	100		300		300		300		300		S
		Pits & Bases	A1030500	NA	NA	100		300		300		300		300		S
		Under-Slab Drainage	A1030600	NA	NA	100		100		100		100		100		P
		Under-Slab Insulation	A1030700	NA	NA	100	C	100	C	100	C	100	C	100	C	A
		Subdrainage Piping	A1030710	NA	NA	100		100		100		100		100		P
B	Shell															
	B10	Superstructure														
	B1010	Floor Construction														
		Upper Floor Framing - Vertical Elements	B1010200	200		200		300		300		300		300		S
		Bearing Walls - CIP	B1010210	NA	NA	200		300		300		300		300		S
		Bearing Walls - Block	B1010215	NA	NA	200		300		300		300		300		S
		Columns - CIP	B1010240	NA	NA	200		300		300		300		300		S

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION			FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORM SET		PRIMARY DISCIPLINE
			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
	Columns - Steel	B1010250	200		200		300		300		300		300		S
	Upper Floor Framing - Horizontal Elements	B1010300	200		200		300		300		300		300		S
	Beams - CIP	B1010310	200		200		300		300		300		300		S
	Beams - Steel	B1010330	200		200		300		300		300		300		S
	Joists - Steel	B1010350	200		200		300		300		300		300		S
	Deck - Metal	B1010370	200		200		300		300		300		300		S
	Upper Floor Framing - Systems	B1010400	200		200		300		300		300		300		S
	CIP Slabs - One Way	B1010410	NA	NA	200		300		300		300		300		S
	CIP Slabs - Flat Plate	B1010412	NA	NA	200		300		300		300		300		S
	CIP Slabs - Flat Plate w/Drop Panels	B1010414	NA	NA	200		300		300		300		300		S
	CIP Slabs - Multispan Joist	B1010416	NA	NA	200		300		300		300		300		S
	CIP Beam & Slab - One Way	B1010420	NA	NA	200		300		300		300		300		S
	CIP Beam & Slab - Two Way	B1010422	NA	NA	200		300		300		300		300		S
	Composite Beam & Slab	B1010430	200		200		300		300		300		300		S
	Composite Beam, Deck & Slab	B1010432	200		200		300		300		300		300		S
	W Shape Composite Deck & Slab	B1010434	200		200		300		300		300		300		S
	Steel Girders w/ Steel Beams	B1010460	200		200		300		300		300		300		S
	Steel Beams w/ Steel Joists	B1010462	200		200		300		300		300		300		S
	Joist Girders w/ Steel Joists	B1010464	200		200		300		300		300		300		S
	Steel Light Gauge Floor System	B1010470	NA	NA	200		300		300		300		300		S
	Balcony Floor Construction	B1010500	NA	NA	200		300		300		300		300		S
	Ramps	B1010600	NA	NA	200		300		300		300		300		S
	Exterior Stairs & Fire Escapes	B1010700	NA	NA	200		300		300		300		300		A
	Floor Raceway Systems	B1010800	NA	NA	100	C	100	C	100	C	100	C	100	C	A
	Fireproofing - Floor Construction	B1010900	NA	NA	100	C	100	C	100	C	100	C	100	C	A
	Steel Beam Fireproofing	B1010910	NA	NA	100	C	100	C	100	C	100	C	100	C	A
	Steel Column Fireproofing	B1010920	NA	NA	100	C	100	C	100	C	100	C	100	C	A

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION			FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
B1020	Roof Construction														
	Flat Roof Framing - Vertical Elements	B1020100	200		200		300		300		300		300		S
	Bearing Walls - CIP	B1020110	NA	NA	200		300		300		300		300		S
	Bearing Walls - Block	B1020115	NA	NA	200		300		300		300		300		S
	Columns - CIP	B1020140	NA	NA	200		300		300		300		300		S
	Columns - Precast	B1020145	NA	NA	200		300		300		300		300		S
	Columns - Steel	B1020150	200		200		300		300		300		300		S
	Flat Roof Framing - Horizontal Elements	B1020200	200		200		300		300		300		300		S
	Beams - CIP	B1020210	NA	NA	200		300		300		300		300		S
	Beams - Steel	B1020230	200		200		300		300		300		300		S
	Joists - Steel	B1020250	200		200		300		300		300		300		S
	Deck - Metal	B1020260	200		200		300		300		300		300		S
	Flat Roof Framing - Systems	B1020300	200		200		300		300		300		300		S
	CIP Slabs - One Way	B1020310	NA	NA	200		300		300		300		300		S
	CIP Slabs - Flat Plate	B1020312	NA	NA	200		300		300		300		300		S
	CIP Slabs - Flat Plate w/Drop Panels	B1020314	NA	NA	200		300		300		300		300		S
	CIP Slabs - Multispan Joist	B1020316	NA	NA	200		300		300		300		300		S
	CIP Beam & Slab - One Way	B1020320	NA	NA	200		300		300		300		300		S
	CIP Beam & Slab - Two Way	B1020322	NA	NA	200		300		300		300		300		S
	Composite Beam & Slab	B1020330	200		200		300		300		300		300		S
	Composite Beam, Deck & Slab	B1020332	200		200		300		300		300		300		S
	W Shape Composite Deck & Slab	B1020334	200		200		300		300		300		300		S
	Steel Girders w/ Steel Beams	B1020360	200		200		300		300		300		300		S
	Steel Beams w/ Steel Joists	B1020362	200		200		300		300		300		300		S
	Joist Girders w/ Steel Joists	B1020364	NA	NA	200		300		300		300		300		S
	Pitched Roof Construction	B1020400	NA	NA	200		300		300		300		300		S
	Canopies	B1020800	100	C	200	A	300	A	300	A	300	A	300	A	A
	Fireproofing - Roof Construction	B1020900	NA	NA	100	C	100	C	100	C	100	C	100	C	A

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION			FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORM SET		PRIMARY DISCIPLINE
			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Steel Beam Fireproofing	B1020910	NA	NA	100	C	100	C	100	C	100	C	100	C	A
		Steel Column Fireproofing	B1020920	NA	NA	100	C	100	C	100	C	100	C	100	C	A
	B20	Exterior Enclosure														
	B2010	Exterior Walls														
		Exterior Wall Construction	B2010100	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Ext. Wall - CIP	B2010110	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Ext. Wall - CMU	B2010140	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Ext. Wall - CMU Cavity	B2010142	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Ext. Wall - Stone Veneer w/ Stud	B2010160	NA	NA	200	B	200	B	200	B	200	B	200	B	A
		Ext. Wall - Metal Siding Supports	B2010170	NA	NA	200	B	200	B	200	B	300	B	300	B	A
		Ext. Wall - Metal Siding Panels	B2010175	NA	NA	200	B	200	B	200	B	200	B	200	B	A
		Ext. Wall - Wood Stud w/ Siding & Shingles	B2010180	NA	NA	200	B	200	B	200	B	200	B	200	B	A
		Parapets	B2010200	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Exterior Louvers, Screens & Fencing	B2010300	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Exterior Sun Control Devices	B2010400	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Balcony Walls & Handrails	B2010500	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Exterior Soffits	B2010600	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	B2020	Exterior Windows														
		Windows	B2020100	100	C	200	A	300	A	300	A	300	A	300	A	A
		Windows - Aluminum	B2020110	100	C	200	A	300	A	300	A	300	A	300	A	A
		Curtain Walls	B2020200	100	C	200	A	300	A	300	A	300	A	300	A	A
		Curtain Walls - Framing	B2020210	100	C	200	A	300	A	300	A	300	A	300	A	A
		Curtain Walls - Panels	B2020220	100	C	200	A	300	A	300	A	300	A	300	A	A
		Storefronts	B2020300	100	C	200	A	300	A	300	A	300	A	300	A	A
		Screened Openings	B2020400	100	C	200	A	300	A	300	A	300	A	300	A	A
	B2030	Exterior Doors														
		Glazed Doors & Entrances	B2030100	100	C	200	A	300	A	300	A	300	A	300	A	A
		Exterior Glazed Doors - Aluminum	B2030110	100	C	200	A	300	A	300	A	300	A	300	A	A

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION			FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
	Solid Exterior Doors	B2030200	100	A	200	A	300	A	300	A	300	A	300	A	A
	Exterior Solid Doors - Aluminum	B2030210	100	A	200	A	300	A	300	A	300	A	300	A	A
	Exterior Solid Doors - Steel	B2030220	100	A	200	A	300	A	300	A	300	A	300	A	A
	Overhead Doors & Roll-up Grilles	B2030400	100	A	200	A	300	A	300	A	300	A	300	A	A
	Overhead Doors	B2030410	100	A	200	A	300	A	300	A	300	A	300	A	A
	Door Wall Opening Elements	B2030500	100	A	200	A	300	A	300	A	300	A	300	A	A
	Other Exterior Doors	B2030900	100	A	200	A	300	A	300	A	300	A	300	A	A
B30	Roofing														
B3010	Roof Coverings														
	Roof Finishes	B3010100	NA	NA	200	B	200	A	200	A	200	A	200	A	A
	Roofing - Built-up	B3010110	NA	NA	200	B	200	A	200	A	200	A	200	A	A
	Roofing - Single Ply Membrane	B3010120	NA	NA	200	B	200	A	200	A	200	A	200	A	A
	Roofing - Preformed Metal	B3010130	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Roofing - Formed Metal	B3010140	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Traffic Toppings & Paving Membranes	B3010200	NA	NA	200	C	200	-	200	-	200	-	200	-	A
	Roof Insulation & Fill	B3010300	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Roof Insulation - Rigid	B3010310	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Roof Flashing & Trim	B3010400	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Base Flashing	B3010410	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Roof Edges	B3010420	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Roof Flashing	B3010430	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Roof Eaves & Soffits	B3010500	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Gutters & Downspouts	B3010600	NA	NA	200	B	200	A	200	A	200	A	200	A	A
	Gutters	B3010610	NA	NA	200	C	200	A	200	A	200	A	200	A	A
	Downspouts	B3010620	NA	NA	200	C	200	A	200	A	200	A	200	A	A
B3020	Roof Openings														
	Glazed Roof Openings	B3020100	100	A	200	A	300	A	300	A	300	A	300	A	A
	Skylights	B3020110	100	A	200	A	300	A	300	A	300	A	300	A	A

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION				FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Roof Hatches	B3020200	NA	NA	200	B	200	B	200	B	200	B	200	B	A
		Smoke Vents	B3020220	NA	NA	200	C	200	C	200	C	200	C	200	C	A
		Roof Accessories	B3020230	NA	NA	200	-	200	-	200	-	200	-	200	-	A
		Gravity Roof Ventilators	B3020300	NA	NA	200	-	200	-	200	-	200	-	200	-	A
C	Interiors															
	C10	Interior Construction														
	C1010	Partitions														
		Fixed Partitions	C1010100	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Partitions - Brick Veneer w/ Stud	C1010115	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Partitions - CMU	C1010120	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Partitions - Tile	C1010135	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Partitions - Drywall w/ Metal Stud	C1010145	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Partitions - Plaster w/ Metal Stud	C1010155	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Partition Components - Metal Framing	C1010185	NA	NA	200	-	300	-	300	-	300	-	300	-	A
		Partition Components - Drywall	C1010190	NA	NA	200	-	300	-	300	-	300	-	300	-	A
		Partition Components - Plaster	C1010195	NA	NA	200	-	300	-	300	-	300	-	300	-	A
		Demountable Partitions	C1010200	NA	NA	100	A	200	A	200	A	300	A	300	A	A
		Partitions- Demountable, Drywall	C1010210	NA	NA	100	A	200	A	200	A	200	A	200	A	A
		Retractable Partitions	C1010300	NA	NA	100	A	200	A	200	A	200	A	200	A	A
		Partitions - Folding	C1010310	NA	NA	100	A	200	A	200	A	200	A	200	A	A
		Site Built Compartments & Cubicles	C1010500	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Interior Balustrades & Screens	C1010600	NA	NA	200	B	300	B	300	B	300	B	300	B	A
		Interior Windows & Storefronts	C1010700	NA	NA	200	A	300	A	300	A	300	A	300	A	A
		Interior Glazed Openings	C1010710	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	C1020	Interior Doors														
		Interior Doors	C1020100	100		100	A	200	A	300	A	300	A	300	A	A
		Interior Doors - Metal	C1020110	NA	NA	200	A	300	A	300	A	300	A	300	A	A

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			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
	Interior Doors - Wood	C1020120	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Interior Door Frames	C1020200	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Interior Door Frames - Metal	C1020210	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Interior Doors with Frames	C1020300	NA	NA	200	A	300	A	200	A	200	A	200	A	A
	Interior Metal Doors with Metal Frames	C1020310	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Interior Wood Doors with Metal Frames	C1020320	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Interior Door Hardware	C1020400	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Door Hardware	C1020410	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Interior Door Wall Opening Elements	C1020500	100	C	200	A	300	A	300	A	300	A	300	A	A
	Interior Door Sidelights & Transoms	C1020600	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Interior Hatches & Access Doors	C1020700	NA	NA	200	A	200	A	200	A	200	A	200	A	A
C1030	Fittings														
	Fabricated Compartments & Cubicles	C1030100	NA	NA	200	B	200	B	200	B	200	B	200	B	A
	Toilet Partitions	C1030110	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Bath & Toilet Accessories	C1030200	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Bath & Toilet Accessories - Commercial	C1030210	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Storage Specialties	C1030300	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Lockers	C1030310	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Shelving	C1030320	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Fabricated Cabinets & Counters	C1030400	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Cabinets	C1030410	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Identifying/Visual Aid Specialties	C1030500	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Signs	C1030510	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Building Directory Boards	C1030520	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Bulletin Boards	C1030530	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Chalkboards & Whiteboards	C1030540	NA	NA	100	B	100	B	100	B	100	B	100	B	A
	Other Fittings	C1030900	NA	NA	100	C	100	C	100	C	100	C	100	C	A

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			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
C20	Stairs														
C2010	Stair Construction														
	Regular Stairs	C2010100	100	C	200	A	300	A	300	A	300	A	300	A	A
	Stairs - CIP	C2010110	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Stairs - Steel	C2010130	NA	NA	200	A	300	A	300	A	300	A	300	A	A
	Stair Handrails	C2010400	100	C	200	A	300	A	300	A	300	A	300	A	A
	Stair, Tread & Landing Finishes	C2020100	NA	NA	100	B	200	B	200	B	200	B	200	B	A
	Stair Soffit Finishes	C2020200	NA	NA	100	B	200	B	200	B	200	B	200	B	A
	Stair Handrail & Balustrade Finishes	C2020300	NA	NA	200	B	200	B	200	B	200	B	200	B	A.
C30	Interior Finishes														
C3010	Wall Finishes														
	Wall Finishes	C3010100	NA	NA	200	B	200	B	200	B	200	B	200	B	A
	Wall Finishes - Paneling	C3010140	NA	NA	200	B	200	B	200	B	200	B	200	B	A
	Wall Finishes - Tile	C3010150	NA	NA	200	B	200	B	200	B	200	B	200	B	A
C3020	Floor Finishes														
	Flooring	C3020400	NA	NA	200	C	200	B	200	B	200	B	200	B	A

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				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Flooring - Terrazzo	C3020420	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Flooring - Tile	C3020430	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Flooring - VCT	C3020440	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Flooring - Wood	C3020450	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Carpeting	C3020500	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Carpet	C3020510	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Carpet Tile	C3020520	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Bases, Curbs & Trim	C3020600	NA	NA	100	C	200	B	200	B	200	B	200	B	A
		Base - Vinyl & Rubber	C3020610	NA	NA	100	C	200	B	200	B	200	B	200	B	A
		Base - Wood	C3020620	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Access Pedestal Flooring	C3020700	NA	NA	100	C	100	C	100	C	100	C	100	C	A
		Subflooring & Underlayment	C3020800	NA	NA	100	C	100	C	100	C	100	C	100	C	A
	C3030	Ceiling Finishes														
		Applied Ceiling Finishes	C3030100	NA	NA	100	C	100	C	100	C	100	C	100	C	A
		Ceiling Finishes - Paint	C3030110	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Ceiling Finishes - Coatings	C3030120	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Ceiling Finishes - Coverings	C3030130	NA	NA	100	C	100	C	100	C	100	C	100	C	A
		Ceiling Finishes - Paneling	C3030140	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Ceiling Finishes - Tile	C3030150	NA	NA	100	C	100	B	100	B	100	B	100	B	A
		Suspended Ceilings	C3030200	NA	NA	100	C	200	A	200	A	200	A	200	A	A
		Suspended Ceilings - Acoustical	C3030210	NA	NA	100	C	200	B	200	B	200	B	200	B	A
		Suspended Ceilings - Gypsum Board	C3030220	NA	NA	100	C	200	A	200	A	200	A	200	A	A
		Drywall & Plaster Ceiling Components	C3030300	NA	NA	100	C	200	C	200	C	200	C	200	C	A
		Ceiling Components - Drywall	C3030310	NA	NA	100	C	200	C	200	C	200	C	200	C	A
		Other Ceiling Finishes	C3030900	NA	NA	100	C	200	B	200	B	200	B	200	B	A

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				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
D	Services															
	D10	Conveying														
	D1010	Elevators and Lifts														
		Elevators - Freight	D1010210	100	C	200	A	200	A	200	A	200	A	200	A	A
		Elevators - Passenger	D1010310	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	D20	Plumbing														
	D2010	Plumbing Fixtures														
		Water Closets	D2010100	100	-	200	B	200	B	200	B	200	B	200	B	P
		Urinals	D2010200	100	-	200	A	200	A	200	A	200	A	200	A	A
		Lavatories	D2010300	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Sinks	D2010400	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Sinks - Kitchen	D2010410	NA	NA	200	A	200	A	200	A	200	A	200	A	A

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			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
	Sinks - Laboratory	D2010430	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Sinks - Service	D2010440	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Wash Fountains	D2010600	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Showers	D2010710	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Drinking Fountains & Coolers	D2010800	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	Drinking Fountains	D2010810	NA	NA	200	A	200	A	200	A	200	A	200	A	A
D2020	Domestic Water Distribution														
	Cold Water Service	D2020100	100	C	200	-	200	-	200	-	200	-	200	-	P
	Hot Water Service	D2020200	NA	NA	200	-	200	-	200	-	200	-	200	-	P
	Domestic Water Supply Equipment	D2020300	NA	NA	200	B	200	B	200	B	200	B	200	B	P
D2030	Sanitary Waste														
	Waste Piping	D2030100	100	B	200	A	200	A	200	A	200	A	200	A	P
	Vent Piping	D2030200	NA	NA	200	A	200	A	200	A	200	A	200	A	P
	Floor Drains	D2030300	NA	NA	200	B	200	B	200	B	200	B	200	B	P
	Sanitary Waste Equipment	D2030400	NA	NA	200	B	200	B	200	B	200	B	200	B	P
	Pipe Insulation	D2030500	NA	NA	100	-	200	-	200	-	200	-	200	-	P
D2040	Rain Water Drainage														
	Pipe & Fittings	D2040100	100	B	200	A	200	A	200	A	200	A	200	A	P
	Roof Drains	D2040200	100	B	200	A	200	A	200	A	200	A	200	A	P
	Rainwater Drainage Equipment	D2040300	100	B	200	A	200	A	200	A	200	A	200	A	P
	Storm Water Piping	D3030100	100	B	200	A	200	A	200	A	200	A	200	A	P

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			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
D2090	Other Plumbing Systems														
	Natural Gas Distribution	D2090100	100	C	200	C	200	C	200	C	200	C	200	C	P
	Acid Waste Systems	D2090200	100	C	200	C	200	C	200	C	200	C	200	C	P
	Interceptors	D2090300	100	C	200	C	200	C	200	C	200	C	200	C	P
	Special Water Systems	D2090600	100	C	200	C	200	C	200	C	200	C	200	C	P
	Piping & Fittings	D2090800	100	C	200	C	200	C	200	C	200	C	200	C	P
	Misc. Other Plumbing Systems	D2090900	100	C	200	C	200	C	200	C	200	C	200	C	P
	Nitrogen Liquid	D2091000	NA	NA	200	-	200	-	200	-	200	-	200	-	P
	Nitrogen Gas	D2091100	NA	NA	200	-	200	-	200	-	200	-	200	-	P
	Vacuum	D2091200	NA	NA	200	-	200	-	200	-	200	-	200	-	P
	Compressed Air	D2091300	NA	NA	200	-	200	-	200	-	200	-	200	-	P
D30	HVAC														
D3010	Energy Supply														
	Steam Supply System	D3010400	100	-	200	-	200	-	200	-	200	-	200	-	M
	Hot Water Supply System	D3010500	100	-	200	-	200	-	200	-	200	-	200	-	M
	Chilled Water Supply System	D3010600	100	-	200	-	200	-	200	-	200	-	200	-	M
D3020	Heat Generating Systems														
	Auxiliary Equipment	D3020300	100	-	200	C	200	C	200	C	200	C	200	C	M
	Insulation	D3020400	100	-	100	-	100	-	100	-	100	-	100	-	M
D3030	Cooling Generating Systems														
	Chilled Water Systems	D3030100	100	-	200	B	200	B	200	B	200	B	200	B	M
	Direct Expansion Systems	D3030200	100	-	200	B	200	B	200	B	200	B	200	B	M
	Other Cooling System Components	D3030300	100	-	200	B	200	B	200	B	200	B	200	B	M

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			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
D3040	Distribution Systems														
	Air Distribution Systems	D3040100	100	-	200	C	300	B	300	B	300	B	300	B	M
	Exhaust Ventilation Systems	D3040200	100	-	200	C	300	B	300	B	300	B	300	B	M
	Steam Distribution Systems	D3040300	100	-	200	C	300	B	300	B	300	B	300	B	M
	Hot Water Distribution	D3040400	100	-	200	C	300	B	300	B	300	B	300	B	M
	Chilled Water Distribution	D3040500	100	-	200	C	300	C	300	C	300	C	300	C	M
D3050	Terminal & Package Units														
	Terminal Self-Contained Units	D3050100	100	-	200	C	200	C	200	C	200	C	200	C	M
	Package Units	D3050200	100	-	200	C	200	C	200	C	200	C	200	C	M
D3060	Controls & Instrumentation														
	Heating Generating Systems	D3060100	100	-	100	B	100	B	100	B	100	B	100	B	M
	Cooling Generating Systems	D3060200	100	-	100	B	100	B	100	B	100	B	100	B	M
	Heating/Cooling Air Handling Units	D3060300	100	-	100	B	100	B	100	B	100	B	100	B	M
	Exhaust & Ventilating Systems	D3060400	100	-	100	B	100	B	100	B	100	B	100	B	M
	Hoods & Exhaust Systems	D3060500	100	-	100	B	100	B	100	B	100	B	100	B	M
	Terminal Devices	D3060600	100	-	100	B	100	B	100	B	100	B	100	B	M
	Energy Monitoring & Control	D3060700	100	-	100	-	100	-	100	-	100	-	100	-	M
	Building Automation Systems	D3060800	100	-	100	B	100	B	100	B	100	B	100	B	M
D3090	Other HVAC Systems/Equip														
	Special Cooling Systems & Devices	D3090100	100	-	200	B	200	B	200	B	200	B	200	B	M
	Special Humidity Control	D3090200	100	-	200	B	200	B	200	B	200	B	200	B	M
	Air Purifiers	D3090500	100	-	200	-	200	-	200	-	200	-	200	-	M

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			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
D40	Fire Protection														
D4010	Sprinklers														
	Sprinkler Water Supply	D4010100	100	C	200	B	200	B	200	B	200	B	200	B	F
	Sprinkler Pumping Equipment	D4010200	100	C	200	B	200	B	200	B	200	B	200	B	F
	Wet Sprinkler Systems	D4010300	100	C	200	B	200	B	200	B	200	B	200	B	F
	Dry Sprinkler Systems	D4010400	100	C	200	B	200	B	200	B	200	B	200	B	F
D4020	Standpipes														
	Standpipe Water Supply	D4020100	100	C	200	B	200	B	200	B	200	B	200	B	F
	Pumping Equipment	D4020200	100	C	200	B	200	B	200	B	200	B	200	B	F
	Standpipe Equipment	D4020300	100	C	200	B	200	B	200	B	200	B	200	B	F
	Fire Hose Equipment	D4020400	100	C	200	B	200	B	200	B	200	B	200	B	F
D4030	Fire Protection Specialties														
	Fire Extinguishers	D4030100	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Fire Extinguisher Cabinets	D4030200	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Other Fire Protection Specialties	D4030900	NA	NA	100	B	200	B	200	B	200	B	200	B	F
D4090	Other Fire Protection Systems														
	Carbon Dioxide Systems	D4090100	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Foam Generating Equipment	D4090200	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Clean Agent System	D4090300	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Dry Chemical Systems	D4090400	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Hood & Duct Fire Protection	D4090500	NA	NA	100	B	200	B	200	B	200	B	200	B	F
	Misc. Other Fire Protection Systems	D4090900	NA	NA	100	B	200	B	200	B	200	B	200	B	F
D50	Electrical														
D5010	Electrical Service/Distribution														
	High Tension Service & Distribution	D5010100	NA	NA	100	B	100	B	100	B	100	B	100	B	E
	Low Tension Service & Distribution	D5010200	NA	NA	100	B	100	B	100	B	100	B	100	B	E

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				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Branch Wiring & Devices	D5020100	NA	NA	200	B	200	B	200	B	200	B	200	B	E
		Receptacles - Wall	D5020110	NA	NA	200	B	200	B	200	B	200	B	200	B	E
		Receptacles - Floor	D5020115	NA	NA	200	B	200	B	200	B	200	B	200	B	E
		Switches - Wall	D5020120	NA	NA	200	B	200	B	200	B	200	B	200	B	E
		Lighting Equipment	D5020200	NA	NA	200	A	200	A	200	A	200	A	200	A	E
		Lighting - Fluorescent	D5020210	NA	NA	200	A	200	A	200	A	200	A	200	A	E
		Lighting - Incandescent	D5020220	NA	NA	200	A	200	A	200	A	200	A	200	A	E
		Lighting - High Intensity	D5020230	NA	NA	200	A	200	A	200	A	200	A	200	A	E
		Light Poles	D5020280	NA	NA	200	A	200	A	200	A	200	A	200	A	E
	D5030	Communications and Security														
		Public Address & Music Systems	D5030100	NA	NA	200	B	200	B	200	B	200	B	200	B	T
		Intercommunication & Paging Systems	D5030200	NA	NA	200	B	200	B	200	B	200	B	200	B	T
		Telephone Systems	D5030300	NA	NA	200	B	200	B	200	B	200	B	200	B	T
		Call Systems	D5030400	NA	NA	200	B	200	B	200	B	200	B	200	B	T
		Television Systems	D5030500	NA	NA	200	B	200	B	200	B	200	B	200	B	T
		Data Networking	D5030600	NA	NA	200	-	200	-	200	-	200	-	200	-	T
		Fire Alarm Systems	D5030700	NA	NA	200	B	200	B	200	B	200	B	200	B	T
		Security & Detection Systems	D5030800	NA	NA	200	-	200	-	200	-	200	-	200	-	T
		Other Communications & Security Systems	D5030900	NA	NA	200	C	200	C	200	C	200	C	200	C	T
	D5090	Other Electrical Systems														
		Grounding Systems	D5090100	NA	NA	200	C	200	C	200	C	200	C	200	C	E
		Emergency Light & Power Systems	D5090200	NA	NA	200	C	200	C	200	C	200	C	200	C	E
		Floor Raceway Systems	D5090300	NA	NA	200	C	200	C	200	C	200	C	200	C	E
		General Construction Items (Elect.)	D5090400	NA	NA	200	C	200	C	200	C	200	C	200	C	E
		Misc. Other Electrical Systems	D5090900	NA	NA	200	B	200	B	200	B	200	B	200	B	E
E	Equipment & Furnishings															
	E10	Equipment		NA	NA	200	A	200	A	300	A	300	A	300	A	A
	E1010	Commercial Equipment		NA	NA	200	A	300	A	300	A	300	A	300	A	A

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION				FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Display Cases	E1010510	NA	NA	200	C	200	C	200	C	200	C	200	C	A
		Office Equipment	E1010800	NA	NA	200	C	200	C	200	C	200	C	200	C	A
		Other Commercial Equipment	E1010900	NA	NA	200	C	200	C	200	C	200	C	200	C	A
	E1020	Institutional Equipment														
		Audio-visual Equipment	E1020500	NA	NA	100	C	100	C	100	C	100	C	100	C	T
		Laboratory Equipment	E1020700	NA	NA	200	B	200	B	200	B	200	B	200	B	LB
		Laboratory Equipment	E1020710	NA	NA	200	B	200	B	200	B	200	B	200	B	LB
		Laboratory Cabinets & Countertops	E1020720	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Laboratory Hoods	E1020730	NA	NA	200	B	200	B	200	B	200	B	200	B	A
		Other Institutional Equipment	E1020900	NA	NA	200	B	200	B	200	B	200	B	200	B	A
	E20	Furnishings														
	E2010	Fixed Furnishings														
		Fixed Casework	E2010200	NA	NA	200	A	200	A	200	A	200	A	200	A	A
		Fixed Multiple Seating	E2010500	NA	NA	200	A	200	A	200	A	200	A	200	A	A
	E2020	Moveable Furnishings														
		Furniture & Accessories	E2020200	NA	NA	200	B	200	B	200	B	200	B	200	B	A

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION				FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRAE	LOD	GRADE	MCA
F		Special Construction & Demolition														
	F10	Special Construction		NA	NA	100	C	200	C	200	C	200	C	200	C	A
	F1010	Special Structures		NA	NA	100	C	200	C	200	C	200	C	200	C	A
	F1020	Integrated Construction		NA	NA	100	C	200	C	200	C	200	C	200	C	A
	F1030	Special Construction Systems		NA	NA	100	C	200	C	200	C	200	C	200	C	A
	F1040	Special Facilities		NA	NA	100	C	200	C	200	C	200	C	200	C	A
	F1050	Special Controls & Instrumentation		NA	NA	100	C	200	C	200	C	200	C	200	C	A
G	Building Sitework - COMPLETION OF THIS SECTION REQUIRES WORKSHOP WITH GSA/ NASA TO REVIEW BIM REQUIREMENTS FOR SITEWORK															
	G10	Site Preparation														
	G1010	Site Clearing														
		Tree Preservation, Clearing & Grubbing	G1010100	NA	NA	100	C	100	C	100	C	100	C	100	C	L
		Tree Removal & Thinning	G1010200	NA	NA	100	C	100	C	100	C	100	C	100	C	L
	G1020	Site Demolition and Relocations														
		Demolition of Site Components	G1020200	NA	NA	100	C	100	C	100	C	100	C	100	C	L
		Utilities Relocation	G1020400	NA	NA	100	C	100	C	100	C	100	C	100	C	L
	G1030	Site Earthwork														
		Site Grading Excavation & Disposal	G1030100	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Borrow Fill	G1030200	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Soil Stabilization & Treatment	G1030300	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Site Dewatering	G1030400	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Site Shoring	G1030500	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Embankments	G1030600	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Erosion Control	G1030700	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Utilities Trenching	G1030800	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	G1040	Hazardous Waste Remediation														
		Removal of Contaminated Soil	G1040100													
		Soil Restoration & Treatment	G1040200	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Other Hazardous Waste Remediation	G1040900	NA	NA	100	C	100	C	100	C	100	C	100	C	C

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION			FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
G20	Site Improvement														
G2010	Roadways														
	Roadway Bases & Sub-Bases	G2010100	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Roadway Paving & Surfacing	G2010200	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Curbs, Gutters & Drains	G2010300	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Guardrails & Barriers	G2010400	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Painted Lines & Markings	G2010500	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Signage	G2010600	NA	NA	100	C	100	C	100	C	100	C	100	C	C
G2020	Parking Lots														
	Parking Lot Bases & Sub-Bases	G2020100	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Parking Lot Paving & Surfacing	G2020200	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Curbs, Gutters & Drains	G2020300	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Guardrails & Barriers	G2020400	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Parking Booths & Equipment	G2020500	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Painted Lines & Markings	G2020600	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	Signage	G2020700	NA	NA	100	C	100	C	100	C	100	C	100	C	C
G2030	Pedestrian Paving														
	Bases & Sub-Bases	G2030100	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
	Sidewalks	G2030200	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
	Brick & Tile Plazas	G2030300	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
	Edging	G2030400	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
	Exterior Steps & Ramps	G2030500	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
	Pedestrian Bridges	G2030600	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
G2040	Site Development														
	Fences & Gates	G2040100	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L
	Retaining Walls	G2040200	NA	NA	100	C	100	C	100	C	100	C	100	C	C/L

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION			FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
			LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
		Terracing & Perimeter Walls	G2040300	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Signage	G2040400	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Site Furnishings	G2040500	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Other Site Development	G2040900	NA	NA	200	C	200	C	200	C	200	C	200	C	C
	G2050	Landscaping														
		Fine Grading & Soil Preparation	G2050100	NA	NA	100	C	200	C	200	C	200	C	200	C	C/L
		Erosion Control Measures	G2050200	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Seeding & Sodding	G2050400	NA	NA	200	C	200	C	200	C	200	C	200	C	L
		Planting	G2050500	NA	NA	200	C	200	C	200	C	200	C	200	C	L
		Other Landscape Features	G2050900	NA	NA	200	C	200	C	200	C	200	C	200	C	L
	G30	Site Mechanical Utilities														
	G3010	Water Supply														
		Potable Water Distribution & Storage	G3010100	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Non Potable Water Distribution & Storage	G3010200	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Well Systems	G3010300	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Fire Protection Distribution & Storage	G3010400	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Pumping Stations	G3010500	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Package Water Treatment Plants	G3010600	NA	NA	100	C	100	C	100	C	100	C	100	C	C
	G3020	Sanitary Sewer														
		Sewage Piping	G3020100	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Manholes & Cleanouts	G3020200	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Septic Disposal Systems	G3020300	NA	NA	200	C	200	C	200	C	200	C	200	C	C
		Lift Stations	G3020400	NA	NA	100	C	100	C	100	C	100	C	100	C	C
		Packaged Water Waste Treatment Plants	G3020500	NA	NA	100	C	100	C	100	C	100	C	100	C	C

January 16, 2015

MODEL ELEMENT BREAKDOWN BY ASTM UNIFORMAT IV CLASSIFICATION				FINAL CONCEPT DESIGN		DESIGN DEVELOPMENT		75% CONST. DOC.		95% CONST. DOC.		100% CONST. DOC.		CONFORMED SET		PRIMARY DISCIPLINE
				LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	LOD	GRADE	MCA
	G3030	Storm Sewer														
		Storm Sewer Piping	G3030100	NA	NA	100	C	200	C	200	C	200	C	200	C	C
		Manholes	G3030200	NA	NA	100	C	200	C	200	C	200	C	200	C	C
		Headwalls & Catch Basins	G3030300	NA	NA	100	C	200	C	200	C	200	C	200	C	C
		Lift Stations	G3030400	NA	NA	100	C	200	C	200	C	200	C	200	C	C
		Retention Ponds	G3030500	NA	NA	100	C	200	C	200	C	200	C	200	C	C
		Ditches & Culverts	G3030600	NA	NA	100	C	200	C	200	C	200	C	200	C	C
	G4010	Electrical Distribution														
		Substations	G4010100	NA	NA	200	B	200	B	200	B	200	B	200	B	E

[redacted]

[redacted]

[redacted]

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0010	06/23/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)	(X)	9A. AMENDMENT OF SOLICITATION NO.
	☐	9B. DATED (SEE ITEM 11)
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 13)
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0010

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 23 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0010.

2. In response to questions submitted to date the NASA MSL Project RFI logs are provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
37	Dwg S001	S001 Notes state that up to 2 feet of existing fill may be required to be removed to achieve stable subgrade. Please confirm that this note applies to the unsuitable fill unit price cost for unsuitable soil included on the bid form?	Confirmed. The unit price "0001D" in the Bid Items table applies to the removal and replacement of such soils.
162	33 62 13.20	Specification Section 31 62 13.20 - 3.4.3 states that static load tests shall be performed on a minimum of 5 test piles. 31 62 13.20 3.4.1 does not indicated how many test piles are to be driven. Please provide the quantity of test piles to be driven or provide the Geotechnical Report so that quantity and size of test piles can be determined.	Provide 8 test piles as indicated in the geotechnical report. Please see the response to #42.
163	34 62 13.20	Specification Section 31 62 13.20 - 3.4.3 states that static load tests shall be performed on a minimum of 5 test piles. 31 62 13.20 3.4.1 does not indicated how many test piles are to be driven. Please provide the quantity of test piles to be driven or provide the Geotechnical Report so that quantity and size of test piles can be determined.	Please see the response to #162.
164	35 62 13.20	The process to set up and perform a static load test is time consuming and expensive. The requirement of performing static load test on 5 test piles appears to be excessive given the foot print size of the building. Can the number of required static load tests be reduced?	Provide 8 test piles as indicated in the geotechnical report.
165	36 62 13.20	Specification 31 62 13.20 requires both dynamic pile analysis test (PDA) as well as static load test (Hydraulic Load Test). Is a PDA test to performed only on test piles similar to the static load test? Is a PDA test required to be performed on a production pile. If so how many PDA tests are to be performed?	As indicated in the geotechnical report, all test piles shall be monitored using the PDA. All test piles should also be re-struck while being monitored with the PDA.
166	37 62 13.20	Per discussions with the precast / prestressed concrete piles subcontractors it does not appear that it is typical for a precast pile project to utilize a dynamic pile analysis test (PDA) test. PDA tests are expensive and time consuming and are not applicable for precast piles. Can the requirement for a PDA test be deleted from the specification requirements given that a static load test is the more applicable test for precast piles?	Please provide PDA testing per the contract documents.
238	03 35 43 POLISHED CONCRETE FLOORS	Para. 1.7.10 prohibits the use of lifts or rolling equipment on concrete. The deductive alternate of deleting terrazzo and using polished concrete instead captures a substantial area of the building. Please consider allowing the use of lifts or rolling equipment with adequate floor protection.	Lifts or rolling equipment will be allowed on the polished concrete floors as long as floor loading requirements stipulated in the structural contract documents are not exceeded, and the floor is protected with a minimum of 1/8 inch smooth Masonite or plywood covering with taped joints.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
265	Amendment 2, Preproposal presentation	Please confirm the deadline for submitting proposals. The SF1442 states 6/20/16 at 2:00PM but the preproposal conference presentation states 1:00PM.	The proposals are due by 1 PM EST.
270	Amendment 8, Preproposal Delivery	Amendment 8, item 2 states the Government wants five (5) CDs delivered to GSA. Response to RFI No. 125 states " all submissions are to be made electronically. Hand delivery is neither permitted or desired." Please confirm the proposal delivery method is to be electronic, and five (5) CDs can be overnighted for delivery the following day. Also confirm that the proposal is to be in an uneditable PDF format.	Please provide 1 copy of the price proposal and one copy of the technical proposal via electronic format. The proposal must be provided in an uneditable PDF format.
271	Amendment 8, Geotechnical Report	The response to RFI No. 29 states "Government accepts no responsibility or liability for the information contained in this document." As this is a design-bid-build project and the design resonsibitly is by the Government please confirm that the Government is responsible and liable for the information provided in the Geotechnical Report.	The response to RFI 042 does not deny responsibility for all of the information in the GET Solutions, Inc. report dated July 23, 2014, only the analysis or conclusions listed in Sections 4 and 5.
272	Form 1442	Form 1442 from the RFP does not indicate the start of work days from Award or NTP, please consider from NTP and confirm.	The contractor shall begin performance within 1 calendar day and must be at Susbtantial Completion within 730 calendar days after the receipt of the Notice to Proceed.
281		Amendment 0008 states " Price Proposals Are Due – July 7, 2016 at 1:00 pm • 1 CD Copy of Price Proposal • DO NOT SEND FAX OR PDFs. Are we no longer able to email the price proposal or do we email price proposal and send price on CD next day. Please advise.	The price proposal can be submitted via email to the attention of Raymond J Porter: raymondj.porter@gsa.gov

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
197	Price Proposal Form	In Amendment 2, an excel pricing spreadsheet was provided including 3 tabs – (1) Base Bid with Spec Section Breakdown, (2) Options, (3) Value Engineering Suggestions. Should these 3 pricing sheets be provided along with the updated Price Proposal Form provided in Amendment 3?	Please utilize the revised Bid Forms dated 6/17/2016.
198	Price Proposal Form	In Amendment 2, an excel pricing spreadsheet was provided including 3 tabs – (1) Base Bid with Spec Section Breakdown, (2) Options, (3) Value Engineering Suggestions. Do we provide the Base Bid with Spec Section Breakdown form as well as the updated Price Proposal Form provided in Amendment 3? If so, how do we deal with the unit pricing on the Price Proposal Form provided in Amendment 3 on the Base Bid with Spec Section Breakdown? Do just include the total price of the unit prices into its appropriate specification categories?	Please utilize the revised Bid Forms dated 6/17/2016.
199	Price Proposal Form	In Amendment 2, an excel pricing spreadsheet was provided including 3 tabs – (1) Base Bid with Spec Section Breakdown, (2) Options, (3) Value Engineering Suggestions. On the Base Bid with Spec Section Breakdown form it adds the TOTAL BASE BID plus TOTAL OPTIONS (NET) = TOTAL EVALUATED PRICE. The Amendment 3 Price Proposal form does not include the Alternate Pricing. Please confirm if the net total of the options will be added to the base price (Price Proposal Form) and in fact be the TOTAL EVALUATED PRICE.	Please utilize the revised Bid Forms dated 6/17/2016. Regarding the specific question, yes, the total evaluated price is the sum of the base bid plus options as indicated on the Bid Forms.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
201	01 23 60	Amendment 2 provided an Options spreadsheet with a column entitled "Days Option Open from Award" listing calendar days the Contracting Officer has to accept the options. Many of these "Days Option Open from Award" are not feasible and will not fit within the project schedule such as: Deduct Option 6: Delete BIM – 90 days. BIM will need to be implemented within 60 days for procurement. Recommend 60 days. Deduct Option 8: LEED USGBC Silver Rating – 180 days. Cannot wait 6 months to start submittals on a 24 month project. Need to provide submittals within 60 days of award. Recommend change to 60 days. Deduct Option 9: Delete Cleanrooms – 240 days. Cannot wait 8 months to hold off on procurement of cleanrooms due to long lead times, and subcontractors will not hold pricing that long. Need to begin procurement within 60 days. Recommend changes to 60 days. Add Option2: Cleanroom Capability – 90 days. Cannot wait 90 days for a redesign of the cleanrooms. Need to begin procurement in 60 days. Recommend change to 60 days. Add Options 1, 3, 4, 5 all show 240 days open for approval. Cannot hold open 8 months on a 24 month project due to procurement issues and subcontractors will not hold pricing that long. We recommend reducing all to 90 days.	The number of days the Contractor is required to hold its option pricing has been reduced to 60 calendar days for all except Add Alternates 1, 3, 4, and 5. It is anticipated that funding for Add Alternates 1, 3, 4, and 5 may not be available until FY 2017, and that it could take up to 240 days for such funding to become available to NASA. The Government understands the concern raised and will endeavor to exercise these options as early as practicable. An updated Bid Form is provided with the revised durations stated above.
275	01 78 25 BIM Execution Plan – Section M	Please make available the Level of Information (LOI) documents as referenced in the specifications but not included in the bid package to identify the effort required to achieve BIM and COBie deliverables as specified. Please also identify if parameters have been created in the existing BIM design for all LOI assets	The LOI specification has already been issued as part of amendment 0007. No, the design BIMs do not contain all necessary LOI parameters or parameter values.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
341	Amendment 8, RFI No. 72 Response, 31 62 13.20 - Precast/ Prestsressed Concrete Piles	The response to RFI No. 72 issued in Amendment 08 provides two different responses which conflict each other. The response dated June 3, 2016 states "The requirements are as stated in the contract documents." The response dated June 6, 2016 states "The design team takes no exception to the elimination of the pile driving points provided the contractor's geotechnical engineer and the pile subcontractor have no concerns that the piles will be damaged during driging operations." Please confirm which response to RFI No. 72 should be followed.	Please disregard the response to RFI 072 on 6/3/2016 and follow the revised response issued on 6/6/16.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
135	230923.132	SSF-1 Controls SSF-1 Side stream Filtration system SECTION 23 65 00 Page 11/12 states: "2.6 SIDE STREAM FILTRATION Provide side stream filtration for condenser water system. Pressure rating minimum 125 psig, temperature rating minimum 100 deg F. Provide capacities as scheduled on the drawings. System shall include: a. Separator b. All interconnecting piping and valves c. UL listed NEMA 4X motor starter and controls including 115 volt transformer and with safety disconnect and H.O.A. switch. d. Inlet/outlet valve kit e. Programmable Logic Controller f. Premium Efficiency Motor g. Pump basket strainer h. Inlet flange/grooved connector i. Outlet flange/grooved connector3/4" purge outlet j. Inlet and outlet pressure gauges k. Reinforced rubber housing However M-601 Points list indicates the following points: a. Pump Status Input, b. Pump Diff. Press. Input, c. Pump Flow Switch Input, d. Pump Off-On Command Output, e. Pump Proof Alarm, f. Pump Vib-Accelerometer Alarm, g. SSF-1 Hi-Analog Alarm, h. SSF-1 Proof Alarm Please indicate the following: a. Are the points as listed on M-601 (shown above) required to be provided by the equipment vendor in section 23 65 00 as part of the controls as listed in that section or are they to be overlaid on top of the controls for that section and provided by 23 09 13 20? b. Is there a requirement to provide integration to the controls for this system?	a. The side stream manufacturer shall provide a side stream filter with pressure gauges for manual reading and a controller with a differential pressure indicator. The BMS manufacturer shall provide [redacted] (b) (5) [redacted] (b) (5) [redacted] b. The BMS manufacturer shall provide, overlaid on top of the side steam manufacturer's controls, the points listed on M-601. The BMS shall receive [redacted] (b) (5) [redacted] c. [redacted] (b) (5) [redacted] (b) (5) [redacted]
137	230923.132	FCU Controls By whom? 230000 Page 30 Fan Coil Units States: Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Please indicate if this paragraph is part of these specifications, or if valves and controls should be included by Div. 23092313 20 [redacted] (b) (5) [redacted] for HAVC?	a. The Div 23 FCU manufacturer shall provide the chilled water control valves with ability to have an [redacted] (b) (5) [redacted] The Div 23 BMS manufacturer shall provide the return air space temperature sensor. b. The FCU shall be controlled by the FCU manufacturer through [redacted] (b) (5) [redacted] (b) (5) [redacted]

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Master RFI #	Spec Reference	Bidder Question	GSA Response
139	230923.132	Electrical Installation Clarification Request 23 09 23.1320 Page 15 states: 2.4.3 Wiring: "Provide complete electrical wiring for the DDC System, including wiring to transformer primaries. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring shall be exposed plenum rated wiring. Wiring shall be routed parallel and perpendicular to building structural members. Where practical, low voltage cables (<100) shall be bundled together and supported from J-hooks and or cable trays. All exposed cable shall be supported as in accordance with the requirements of the National Electric Code and as a minimum be supported every 5 ft. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, above suspended ceilings, in attics, and within ductwork. Contractor shall submit electronic files of the drawings." Please identify / clarify the following: 1. Where conduit would be required for control circuit wiring? 2. Please confirm that this specification allows for all class 2 control wiring less than 100 volts to be exposed cabling where properly support by J-hooks and cable trays.	1. Wiring where 120 volt has been specified requires metallic tubing. 2. Confirmed, J-hooks and cable trays are acceptable for the less than 100 volt wiring.
140	230923.132	Trane Summit t Version 17.0 or Trane Tracer ES Spec section 230923.1320 paragraph 2.1 requires the [redacted] (b) (5) [redacted] (b) (5) SPec section 012360 paragraph 3.1 deduct alternate no. 10 specifies connecting building control systems to the Trane Tracer ES. Please clarify what is required for this project? What Trane system is the MSL building required to interface? What are the interface and integration requirements of the MSL project DDC system specified in 230923.1320? Thank you.	[redacted] (b) (5)

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Master RFI #	Spec Reference	Bidder Question	GSA Response
141	230923.132	Vib-Accelerometers Spec Requirements / Manufacturer requested 230548.0040 Page 7/8 states: 2.2.8 Vibration Accelerometers Provide 24 volt Vibration Accelerometers, with internal DIP switch, capable of accepting signal input of acceleration, velocity, temperature and displacement, capable of dual banding for filter outputs. Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers. Provide pressure switches on each set of filter banks. Provide vibration accelerometers with breakout boxes. Provide vibration accelerometers with signal conditioners. We are unable to locate a Vibration Accelerometer which meets all of the specifications as listed above. Please provide a manufacturer / make / model which this specification is based on or which is approved as meeting all of the requirements above. In-lieu of the former request please provide a Vibration Accelerometer manufacturer / make / model which is currently in use and is deemed acceptable to NASA at this time.	Connection Technology Center, Inc. is an approved vibration accelerometer manufacturer - CTC AC102-1A and CTC LP202-1R1-1D
142	230923.132	Main Steam Meter connection M-707 Shows Main Steam Meter connection (b) (5) Also indicates Steam Pressure and Steam Temperature but does not indicate if it is connected to the (b) (5) (b) (5) Please indicate if the (b) (5) referred to is the system defined in SECTION (b) (5) (b) (5) and is therefore to be included in this project under that sections scope of work. Please indicate if the steam pressure and temperature sensors shown are also connected to the (b) (5)	a. Yes, the main steam pressure and temperature need to be connected to the (b) (5) b. Yes, the (b) (5) is defined in division section (b) (5) (b) (5) c. Yes, the main steam pressure and temperature need to be connected to the (b) (5) d. Note: The steam meter manufacturer shall provide a steam meter with an output of pressure and temperature; the BMS manufacturer shall (b) (5) (b) (5) and the BMS manufacturer shall (b) (5) (b) (5)

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Master RFI #	Spec Reference	Bidder Question	GSA Response
144	230923.132	Lab Control Equipment / Clarifications Required Clarification is needed for all fume hood scheduled airflows and valve numbers. It appears that the schedules do not match the plans. Box type, Box flows and If designate as Lab (Yes/No) are not correct. For example: It appears that 9 fume hoods are present with only 5 scheduled on the VAV BOX SCHEDULE for LABS and only 1 fume hood 2-EF-1-1 is consistent with the air balance schedule from M-102L showing 825max CFM. Other Fume hoods scheduled for example 3-EF-1-3 and 3-EF-1-4 show 0 CFM. Fume hoods 4-EF-1-1 and 4-EF-1-2 do not appear to be scheduled. Fume hoods 3-EF-1-1 and 3-EF-1-2 appear to be scheduled in the Non-Lab portion of the schedule. Additionally it is requested that Clarification be provided with regard to the Sequence of Operations for lab module types 1 (W/O fume hoods) and type 2 (W/ fume hoods). A sequence is requested for each lab room configuration as the Types shown do not match the room equipment and configurations on the plans	a. Each of the 9 fume hoods requires Lab VAVs with 825 CFM each. The EF for all of the fume hoods is on schedule M-802. The VAV schedules for the rooms with fumes hoods are on schedule M-804. The seq of operation for lab VAVs with fume hoods is in the drawings, on sheet M-609 detail 2. b. The seq of operation for office VAVs is in the drawings on sheet M-605 detail 2. The seq of operation for lab VAVs is in the drawings, on sheet M-609 detail 1, 2, and 3.
155	33 61 13	Drawing M200 note 3, detail 2 on M200 (by referencing the specification), and specification section 33 61 13 describe the steam tunnel as a pre-engineered, pre-cast concrete trench and lid structure. However, detail 8 on S504 shows the steam tunnel as cast-in-place concrete. Please confirm that the steam tunnel shall be pre-cast structure in its entirety.	Mechanical trench is to be constructed as a pre-cast trench from the Utility Tunnel to the stair side / south face of shear wall E. From the opposite face of shear wall E, the trench is to be a cast-in-place structure below the slab on grade until it opens into the steam pit – see 8/S504 and section on M201B for the cast-in-place portion. The pre-cast trench shall be as indicated by M200 and Specification Section 33 61 13.
156	Structural Dwgs, Mechanical Dwgs	Reference drawing S101B, detail 10 on S526, and drawing M201B. The steam tunnel route conflicts with the piles and combined pilecap at shearwall 6 and 3. It does not appear that the steam tunnel can be installed at this location. Alternate routes include shifting the tunnel to the west and going around the pilecap or entering the east side of the building between column lines A.7 and B to avoid the urban bioretention filter. Please advise.	The mechanical trench runs above the pile cap at this location. Reference 2/S-302 for relative elevations of mechanical trench opening and pile cap.
157	Civil Dwgs, Mechanical Dwgs	Note 2 on drawing M200 states "demo existing trench between trees." Drawing CD105 notes that these trees are to remain and be protected. However, it may not be possible to demolish the existing trench and install the new trench without damaging the trees. In accordance with specification section 01 35 40.00 41 paragraph 3.11.2, please advise what replacement strategy is acceptable if it is necessary to remove these trees.	All of the large specimen trees are of vital importance to NASA. The building design was, in part, based upon preservation of the trees indicated. The Contractor is expected to exercise extreme care including hand work if necessary to preserve these trees.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
220	Civil Dwgs, Landscape Dwgs	The Civil drawings indicate several mature trees on the South side of the site that are to be protected and preserved throughout the duration of construction. The Civil drawings also indicate several major pieces of work that need to take place within the indicated tree protection zone including demolition and relocation of storm sewer structures and piping, demolition of existing sidewalks, placement of new sidewalk and landscape features, as well as demolition of an existing utility tunnel and install of a new pre-cast utility tunnel. The work associated with the utility tunnel is of most concern as the existing tunnel is within feet of a tree that is called to be protected and preserved. Due to the amount and extent of work that is required in and around the tress called to be protected there is a strong likely hood that the trees will not survive throughout the duration of construction. These trees are mature trees with unknown root structures. It is unreasonable to assume that the contractor can protected these trees with the amount of construction activity and excavation that needs to take place around these trees. The contractor will do everything possible to protect these tress; however, what will be required by the contractor to replace these trees if they can not be saved in order to install work as indicated on the Drawings? How critical are these trees and is there any ability of the Government to relax the extent of the tree protection requirements in order to install the work as indicated on the Drawings?	All of the large specimen trees are of vital importance to NASA. The building design was, in part, based upon preservation of the trees indicated. The Contractor is expected to exercise extreme care including hand work if necessary to preserve these trees.
224	07 42 13	Specification 07 42 13 paragraph 2.3 calls for MPL-1 to be white with a clear coat. A clear coat on white is unusual. Please confirm that the clear coat is required.	Confirmed. The clear coat is required.
235		2) Approximately how much (b) (5) cable will be needed within the existing Utility Tunnel #4 to get from the new duct bank to the existing (b) (5) splice location?	See Demolition Telecom Site Note #1 on T002.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
237	01 23 60 OPTIONS	Para. 3.1 Schedule of Alternates, Deductive Alternate 2 makes reference to Specification Section 03 35 43 Polished Concrete Floors. It also mentions low sheen 400 grit polish level and a "stain" in the last sentence of the 3rd paragraph. a. Section 03 35 43 (listed as 03 37 00 in the spec title) Polished Concrete Floors calls for 800 grit in 3.4.G.2. Please clarify if 400 grit or 800 grit is required. b. Section 03 35 43 (listed as 03 37 00 in the spec title) Polished Concrete Floors does not make mention of using a stain. Please advise as to the desired stain.	A. Provide 400 grit polish level. B. Stain is not required.
253	01 23 60	Add Alternate 2 changes the cleanroom classifications and has significant design increases to base bid utilities and HVAC serving the cleanrooms. Since this is a design-bid-build, not enough information is provided to price this Alternate. Please provide the design documents to allow for proper pricing?	Provide a price for this Add Alternate using the information available in the documents and input as required from vendors and suppliers.
254	01 33 29	The LEED scorecard is showing construction credit Sustainable Site 4.3 Alt Transp – LEV & HEV Preferred Parking to achieve 3 points. Please confirm that the design has allowed for preferred parking or that the end user intends to institute a vehicle sharing system in order to achieve the points in this credits. Please also confirm that furnishing, installing, or providing infrastructure for alternative fueling stations is not included in this design.	Confirmed - the design has allowed for preferred parking. Confirmed - furnishing, installing, or providing infrastructure for alternative fueling stations is not included in this design.
258	01 33 29	The LEED scorecard is showing construction credit Energy & Atmosphere 6 Green Power to achieve 2 points. Please confirm that the end user intends to purchase offsite renewable energy or renewable energy credits for the required duration to achieve the points in this credit.	Confirmed.
259	01 33 29	The LEED scorecard is showing construction credit Innovation and Design Process 1.5 Green Housekeeping to achieve 1 point. Please confirm that the end user will enter into a Green Cleaning agreement and provide the necessary maintenance training to achieve the point in this credit.	Confirmed.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
266	230923.132	230923.132 3.3.1 Storage Cabinets states the following: "In each project mechanical room, provide a wall-mounted metal storage cabinet with hinged doors. In addition to the number of manuals specified above, provide an additional copy of the manuals in each of these mechanical room storage cabinets. Provide cabinets large enough to hold the entire set of Controls System Operators Manuals, and the HVAC operation and maintenance manuals provided under Division 15 MECHANICAL. Locate cabinets adjacent to DDC control panels where applicable. Have each cabinet's proposed installation site approved in advance by the Contracting Officer and the BAS Owner. Prominently label each cabinet with the wording "OPERATION AND MAINTENANCE MANUALS." Prominently label each binder with the wording "MECHANICAL ROOM COPY - DO NOT REMOVE."" Please confirm this section is to remain part of the project / contract requirements.	These cabinets and additional manuals are not required. Please disregard specification 23 09 23.13 20 paragraph 3.3.1.
277	Air Barrier	There are different parapet details shown but in most cases it has the air barrier running down the entire backside of a parapet. Typically air barrier can terminate once it ties into the roofing system either three inches on top of the parapet or three inches down on the backside of the parapet. Would either of these work rather than having transition membrane and air barrier extend down the the entirety of the parapet?	The air barrier is shown extending down the back face of the parapet where there is a wall assembly / finished material on the inside face, it then transitions to roof construction where the stud-framed portion of the parapet meets the concrete. There, the barrier that is a part of the roofing system is tied into the barrier from the wall system. For example see 1/A513. Per 07 54 23 / 2.5 - 'General: Preformed roof insulation boards, vapor retarder, and accessories manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation. See Section 07 22 00, ROOF AND DECK INSULATION.'
278	Air Barrier	A-501/6 is an example of redundancy where there are two layers of air barrier being applied. ABAA states that when there is a change of plane or a change of substrate, transition membrane should be used but only needs to be applied to 3" on either plane or new substrate, respectively. Can redundancies such as this be eliminated?	6/A501 - Only a single layer of air barrier with appropriate transition membranes is to be installed per MPL1F. The second continuous layer is to be removed.
280	Detail 7/A-514	Please refer to detail 7/A-514 and confirm that there is metal decking underneath the canopy TPO roof assembly, above the beam and underneath the 1/2" sheathing. The detail does not show the metal decking.	Provide cold form metal infill framing between the steel outriggers at 24" o.c. to support the 1/2" sheathing.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
288	Drawing A-611	Drawing A-611 partitions IX & 2X states CH stud at 16" oc. Shaftwall framing is 24" oc to allow for the 1" shaftwall liner which only is made 24" wide. UL U415 calls for 24" spacing.	Shaft wall framing shall be spaced per the UL Assembly.
293	Drawings M200 Drawing S101B	Drawing M 200 call for precast concrete trench (note #) for the utility tunnel . Additional the detail refers to specification - Specification Section 33 61 13 identifies a Precast construction. However drawing S101B provides section 8/S504 which is a cast-in-place trench . Please advise what is required?	Please see response to #155.
294	Sheet Q-201A	Sheet Q-201A - The note "powder coated overhead structural frame with stainless steel fittings, clamps and fasteners" – does this apply to the "clean room ceiling grid" components? These are located in the same room (with different type of dashed line) and throughout the project but the finish requirements are not clearly stated. Please advise.	Please see response to #269
311	Sheet A-101B	Sheet A-101B – Floor plan key notes – Item # 1 states "double" track ceiling supported frosted glass marker board sliding panels. The graphic doesn't match the other sheets with the same note – see sheet A-101A for example. This keynote shows two (2) dashed lines. Is sheet A-101B correct or should it be a single track assembly - see keynote # 9? Please advise.	A-101B is correctly noted as keynote #1.
343	31 62 13.20 - Precast/ Prestsressed Concrete Piles	Can the Government please confirm whether pile driving points are required? If pile driving points are required, neither the specification or the Geotechnical Report provides a description or detail of what is required. There are many kinds of pile driving points, which also impact the cost. Please provide a description or detail of what is required.	Please see response #341 above.
347	12 24 13	Section 2.1.1.b calls for front fascia, RCP general note #13 indicates to provide recessed roller shade and pocket at all perimeter glazing. Which is correct? Are the shades to be mounted below the ceiling with a front fascia or above the ceiling in a recessed shade pocket?	Shades are to be mounted above the ceiling in a recessed shade pocket.
348	12 24 13	Please advise if a standard color housing is acceptable or if, per section 2.1.1.e, we will need to include price for custom painting the fascia/pocket throughout the project.	Per 12 24 13 / 2.1.1.e, provide paint to match the ceiling color.
349	12 24 13	The ceiling legend shows a graphical representation of WT-1 and WT-2 on the RCP drawings; however, the graphical representation appears to be inconsistent and is extremely illegible. Can an architectural annotation be provided on the RCP drawings that shows the designation of WT-1 and WT-2 for each shade required?	See Finish Schedule A-701 for WT-1 / WT-2 locations.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
350	12 24 13	General note #13 on the RCP drawings indicates to provide recessed roller shade and pockets at all perimeter glazing. There are numerous rooms that do not appear to require shades (see H1A, H1D, H1F, H2A, H2C, H2F, etc.). Please clarify if ALL perimeter glazing is to be covered by this scope.	Confirmed. All perimeter glazing along the office areas are to receive recessed roller shades and pockets - see drawing-referenced wall sections and details for shade scope in shared spaces and corridors.
351	10 10 00	The specifications for the marker board calls for both a recessed tray and a magnetic tray. Does the owner want a combination of both, or will each MB1 receive just a magnetic tray?	Please see the design drawings - interior elevations and sections - for recessed marker board tray locations. All other marker boards not identified with a recessed tray are to receive a magnetic tray.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
225	07 42 13	Specification 07 42 13 paragraph 2.3 calls for MPL-2 to receive Reynobond EcoClean at horizontal surfaces. IF this coating is used the hoizontal surfaces will not match the vertical surfaces. It is suggested that this coating be used on all surfaces or none. Please advise.	Coatings are to be provided as specified in 07 42 13.
231		2. Also ref 074213- clarify what type of Fabricator "system method" is intended for the Reynobond material since Reynobond only makes the sheet material. Ref sht A301 for MPL-1,2,4 which appears to detail a Rainscreen system. The Arcwall 2510 system is a Flat plate design with extruded perimeter frame and is a Barrier wall to prevent ,moisture intrusion and not a rainscreen.	As indicated on A-301, MPL-1 through 4 are all intended to be Rainscreen systems. Per the manufacturer, Arcwall 2510 is also available as a rainscreen system.
232		3. Ref spec 074213 para 1.3.3- 1.3.5 – Please clarify what test results are expected to be met? There are no published values for each test explaining how much air or water intrusion and what test pressure needs to be met. The Arcwall 2510 system meets the following for example: "Air and Water Infiltration Tests: If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards: Air Infiltration - When tested in accordance with ASTM E 283, air infiltration at 6.24 lb/ft^2 (75 Pa) must not exceed 0.02 ft3/min. per ft^2 of wall area (305 cm3/s per m2 of wall area). Water Infiltration - Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. No uncontrolled leakage shall occur in any system under a differential static pressure of 4 lb/ft^2 (300 Pa) after 15 minutes of exposure in accordance with ASTM E 331."	07 42 13 METAL WALL PANEL SYSTEMS, SCREEN WALL, AND CANOPIES includes the metal panels that are part of the metal panel exterior wall systems. Per A-301, the wall system are to be rainscreen type. Air/water infiltration of the system are as indicated in 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS and 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
234		1) Drawing T-002 note 3 states [redacted] (b) (5) [redacted] (b) (5) [redacted] Is this acceptable?	On sheet T-002, replace New Telecom Site Note 3 with the following: [redacted] (b) (5) [redacted] (b) (5) [redacted] NASA requests use of labeling specified by their cable plant, available after contract award.
243	23 09 23.13 20	Paragraph 2.10 (Pages 37 to 42) – The laboratory control system is explained at length in this section, and it is noted that "System startup shall be provided by factory certified and trained employees of the LACS manufacturer". However, the LCS is not explicitly mentioned in the commissioning specification, nor under the [redacted] (b) (5) yet it is understood it is required [redacted] (b) (5) [redacted] What responsibility, if any, do we have pertaining to this system? Please note that the Clean Room system specified in Par. 2.14 is mentioned in the Cx specification (Fan Filter Units), under Par. 1.5.3.3 a.(1).	The GC shall commission the [redacted] (b) (5) [redacted] (b) (5) [redacted]
257	01 33 29	The LEED scorecard is showing construction credit Energy & Atmosphere 5 Measurement and Verification to achieve 3 points. Please confirm that the required meters, submeters, circuits, and communications infrastructure have been incorporated into the base design to achieve the points in this credit.	The mechanical documents include meters, including chilled water, steam, and domestic water. The electric drawings include electrical sub meters.
282	Section 054000	Section 054000 para. 2.1.a.1 calls for Sheet Steel Grade to be NLT 55 ksi. 50 ksi steel is standard for all stud manufacturers for 54 mil and heavier gauge. 55 ksi presents a problem with cold formed stud in the rolling process.	The design team takes no exception to the use of 50 ksi steel for light-gage framing on the project.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
283	Section 092200	Section 092200 para. 1.2 calls for Shop Drawings signed and sealed by engineer. This not a normal requirement for this Section	The requirement for Shop Drawings signed and sealed by an engineer will be removed from 09 22 00.
285	Section 092200	Section 092200 para. 2.1.2.2 states ASTM certified third testing statement for equivalent thickness shall not apply. Also Dimpled Metal Studs will not be a lowed. This is the process that all manufacturers use for interior metal studs. It uses heavier grade metal and thinner metal to accomplish the older method. Sheet A-610 general note 3 addresses this.	Studs shall be provided as specified in 09 222 00.
286	Section 092200	Section 092200 para. 2.1.2.4 states to use double runner system for top track at interior walls. This is an outdated system and most manufacturers do not make anymore. Suggest use track with 2" legs for deflection or slotted track.	The use of a deeper track or slotted track is acceptable.
287	Drawing A-611	Drawing A-611 partition type 2X914 & 2X914S calls to use 811 shaftwall CH stud. 811 CH studs are not made. 611 wide CH stud is the largest	Provide 611 CH studs in lieu of 811 CH studs.
289	Drawing A-611	Drawing A-611 states all walls with sound attenuation blankets to use a clip to fasten to stud. All SAB are friction fitted and no clip is required.	Provide clips as indicated/specified.
290	Drawing LP501	The quantities in the plant schedule (LP 501) are not matching the show on LP 201, LP 202 and LP 203. Specifically Plant (QP) has a quantity of 3 in the schedule but has 22 shown on drawing LP 201 and LP 202. Please advise what takes precedence?	Plans take precedent when showing quantities.
291	Drawing LP 201, LP202	Drawing LP 201, LP202 calls for Plant type (QF) and (MC). These are not included in the plant schedule on LP501. Please provide info.	QF = QA on the plant schedule. The MC should be MP.
295	Sheet Q-201D	Sheet Q-201D – "overhead structural frame" is located in the replication Shop – does this follow the same requirements as the clean room ceiling grid materials?	There are 2 grid systems in the cleanrooms - the ceiling grid system and the suspended grid system. The ceiling grid system is integral to the cleanroom package. See spec 13 20 00. The suspended grid system is part of Division 5, and is suspended from the ceiling grid system in the cleanrooms. In a typical (non-cleanroom lab) the suspended grid system is to be suspended from the structural slab above.
296	Sheet P-600	Sheet P-600, plumbing fixture connection schedule: ES/EW-2 - who's responsible for this item, Plumbing contractor or Casework contractor?	ES/EW2 has since been deleted from this project.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
297	Sheet P-600	Sheet P-600 – Plumbing Fixture connection schedule – SK-3, SK-4 and SK-5 are listed as "specified in section 123610. Section 123610, 2.2.4 lists stainless steel sinks as specified in section 220000. Please confirm who is responsible for the lab sinks and the type of materials needed. Is this from the plumber or the casework contractor? What is the material we are to provide? Sheet Q-401, detail B lists epoxy resin as the worksurface and sink material. Please advise.	Epoxy sinks are integral part of the epoxy countertops and are to be provided by the Casework Contractor. Stainless steel sinks are freestanding and are to be provided by the plumbing contractor. Refer to lab drawings for quantity and location of the different sink types. SK-3, SK-4, and SK-5 are specified in 22 00 00 - 2.4.11 Laboratory Sinks. The plumbing fixture schedule on P-600 will be revised.
298	Section 123610	Section 123610 , 2.2.6 – Please confirm the quick connect/quick disconnect fittings are also required per this section. Will standard chrome finish be acceptable?	Yes. Standard chrome finish is acceptable.
299	Section 226070	Section 226070, 2.3, G: requires all gas pipe and fittings to be supplied cleaned and sealed for oxygen service, does this apply to all Gas/CA/NIT fixtures specified in section 123090? Please advise is this is required.	Yes.
301	Section 123610	Section 123610 - 2.2.7 – Kewaunee Scientific standard drawer slide is 100 lb static load, full extension, self-close, soft-close and meets SEFA 8 2012 requirements, will this standard slide be acceptable for this project?	No. Provide as specified. 150 lbs is required.
302	Section 123610	Section 123610, 2.2.7.2 – Kewaunee Scientific does not manufacture steel cabinets with a roller catch but use a positive catch as standard product instead. This is a superior closing mechanism, will this be acceptable? This closure meets SEFA 8 guidelines. Please advise	Provide metal cabinets with roller catch as specified.
303	Section 123610	Section 123610 – 2,2,7.2 – calls for the lab casework supplier to furnish and install vinyl cover base. This is typically found in the flooring contractors section, please review and advise if this can be changed, The project will get a better cost/install from a flooring contractor versus a casework contractor.	Provide as specified in this section.
304	Sheet Q-402	Sheet Q-402, detail 7 – clean room pass-thru: Please expand on this item. Are we to use this detail for all clean-room pass-thru requirements? Please see sheet Q-304F, elevation 1 as an example shows a "utility pass-thru – see Arch" in multiple locations. What is the dimension for these items? Additionally, these are not shown at the same height AFF as shown on detail 7. Please advise if this is the correct detail. Please provide the correct specification for this item if it differs from the clean room pass-thru detail # 7.	There is a difference between a "cleanroom pass-thru" and "an utility pass-thru". The clean room pass-thrus, detailed on drawing Q-402, are to be provided and installed by the cleanroom provider. They are specified in section 13 20 00. The cleanroom is a turnkey item and all components associated with the cleanroom shall be provided by the cleanroom manufacturer. Laboratory Utility Pass-Throughs (non-cleanroom) are to be 8"x8" as located on the Q drawings. Provide one panel for each side of the partition. Basis of Design: WB RP 110 Series Removable Panel Access Door w/ primed grey baked enamel finish - to be included in 09 29 00 - GYPSUM BOARD / 2.1.14 LABORATORY UTILITY PASS-THROUGHS
305		Clean Room pass—thru cabinet: - detail # 7 on sheet Q-402, please provide the specification for this item.	Refer to specification 13 20 00 as indicated above. This item is an integral component of the cleanroom package.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
306	Section 132000	Section 132000 – 2.4: Clean room grid system. Please confirm this material is integral to the clean room supplier/manufacturer/vendor and not part of Division 5 – miscellaneous metals section 055013 – 2.19 and 2.20 respectively.	See response to #295.
307	Section 13200	Section 13200 – 2.4.1: Grid system shall be manufactured of 2" extruded aluminum alloy 6063, temper T5 with a painted finish. This doesn't match section 055013, 2.19 or 2.20. Please advise which spec section is correct for the clean room grid system and if this is to come directly from the clean room vendor.	See response to #307 above.
308	Section 122210	Section 122210, 2.2 – details the "fabric" composition for this project. In section 132000, 2.14.1 – details an "all-metal" cleanroom laser curtain. Please update the 122210 spec to include the metal laser curtain if applicable to this section. Otherwise this item will be excluded and left with the clean room vendor's scope. Please advise, thank you.	The metal laser curtain in the cleanroom item is integral to the cleanroom package. See spec 13 20 00.
309	Section 122210	Section 122210 – interlock system – this is also noted in spec section 284002. Is section 284002 be responsible for the furnishing wiring/devices/installation for materials located within the building and section 12210 is responsible for the track, curtains and interlock wiring within the curtains only? Please confirm this accurate. We also see this applicable within section 132000, please confirm all areas of responsibility, thank you	The laser curtains shall be complete with curtains, tracks, and wiring within the curtains. Refer to specification section 12 22 10 for scope of work. Metal laser curtain for the cleanroom shall be provided as part of the cleanroom package.
310	Section 102243	Section 102243, 2.3, 2, a – lists clear anodized aluminum for the top and bottom rails but in paragraph 2.3,2 the requirement is white powder coat, please clarify if two (2) finishes are required or if it's only one (1), which one to furnish?	Two finishes are required. Per 10 22 43 / 2.3 (2) clear anodized aluminum is for the top and bottom panel rails - (6) white powder coat is for the ceiling track system.
312	Section 115300	Section 115300, 2.2.2.1 – specification dimensions do not match sheet Q-403 dimensions listed for the same item. Please provide the correct size needed for this project.	Fume hood exterior depth shall be 32" nominal. Minimum clear interior worksurface depth shall be 24".
313	Sheet E-221B	Sheet E-221B – note 14 states paint booth fan furnished with booth local start/stop switch control mounted on the exterior of the paint booth. Who is responsible for supplying the control switch and mounting this unit?	Paint booth shall be provided complete with fan and light fixtures as specified in section 11 53 00, paragraph 2.2.2. Local switch and control shall be provided by the booth manufacturer. Coordinate with electrical. Coordinate with mechanical, including schedule on sheet M-802 for exhaust stack schedule.
314	Section 115300	Section 115300, 2.2.5.1 – Stainless steel canopy hood – requirements call for an on/off switch. Please confirm that we will only need to provide the cut-out for the switch and the electrical contractor will provide the wiring and the switch.	Fan and on/off switches shall be provided by the canopy hood manufacturer as specified in section 2.2.5.1. Coordinate with electrical and mechanical drawings.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
315	Section 115300	Section 115300 – 2.2.5.1 – Flourine Exhaust – please confirm Division 23 will furnish and install the Flourine exhaust fan. This division (11) has the cylinder cabinets.	There is a stainless steel exhaust canopy for fluorine exhaust. The fan shall be provide by Division 23, coordinate with the canopy manufacturer specification Division 11. In addition to the exhaust canopies, provided by Division 11, there are vented cylinder cabinets specified in section 11 53 00, paragraph 2.2.6, with a very detailed scope of work. Coordinate with mechanical design documents, schedule on sheet M-802 for exhaust fan EF-13.
316	Section 115300	Section 115300 – 1.4.5 – testing "as manufactured" ... are mock-ups required for the chemical fume hoods? If so, please advise which item(s) would be required and if they can be incorporated into the final project.	Testing "As Manufactured": Manufacturer shall construct an operating prototype of the type of hood to be supplied for the project and a test report ANSI/ASHRAE Test 110-1995 shall be provided. The prototype hood could be incorporated into the final project. Refer to specification 11 53 00 for additional requirements.
317	Section 115300	Section 115300 – 1.4.5 – fume hoods are required to be CSA certified and UL 1805 classified. Will hoods also be required to meet UL61010 requirements since they are pre-wired at the factory? Please advise.	Yes.
318	Section 115300	Section 115300 – 2.1.6 – HEPA Filter – where does this apply? Please advise, thank you.	Refer to response #153.
319	Section 2.2.1.8	Section 2.2.1.8 – requires duct collar to be 4" high – type 316 SS. Kewaunee standard is type 304 with 1" high, will this be acceptable?	Provide 316 SS duct collar, 2" high min.
320	Sheet Q-401	Sheet Q-401 – Detail 3: Notes indicate the Overhead structural frame is to painted to match the lab casework. Does this paint need to meet SEFA 8 performance requirements?	Paint on overhead structural frame does not need to meet SEFA 8 performance criteria.
321	Sheet Q-401	Sheet Q-401 – Detail 3: Structural frame and support on 36" centers ..... see structural drawings. On sheet Q-401, detail # 2 – "provide multi-directional bracing as required - see Arch and Struct drawings. Please provide the correct detail for this bracing. We couldn't identity the specific detail showing this type of bracing for this item. Are we to use detail # 2 on sheet S-555?	Bracing is to be designed and provided as needed by the structural frame manufacturer.
322	Sheet Q-402	Sheet Q-402- detail 2C, typical vacuum pump exhaust outlet, please confirm this material is specified and furnished by the Mechanical Contractor and not the Casework Contractor.	Vacuum pump exhaust outlets to be provided by mechanical Division 23 contractor as indicated on lab drawing Q-402. Coordinate with mechanical design documents, ductwork to be same material as the exposed ductwork in labs. Exhaust duct shall extend to a minimum of 7' -6" above finish floor.
323	Sheet Q-401	Sheet Q-401 detail # 2 – the graphics are a little misleading, does the cable tray connect to the deck above or connect to the overhead structural frame assembly?	Cable tray is located above the grid. See 6/A-731 for Lab Zoning Elevation/Section.
324	Sheet Q-401	Sheet Q-401, metal casework – detail B – sink information: Size listed is available but where is this applicable? The sink schedule on P-600 doesn't list the type of sink but refers to section 123610. Please confirm we are to use sink schedule on Sheet Q-001 for all sinks locations within this section.	Refer to response to #297

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
325	Sheet Q-001	Sheet Q-001, Casework types: R09 is often shown on the plans as a single unit in a lab room. Does this cabinet require an epoxy resin worksurface or is the painted steel cabinet top sufficient for this project?	Painted metal top is sufficient. Epoxy top is not required
328		General Question – are stamped engineering drawings required as part of our submittal process for the lab casework, lab equipment, overhead service carriers and curtains?	Stamped engineering drawings are not required for the lab casework, lab equipment, lab overhead service carriers, or lab curtains.
329	Section 102243	Section 102243 – 2.3,: 3/8" thick laminated safety glass in 12' sections is not manufactured any longer. The weight limit of 330 lbs per panel is not physically possible, do you have any flexibility in these specifications?	Several manufacturers have been contacted. Laminated safety glass as specified in 10 22 43 / 2.3 can be manufactured and will not exceed the maximum weight limit indicated.
330	Section 102243	Section 102243 – 1.4.1: Glass manufacturers typically do not provide LEED certification, this will be excluded from our proposal. All other submittal items are acceptable.	It is understood that products do not themselves have LEED certifications. However, glass and associated metal frame work could potentially contribute to Recycled Content (MRc4) or Regional Materials (MRc5). Also any adhesive used in the field associated with this product would be subject to adhere to Low-Emitting Materials for Adhesives and Sealants (IEQc4.1). Refer to sections 1.4.2, 1.4.3 and 1.4.4 of this same section. Any product that contributes or is subject to LEED credits would have associated documentation for the purpose of documenting the building. Furthermore these noted credits are the responsibility of the general contractor to achieve.
331	Section 115300	Section 115300 – 2.2.2.2: and sheet E-502 - paint booth – the specifications do not mention wiring the unit to meet Class I, Division 1 yet this is noted on sheet E-502. Will standard wiring/electrical devices at time of manufacture be acceptable for this project? Please advise.	The paint booth internal wiring will be required to meet the classifications as shown on E-502.
332	Section 122210	Section 122210 - Provide laser safety requirements for each lab as calculated by the lead staff member from each lab and verified by the responsible Laser Safety Officer. In particular, for each laser curtain, window block and laser barrier, provide according to ANSI Z136 the required Damage Threshold. Alternatively, please provide location of each laser in each room plus detailed specifications of the output characteristics of each laser to facilitate the calculations required to specify appropriate barrier materials.	Laser curtains are to be provided as specified in 12 22 10.
333	Section 122210	Section 122210 – 2.4 - It is our experience that double-track and by-pass curtain breaks or entryways create difficulties in establishing a reliable and error-free interlock system. Will the customer consider a single-track system with engineered curtain breaks which can be interlocked?	Provide double-track as indicated on drawings and as specified in section 12 22 10.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
334	Section 122210	Section 122210 – 2.4 Confirm that we have identified all of the room locations (non-cleanroom) for which laser curtains, window blocks, and barriers are required. We identified these rooms: 319, 200, 212, 408, 418, 428, 440 and 564 Provide more information on each laser curtain, window block, and barrier: Configuration: Straight runs? Curves? L-Shapes? Vestibule blocks? Configuration: breaks and entry points? Height: Estimate finished ceiling height. Confirm floor positioning of each curtain (1" drag, 2" drag" or ¼" elevation from finished floor) Length? Will all room doors require magnetic locks? Describe whether each is secure or non-secure. Describe whether each is a single or double door.	It is the contractor's responsibility to review all drawings and equipment lists for scope of work. Contractor to verify quantity, dimension and configuration of laser curtains. There is no room 319. Refer to lab interior elevations (drawings Q-300 series) for ceiling height and top of curtain dimensions. Curtains shall be designed with a 2" floor overlap as specified. Refer to specification 28 40 02 for Laser Interlock System requirements.
335		Provide more detail on how the curtain interlocks (for each room, each curtain, each curtain section) and any window block interlocks will be used: Location of hardware including keypads, access controls, interlock by-pass switch (interlock override), and other switches or devices connected to the interlock system Describe wire chase locations? (how will wiring in laser curtains and window blocks be connected to the interlock system? Where are the exit points?) Are any of the laser rooms or laser working areas linked or interdependent? For example, will laser safety in any room depend on laser safety in any other room? It appears that the working spaces on the 3d floor will require laser curtains and interlocks that are carefully coordinated with work processes. Is there a specification for the wiring in the curtains to handle the interlocks and any supplementary devices? (wire gauge, color coding, shielding, etc.) It appears that the interlock system will require [redacted] (b) (5) Provide the counts and locations for interlocks in each laser curtain section and each window block.	Interlocks will be as indicated in the TY drawings and as described in: 28 40 02 - LASER INTERLOCK SYSTEM. Warning lights, etc. are to be located as indicated on 1/A-731.
336		Section 122210 – 2.4: Customer specified dual track of aluminum construction. Will customer accept steel track with black low-reflectance coating, such track to be supported by superstructure using UniStrut or similar? Are there laser curtain configurations in which our standard 26" radius curve will not be acceptable?	Provide curtain as specified. Refer to lab drawings for radius and laser curtain plans.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
337	Section 12210	Section 12210 – 2.3: Will customer consider alternate laser barrier materials? The specification indicates a vinyl-laminated construction. The specification does not indicate the desired (required) ANSI Z136 damage threshold. We will provide single-layer, non-laminated, laser barrier fabrics suitable for the intended applications and certified to appropriate power levels. Please see our questions also in the "Laser Safety" section of this document. Please clarify: ANSI Z136 requires 100 seconds until "burn through" for a laser barrier. The specification for this project refers to ANSI Z136 yet mentions 60 seconds as a target. The laser barrier fabrics we employ do not require reinforcing strips at any seam or grommet placement. Please confirm this is acceptable. We place grommets every 12" (nominally) on center to improve "stacking depth" of the curtains when pushed to their fully open position. This grommet spacing does not impact system performance. Please confirm this is acceptable. It is our experience that weighted hems can actually interfere with the overall light blocking when an extended floor drag is specified. Confirm that customer will accept appropriate light-blocking design for those spaces requiring this attribute. Confirm that 2" drag without a weighted hem using our fabric will be acceptable. Specification calls for vertical strips of Velcro where laser curtains attach to hard surfaces. We believe that other attachment methods are more consistent with the laser interlock requirement. Velcro is easy to defeat. Will customer consider quick-disconnect mechanical fasteners? Clarify the flame retardancy specification required. The reference to NFPA 701-1999 is not consistent with the reference to NFPA 701-2010.	Provide as specified and as indicated on drawings.
338	230923.132	M-609 Notes indicate that only one LCP Lab Panel should be installed for every two lab rooms? Please confirm this is the case as the Labs without these panels will not have a means to display the status of the room conditions inside that room?	One LCP Panel shall be installed for every two labs and it must have the capability to display the status of each of the two room conditions individually.
339	230923.132	Page 40 of this specification requires Dip Switch selectable Fail Safe positioning for the Lab Valves. Please confirm this is a requirement.	The Lab valves shall maintain their current position upon power failure.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
340	230923.132	The sequence of Operation for the AHUs sates the following [redacted] (b) (5) (b) (5) Is it requires to provide damper end switches and interlock wiring to Fire-Smoke and or Smoke dampers a part from the AHU (D-1 and D-5) Isolation dampers?	All smoke dampers and end switches associated with the individual AHU shall be [redacted] (b) (5)
352	10 10 00	Under the basis of design there is no mention of the functional reveal rail nor the chartrail insert and hook for the boards. However, in the specifications, the reveal rail and chartrail insert are mentioned. Is the chartrail insert and functional reveal rail required?	Yes. The chartrail insert and functional reveal rail are required.
356	Base Bid GC Price Proposal Form	Division 13b requires an allowance for the WIS3R Lab that is to be provided by amendment. Please provide.	Please see the Bid Forms issued with Response 011.
359	Amendment 0002, Item 2	Item 2 only referes to one (1) copy of the Price Proposal in electronic format. Please confirm no hard copies are required.	Confirmed. No hard copies are required.

BASE BID

MSL

GC Price Proposal Form

CONSTRUCTION		
Spec Division	**Spec Description**	**Price Proposal**
01	General Requirements/General Conditions	
02	Existing Conditions	
03	Concrete	
04	Masonry	
05	Metals	
06	Wood, Plastics, & Composites	
07	Thermal & Moisture Protection	
08	Openings	
09	Finishes	
10	Specialties	
11	Equipment	
12	Furnishings	
13a	Special Construction	
13b	Drawings RQ & Spec 132754 (Allowance)	$ 1,600,455.00
14	Conveying Equipment	
21	Fire Suppression	
22	Plumbing	
23a	Heating, Ventilating, & Air Conditioning	
23b	Building Controls (Only)	
23c	Bldg Control Integration into Campus BAS (Only)	
26	Electrical	
27	Communications	
28	Electronic Safety & Security	
31	Earthwork	
32	Exterior Improvements	
33	Utilities	
43	Process Gas	
	TOTAL BASE BID	$ 1,600,455.00
	TOTAL OPTIONS (NET):	$ -
	TOTAL EVALUATED PRICE:	$ 1,600,455.00

NAME SIGNATURE DATE

BID ITEMS

MSL

GC Price Proposal Form

CONSTRUCTION						
Spec	**Paragraph**	**Item**	**Unit**	Unit Price	No. Units	Extension
002213	0001A	Entire Work less Bid Items 0001B, 0001C, and 0001D				$ -
002213	0001B	Test Piling	Linear Feet	$ -		$ -
002213	0001B	Driven Piling	Linear Feet	$ -		$ -
002213	0001B	Batter Piling	Linear Feet	$ -		$ -
002213	0001C	Pile Load Test	Each	$ -		$ -
002213	0001D	Unsuitable Soil	Cubic Yard	$ -	3,000	$ -
					TOTAL BASE BID	$ -

OPTIONS

MSL

OPTIONS as per Spec Section 012360

Option #	Option Title	Days Option Open from Award Date	Overall DEDUCT Amount	Overall ADD Amount
Deduct Alternerate				
1	Delete Cove Light Fixtures	60	$ -	$ -
2	Delete Terrazzo & Stair Tread	60	$ -	$ -
3	Delete Glass Marker Boards	60	$ -	$ -
4	Delete Vibration Points	60	$ -	$ -
5	Delete 10 VCC & Ductwork	60	$ -	$ -
6	Delete BIM Requirements	60	$ -	$ -
7	Delete COBie Requirements	60	$ -	$ -
8	Downgrade to LEED USGBC Silver Rating	60	$ -	$ -
9	Delete Clean Rooms	60	$ -	$ -
10	Remove BAS Integration Requirement	60	$ -	$ -
Add Alternate				
1	Parking Lot	240	$ -	$ -
2	Cleanroom Capability	60	$ -	$ -
3	Telecom Cabling & Equipment	240	$ -	$ -
4	AV Cabling & Equipment	240	$ -	$ -
5	Security Cabling & Equipment	240	$ -	$ -
6	Provide Trane BAS system	60	$ -	$ -

Sub-total DEDUCT and ADD amounts:	$ -	$ -

Total combined DEDUCT and ADD amounts:	$ -

Value Engineering Suggestions

MSL
GC Price Proposal Form

Please list below any Value Engineering suggestions you would like to make to the Government. These suggestions may be taken into consideration by the Government when scoring your technical proposal to the extent they demonstrate innovation, creativity, and overall value to the Government.

The Value amounts you provide are for comparison purposes only and will NOT be used to adjust your bid. Any VE suggestions the Government wishes to pursue will be addressed after contract award as changes to the contract.

	VE Scope	Value ($)
1		
2		
3		
4		
5		
6		
7		

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0011	06/23/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)	(X)	9A. AMENDMENT OF SOLICITATION NO.
	☐	9B. DATED (SEE ITEM 11)
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 13)
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA (Signature of Contracting Officer)	16C. DATE SIGNED

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0011

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 23 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0011.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. Measurement Systems Laboratory (MSL) Project bid sheet is incorporated with this amendment.

4. The GSA/NASA project team is setting a tentative date of 19 July 2016 and 20 July 2016 for interviews at the NASA Langley site. The time and location of the interviews and the required attendees shall be provided via a calendar invite The GSA/NASA project team project team request that contractors limit interview attendees to key personnel submitted on project.

5. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
12	01 23 60	The specifications and drawings reference a number of deduct and add bid options. However, the bid form provided in amendment 0003 does not list the bid options. Please confirm that the options are to be provided and clarify how they shall be included in the price form.	See the "Options" tab in the Excel file that was sent.
40	01. 01 33 00	Specification 01. 01 33 00, 1.10e Submittal Review Period: Requires Contracting Officer to have 30 working days for approval of submittals. Due to the nature of the project, we request to reduce this approval time to 15 working days.	The timeframe specified in section 01 33 29, paragraph 1.10.e for submittal review by the Contracting Officer is reduced from thirty (30) working days to fifteen (15)working days.
41	01 23. 60, 01 33 29	Specification 01 33 29 LEED Documentation, Section 1.3 states project designed for LEED Silver. 01 23 60 Options, deduct alternate 8 requests credit to achieve LEED Silver. Please clarify that the base bid requires LEED Silver be obtained.	Specification 01 33 29, paragraph 1.3 is in error. The LEED rating in the first sentence should state "GOLD" and not "SILVER".
42	31 23 19	The geotechnical report does not appear to be provided in the RFP documents per Specification 31 23 19, 1.4.1. Can a copy of the geotechnical report be provided?	A Report of Subsurface Investigation and Geotechnical Engineering Services was prepared for this project by GET Solutions, Inc. dated July 23, 2014. The information contained in this report is being provided as information only. The government accepts no responsibility or liability for the analysis or conclusions contained in this document.
44	01 10 00	At the end of section 01 10 00 there is a section 2.14 Site Signage. Please confirm the only purpose of this is to define the requirements of the construction sign.	Confirmed.
45	01 31 10	Section 01 31 10, 1.5,F,4.e Time Impact Analysis. Please consider making the TIA due 15 work days from the beginning of a delay caused by unforeseeable circumstances in lieu of the 5 work days specified.	The timeframe specified in section 01 31 10, paragraph 1.5.F.4.e.iii for submission of a TIA in the event of an unforeseeable delay is extended from five (5) days to fifteen (15) days, provided that written notification to the Contracting Officer is provided as soon as practicable after the delay begins and in no case more than the five (5) days originally specified.
54	L503	Please provide a basis of design or finish and dimension information for the decorative bollards shown in detail 3/L503.	See 05 50 13 / 2.9 for structure sizing. Bollards to be finished with High Performance Coating - Color to be selected by Architect from Manufacturer's full range.
55	Architectural Dwgs, Structural Dwgs	Drawing A105A shows an MPL 4 screen wall on column line G.6. Please provide a section through this screen wall. Additionally, the MPL 4 detail on A301 references the structural drawings for information on the screen wall post supports. This information could not be located. Please provide.	Screenwall construction to be similar to 6/A-504 & 12/S-553.
56	Architectural Dwgs	The lens display area shown in detail 4/A740 references the structural drawings for information on the structural steel support. This information could not be located. Please provide.	Sizing for the steel members shown in 4/A740 shall be HSS5x5x1/4.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
57	01 35 26.00 41, 09 90 00, 21 13 00.00 40	The specifications are contradicting regarding the painting of sprinkler pipe throughout different sections where it is referenced. Please clarify the color (red or match adjacent) and number of coats for the painting of sprinkler pipe according to its location (concealed or unconcealed). Section 01 35 26.00 41 Paragraph 1.18.11 states "Sprinkler piping that is concealed does not have to be painted. Unconcealed sprinkler piping shall be painted RED." Section 09 90 00 Paragraph 3.7.1.a "Piping in Unfinished Areas" states "Provide primed surfaces with one coat of red alkyd gloss enamel..." Section 09 90 00 paragraph 3.7.1.b "Piping in Finished Areas" states "Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems." Section 21 13 00.00 40 paragraph 3.1.1 states "apply two coats of enamel paint to all fire protection piping, valves, and appurtenances, excluding Siamese connections. Use paint color No. 11105 (red) in accordance with section 09 90 00." Therefore, in this section is it calling for all (concealed and unconcealed) fire sprinkler piping to be painted red.	Comply with the statements in Specification Section 21 13 00.00 40. Provide priming as required, and two coats of red paint to all fire protection piping, valves and appurtenances, whether concealed or exposed.
62	Amendment 0002	Revised Technical Evaluation Factors for Phase II still require a narrative on the contractor's approach to procuring and installing the HIRF laboratory even though the same amendment replaced the HIRF lab with the WISE3R space. Please clarify.	For the purposes of the Technical Evaluation, please assume that the WISE3R will be substantially similar to the HIRF and will be furnished by the same vendor.
63	Amendment 0002	Technical Evaluation Factors for Phase II state there is a maximum of five (5) pages allowed for Factor 1 PROJECT MANAGEMENT/DELIVERY PLAN (PMDP). There are no less that fourteen (14) sub-factors to respond to in Factor 1. Five (5) pages will not be enough to properly address each sub-factor. Request at least fifteen (15) pages be allowed. Would prefer thirty (30) page maximum.	The page limits remain as stated. Please note that a schedule and staging plan do not count against the stated page limit.
65		Please provide the missing section designations (section bubbles with no reference in it) on S101-A, S101-B, S-102A, S-102B, S-103A, S-103B, S-104A, S104B, S-105A, S-105B, S106A, and S-106B.	A printing error has resulted in working view sections in the Revit model. These section marks do not represent intended documentation views
97	Spec 016230, LP202	Spec 012360 lists Add Alternate 1: Parking lot. Add parking lot north of Victory Street, west of West Taylor Street and south of Langley Boulevard as shown in the construction documents. When a count was done on plants show on LP202, it appears there is a conflict. Please confirm the planting schedule on LP501 only contains plants in the base bid, and does NOT include the plants in the add alternate.	The plant schedule on sheet LP501 contain the species/quantities inclusive of the alternate for the parking. Quantities on the plans govern with the following quantity updates to the schedule for the trees: 43 – MV, 15 – PP, 7 – PT, 9 –QA(QF), 21 – QP.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
98	LP501, LP202	LP202 indicates location and quanties of exterior plants in the Add Alternate 1: Parking Lot. There are a number of trees identified as QF, that do not appear on the plant schedule on sheet LP501. Please provide additional information on these plants.	QF is a typo, it is QA – the White Oak in the plant schedule on LP501.
106	Spec 062000	Spec 062000/2.4.4 and 062000/3.3 lists closet hanger rods. None are shown on the drawings, please provide locations, sizes, and quantities.	Closet hanger rods are not required under this contract. Delete 06 20 00 / 2.4.4.
107	Spec 062000	Spec 062000/3.1.2 lists wood base. None are shown on the drawings, please provide locations, sizes, and quantities.	Wood wall base is not required under this contract. Delete 06 20 00 / 3.1.2.
108	Spec 129300	Spec 129300 lists tables and chairs, waste receptacles but none are shown on the drawings. Please provide locations and quantities.	Movable tables and chairs and waste receptacles are not included under this contract. Delete 12 93 00 / 2.7 & 2.8.
109	07 54 23 / 07 42 13	Refer to Section 1.11.1 of Specification 07 54 23 Thermoplastic Polyolefin (TPO) Roofing and 1.9.1 of Specification 07 42 13 Metal Wall Panel Systems, Screenwall and Canopies, where it identifies the requirement of a "No Dollar Limit" Manufacturer's Warranty for the roofing system and the metal panels. Please be advised that roofing and metal panel subcontractors will not be able to comply with this requirement as the bonding sureties, who back their project obligations and project warranties, will not provide a payment and performance bond, nor back the roofing and metal panel warranties, if the "No Dollar Limit" warranty is a contractual requirement. In addition, General Contractor's will also not be able to bond the "No Dollar Limit" warranty. Can the Government waive the requirement for "No Dollar Limit" warranties for the roofing and metal wall panel systems?	The NDL warranties are from the manufacturers, not the GC or the subs, so there should be no effect on bonding. Refer to 07 42 13.1.9.1: Metal Wall manufacturer warranty requirements Refer to 07 54 23.1.11.1: Roof Manufacturer warranty requirements Refer to 07 54 23.1.11.2: Roofing System Installer Warranty for installer warranty requirements
111	J&A Documents	Please confirm the GSA will not accept alternative manufactures for the items identified in the J&A's included in Amendment 0002.	Confirmed.
112	Amendment 0003	Confirm we to write in the actual actual quantities in the No. Units column for Bid Items 0001B and 0001C.	Confimed.
113	Amendment 0003 and S-101A and S-101B	Provide a Unit Price Bid Item for the battered piles found on the structural drawings. These will be a different cost than the compression piles.	Please see update Bid Sheet, which adds a line item for Batter Piles.
114	Amendment 0003	Confirm the TOTAL BASE BID cost on the GC Price Proposal Form by Division breakdown should equal the TOTAL BASE BID cost on the GC Price Proposal Form by Paragraphs 0001A - 0001D.	Confirmed. The total amounts on the two tabs should equal.
116	08 41 13	Please provide ATFP blast requirement, charge weight and level of protection for aluminum storefront and curtainwall.	See response to Question 09.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
118	01 33 29 LEED Documentation	Paragraph 1.3 states that no substitutions or variations to the credits will be allowed without written consent from the Contracting Officer. The documents require Silver certification. In achieving Silver certification on our previous projects, we generally apply for a total of 54-58 points. Table 1 shows a total of 66 required points. This puts the project in the Gold certification range. Will the contractor be allowed to submit for Silver certification or will we be required to submit for Gold certification, thus complying with all of the indicated Contractor credits?	Specification 01 33 29, paragraph 1.3 is in error. The LEED rating in the first sentence should state "GOLD" and not "SILVER".
120		Please provide the anticipated delivery date and the installation duration of the owner-furnished/owner installed WISE3R lab so that we may address this item in our proposal schedule.	The WISE3R delivery date is not yet known The installation duration is to be determined by the General Contractor.
124		Please advise where Oral Discussions will be held. NASA Langley or GSA Mid-Atlantic Region Philadelphia. This has a cost impact to the project.	Oral Discussions will be held at NASA Langley.
125		Respectfully request an extension to the proposal due date to June 23. Monday bid dates are unconventional as it will require travel on Sunday in order to hand deliver the proposal.	The proposal due date remains unchanged. Any extension will be communicated via an official amendment. Please note that all submissions are to be made electronically. Hand delivery is neither permitted nor desired.
127	C201 and 01 30 00 and 01 35 26.00 41	Phase I submission requirements outline the Key Personnel as does Section 01 30 00. C201 states the Construction Project Manager, the Construction Superintendent, the Construction MEP Coordinator and the Quality Control Manager be on the construction site, full time and totally dedicated to the project, i.e. no other duties. It seems odd Section 01 35 26.00 41 NASA LANGLEY SAFETY REQUIREMENTS does not indicate a Site Safety and Health Officer (SSHO) requirement to be full time and on-site. Section 01 45 00.00 10 QUALITY CONTROL refers to the Safety and Health Manager (SHM) as part of the QC staff, but does not provide duties or state they are required full-time. Please advise what the GSA requirements are for the SSHO or SHM.	The requirements for the Safety and Health Manager are as stated in specification 01 45 00.00 10 (Quality Control). The General Contract has complete responsibility for jobsite safety and is given the latitude to manage safety in a manner it deems most effective.
128	01 35 26.00 41	The specifications refer to asbestos abatement. However, we do not find any on the drawings. Please advise if asbestos abatement is required.	No asbestos containing materials are anticipated to be encountered on this project.
129	31 23 19	Please provide a copy of the geotechnical report and soil borings. It is not included in the project manual.	See Question #42.

BASE BID

MSL

GC Price Proposal Form

CONSTRUCTION		
Spec Division	**Spec Description**	**Price Proposal**
01	General Requirements/General Conditions	
02	Existing Conditions	
03	Concrete	
04	Masonry	
05	Metals	
06	Wood, Plastics, & Composites	
07	Thermal & Moisture Protection	
08	Openings	
09	Finishes	
10	Specialties	
11	Equipment	
12	Furnishings	
13a	Special Construction	
13b	Drawings RQ & Spec 132754 (Allowance)	$ 1,600,455.00
14	Conveying Equipment	
21	Fire Suppression	
22	Plumbing	
23a	Heating, Ventilating, & Air Conditioning	
23b	Building Controls (Only)	
23c	Bldg Control Integration into Campus BAS (Only)	
26	Electrical	
27	Communications	
28	Electronic Safety & Security	
31	Earthwork	
32	Exterior Improvements	
33	Utilities	
43	Process Gas	
	TOTAL BASE BID	$ 1,600,455.00
	TOTAL OPTIONS (NET):	$ -
	TOTAL EVALUATED PRICE:	$ 1,600,455.00

NAME SIGNATURE DATE

BID ITEMS

MSL

GC Price Proposal Form

CONSTRUCTION						
Spec	**Paragraph**	**Item**	**Unit**	Unit Price	No. Units	Extension
002213	0001A	Entire Work less Bid Items 0001B, 0001C, and 0001D				$ -
002213	0001B	Test Piling	Linear Feet	$ -		$ -
002213	0001B	Driven Piling	Linear Feet	$ -		$ -
002213	0001B	Batter Piling	Linear Feet	$ -		$ -
002213	0001C	Pile Load Test	Each	$ -		$ -
002213	0001D	Unsuitable Soil	Cubic Yard	$ -	3,000	$ -
					TOTAL BASE BID	$ -

OPTIONS

MSL

OPTIONS as per Spec Section 012360

Option #	Option Title	Days Option Open from Award Date	Overall DEDUCT Amount	Overall ADD Amount
Deduct Alternerate				
1	Delete Cove Light Fixtures	60	$ -	$ -
2	Delete Terrazzo & Stair Tread	60	$ -	$ -
3	Delete Glass Marker Boards	60	$ -	$ -
4	Delete Vibration Points	60	$ -	$ -
5	Delete 10 VCC & Ductwork	60	$ -	$ -
6	Delete BIM Requirements	60	$ -	$ -
7	Delete COBie Requirements	60	$ -	$ -
8	Downgrade to LEED USGBC Silver Rating	60	$ -	$ -
9	Delete Clean Rooms	60	$ -	$ -
10	Remove BAS Integration Requirement	60	$ -	$ -
Add Alternate				
1	Parking Lot	240	$ -	$ -
2	Cleanroom Capability	60	$ -	$ -
3	Telecom Cabling & Equipment	240	$ -	$ -
4	AV Cabling & Equipment	240	$ -	$ -
5	Security Cabling & Equipment	240	$ -	$ -
6	Provide Trane BAS system	60	$ -	$ -

Sub-total DEDUCT and ADD amounts:	$ -	$ -

Total combined DEDUCT and ADD amounts:	$ -

Value Engineering Suggestions

MSL
GC Price Proposal Form

Please list below any Value Engineering suggestions you would like to make to the Government. These suggestions may be taken into consideration by the Government when scoring your technical proposal to the extent they demonstrate innovation, creativity, and overall value to the Government.

The Value amounts you provide are for comparison purposes only and will NOT be used to adjust your bid. Any VE suggestions the Government wishes to pursue will be addressed after contract award as changes to the contract.

	VE Scope	Value ($)
1		
2		
3		
4		
5		
6		
7		

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0012	06/23/2016		

6. ISSUED BY CODE 3PQC

GSA PBS - Region 3
The Dow Building
100 S. Independence Mall West
Philadelphia, PA 19106

7. ADMINISTERED BY (If other than Item 6) CODE 3PQC

GSA PBS - Region 3
The Dow Building
100 S. Independence Mall West
Philadelphia, PA 19106

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE FACILITY CODE

(X) ☐ 9A. AMENDMENT OF SOLICITATION NO.

☐ 9B. DATED (SEE ITEM 11)

☐ 10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0012

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 23 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0012.

2. In response to questions submitted to date the NASA MSL Project RFI logs are provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
274	Section 01 33 29 – Para - 1.3.1 Credit Validation and LEED Scorecard	Please advise if MSL will have green power available for EAc6 or if the purchase of RECs will be required.	NASA will purchase green power to fulfill credit EAc6.
276	Amendment 0008	Much of the subcontractor market is pacing themselves relative to understanding the project with the final pricing date. Three key concrete subcontractors have not looked at the documents so the Prime contractor cannot understand how best set the crane strategy, production of concrete along with access around the building. Another example is the pile contractors have not look closely at the project to understand their production and staging plan. Will GSA move the Proposal date to the same date as the Pricing date of 7/7. There is minimal information in the proposal for review by the SSEB and by extending the proposal delivery date, the offeror will be able to clearly understand production of key subcontractors and equipment delivery along with site/construction phasing. This extension will allow a more defined schedule and phasing plan that have been vetted in the subcontractor market for greater efficiency in time and cost of work.	The technical proposal due date has been extended to 6-30-16 per amendment 0009. The price proposal due date remains at 7-7-16. Please refer to any subsequent amendments for the most current response dates and not this RFI response.
284	Section 092200	Section 092200 para. 1.5.l prohibits using powder actuated fasteners. Can I assume that gas actuated fasteners are acceptable?	Powder actuated fastener tools are acceptable to use here at LaRC. With the following stipulations 1. Users must be trained on how to properly use the tool. 2. The company that each user is employed by, must either issue users cards stating they have been trained or that company can submit, on company letter head, a brief statement of employee training with a list of user names and signed by company management. 3. Tools can not be altered in any way and all safeties must be functional
300		General Question – please confirm this project is to be drawn in Revit, thank you.	Yes.
345	GSA Pricing	Will this project qualify for a GSA standard pricing schedule? If so, please provide.	Please clairfy the question.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
357	GSA RFIU #08	Is the Small Business Subcontracting Plan to be submitted in the Technical Proposal or in the Price Proposal?	Technical Proposal.
358	Solicitation C201	Please provide a list of ALL items required to be submitted in the Phase II Price Proposal.	Items include: SF1442; Project Bid Sheet; Project Labor Agreement; Proof of Bonding; Reps and Certs;
360	Amendment 0002, SF 1442, Item 13.b.	Item 13.b. states a bid guarantee is required. Please provide form and amount of bid guarantee.	28.101-2 -- Solicitation Provision or Contract Clause.(b) The contracting officer shall determine the amount of the bid guarantee for insertion in the provision at 52.228-1 (see 28.102-2(a)). The amount shall be adequate to protect the Government from loss should the successful bidder fail to execute further contractual documents and bonds as required. The bid guarantee amount shall be at least 20 percent of the bid price but shall not exceed $3 million. When the penal sum is expressed as a percentage, a maximum dollar limitation may be stated.
361	Amendment 0002, SF 1442, Item 13.b.	Is the bid guarantee to be submitted only on the electronic format or is a hard copy required?	The bid guarantee shall be provided electronically. No hard copy is required.
362		Please provide the construction cost budget or limitation.	The construction cost budget is not being shared at this time.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0013	06/27/2016		

6. ISSUED BY	CODE 3PQC	7. ADMINISTERED BY *(If other than Item 6)*	CODE 3PQC
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106		GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0013

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 27 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0013.

2. The WISE3R Revision 1 is incorporated as part of this amendment. The package shall include the narrative description, revised drawings and the ETS report.

3. The due date for submissions of Request for Information (RFI's) is extended to 30 June 2016 by 4 PM EST.

4. All other terms and conditions remain unchanged.

REVISION 1 NARRATIVE

The First Floor area is being modified to reflect new programmatic requirements for NASA Langley Research Center. Specifically, the HIRF Facility is being replaced with a smaller Shielded Chamber Facility, an extended Utility Corridor, and four additional electronics laboratory modules. The narrative below is a companion to the modified drawings reflecting the revised area and building infrastructure impacts, and miscellaneous changes.

LIFE SAFETY

SHEET	TITLE	DESCRIPTION OF WORK
LS-001	LIFE SAFETY CODE SUMMARY	LS Code analysis updated to reflect new titles and layouts for labs
LS-101	LIFE SAFETY PLAN - FIRST FLOOR	Level 1 life safety plan updated to reflect updated layout, travel distances, and occupant loads

ARCHITECTURE

SHEET	TITLE	DESCRIPTION OF WORK
A-101	FIRST FLOOR OVERALL FLOOR PLAN	Sheet updated to reflect the plan new background
A-101B	FIRST FLOOR SEGMENT B FLOOR PLAN	Plan updated to reflect the new WISE3R laboratories, layout, details, room numbers, etc.
A-111B	FIRST FLOOR SEGMENT B RCP	Update plan to reflect the new WISE3R laboratories, layout, etc.
A-203	ELEVATIONS	Updated 1 & 2/A-203 South Elevation to reflect the new louvers at the elevator 3 machine room
A-311	BUILDING OVERALL SECTION	2/A-311 Overall Building Section East-West updated to reflect new layout
A-404	ENLARGED ELEVATIONS & WALL SECTIONS	1/A-404 updated
A-431	ELEVATOR 3	Updated 6/A-431 elevator 3 section @ east -west to reflect the new louvers at the machine room.
A-541	CEILING DETAILS	Detail added at WISE3R Chamber
A-601	DOOR SCHEDULE	Door Schedule updated to reflect new and revised doors
A-603	DOOR SCHEDULE & DOOR DETAILS	Door Schedule updated to reflect new and revised doors
A-604	WINDOW/LOUVER DETAILS	New window type W2 created New louver type LV3 created
A-621	INTERIOR SIGNAGE SCHEDULE	Signage Schedule updated to reflect new and revised rooms
A-701	FINISH SCHEDULE & FLOOR TRANSITION DETAIL	Schedule updated
A-711B	FIRST FLOOR SEGMENT B - FINISH PLAN	Plan updated to reflect the new WISE3R laboratories, layout, etc.
A-730	INTERIOR ELEVATIONS	Elevations updated to incorporate new laboratories and accurately reflect the corner guard locations

LABORATORY

SHEET	TITLE	DESCRIPTION OF WORK
Q-101	FIRST FLOOR LAB KEY PLAN	Drawing updated to reflect changes for WISE3R spaces
Q-201D	FIRST FLOOR ENLARGED LAB PLAN	Drawing updated to document Rooms #154 and #156 WISE3R single module labs, and New Lab #158
Q-201F	FIRST FLOOR ENLARGED LAB PLAN	Drawing updated to reflect changes to Room #170 - WISE3R Support
Q-301D	LABORATORY ELEVATIONS	Drawing updated to reflect changes to Room #170 - WISE3R Support
Q-301E	LABORATORY ELEVATIONS	Drawing updated to reflect changes to Room #170 - WISE3R Support
Q-301F	LABORATORY ELEVATIONS	New drawings created to document Rooms #154 and #156 WISE3R single module labs, and New Lab #158
Q-403	LABORATORY EQUIPMENT SCHEDULE	Schedule updated to add equipment required by labs #154, 156, 158, and 170

STRUCTURAL

SHEET	TITLE	DESCRIPTION OF WORK
S-101B	FOUNDATION PLAN SEGMENT B	Slab plan updatedto reflect the new WISE3R configuration and layout Deep foundations updated to accommodate primary building columns at B-17 and B-18 which will extend to the foundation level
S-102B	SECOND FLOOR SEGMENT B FRAMING PLAN	Structural plan updated to eliminate transfer beams along Gridlines 17 and 18
S-102BM	SECOND FLOOR SEGMENT B FRAMING PLAN - MILD REINFORCEMENT	Reinforcement plan updated to eliminate transfer beams along Gridlines 17 and 18 Reinforcement plan modified to extend 2-way slab system to Gridline B in impacted area
S-501	FOUNDATION SECTIONS AND DETAILS	Foundation details updated at slab transition at new WISE3R configuration and layout
S-521	CONCRETE COLUMN SCHEDULE	Column schedule updated to reflect eliminated transfer column condition
S-531	CONCRETE BEAM SCHEDULE	Beam schedule updated to reflect eliminated transfer column condition

MECHANICAL

SHEET	TITLE	DESCRIPTION OF WORK
M-101Z	FIRST FLOOR - HVAC ZONING	Zoning updated to reflect the new layout
M-101B	FIRST FLOOR SEGMENT B - DUCTWORK	Ductwork, diffusers, exhaust grilles updated to reflect the new layout
M-101L	FIRST FLOOR - LAB AIR BALANCE	Lab air balance updated to reflect new layout
M-102B	SECOND FLOOR SEGMENT B - DUCTWORK	Ductwork and exhaust fans updated to reflect new WISE3R laboratories. Ductwork sizes updated.
M-103B	THIRD FLOOR SEGMENT B - DUCTWORK	AHU name(s) updated to reflect new WISE3R laboratories. Ductwork sizes updated.
M-104B	FOURTH FLOOR SEGMENT B - DUCTWORK	AHU name(s) updated to reflect new WISE3R laboratories
M-105B	PENTHOUSE SEGMENT B - DUCTWORK	AHU name(s) updated to reflect new WISE3R laboratories. AHU3-LAB size increase. Ductwork layout updated.
M-106B	PENTHOUSE ROOF SEGMENT B - DUCTWORK	Added backdraft dampers to ACD-2.
M-201B	FIRST FLOOR SEGMENT B - PIPING	Piping updated to reflect new layout
M-305B1	PARTIAL ENLARGED PENTHOUSE SEGMENT B1-HVAC	Updated ductwork sizes, etc. to reflect new layout
M-305B2	PARTIAL ENLARGED PENTHOUSE SEGMENT B2-HVAC	Updated ductwork sizes, etc. to reflect new layout
M-305B3	PARTIAL ENLARGED PENTHOUSE SEGMENT B3-HVAC	Updated ductwork sizes, etc. to reflect new layout
M-501	AIRSIDE RISER DIAGRAM	Airside riser diagram updated to reflect new WISE3R laboratories
M-502	AIRSIDE RISER DIAGRAM	Airside riser diagram updated to reflect new WISE3R laboratories
M-503	STEAM & WATERSIDE RISER DIAGRAM	Steam & waterside riser diagram updated
M-601	CONTROL DIAGRAMS	Details for Control Diagram 1 added. Control Sequence 2 updated.
M-608	CONTROL DIAGRAMS	Added Control Diagrams 5 and 8.Updated Control Diagrams 4 and 9. Updated Control Points.
M-701	MECHANICAL DETAILS	Details updated to reflect AHU changes
M-801	MECHANICAL SCHEDULES	Schedules updated to reflect AHU changes
M-802	MECHANICAL SCHEDULES	Schedules updated to reflect Exhaust Fan changes
M-804	MECHANICAL SCHEDULES	Schedules updated to reflect Terminal Unit changes
M-805	MECHANICAL SCHEDULES	Air Cooled Duct schedule updated.

ELECTRICAL

SHEET	TITLE	DESCRIPTION OF WORK
E-001	ELECTRICAL SYMBOLS AND LEGEND	Symbols and legend updated to show special purpose receptacles associated with WISE3R
E-201B	FIRST FLOOR - ELECTRICAL LIGHTING - SEGMENT B	Lighting plan updated to reflect new layout
E-211B	FIRST FLOOR - ELECTRICAL POWER - SEGMENT B	Power plan updated to reflect new layout
E-221B	FIRST FLOOR - EQUIPMENT CONNECTIONS - SEGMENT B	Equipment plan updated to reflect new layout
E-225B	PENTHOUSE - EQUIPMENT - SEGMENT B	Equipment plan updated to reflect new equipment associated with the WISE3R area
E-231B	FIRST FLOOR - ELECTRICAL GROUNDING - SEGMENT B	Electrical grounding plan updated to reflect new layout
E-303	FIRST FLOOR - ENLARGED LABORATORY ROOMS	4/E-303 updated to reflect EPO for new Rooms #154 and #156 WISE3R single module labs, New Lab #158, WISE3R Laboratory (#170A, D, & E), & WISE3R Support (#170)
E-304	FIRST FLOOR - ENLARGED LABORATORY ROOMS	1/E-304 updated to reflect new WISE3R Laboratory (#170A, D, & E) & WISE3R Support (#170)
E-304	FIRST FLOOR - ENLARGED LABORATORY ROOMS	New drawings created to document Rooms #154 and #156 WISE3R single module labs, and New Lab #158
E-503	ELECTRICAL POWER DETAILS	Shielded Enclosure Power Riser Diagram updated
E-506	ELECTRICAL LAB DETAILS	Shielded Enclosure Typical Lighting Connection Detail updated
E-600A	ELECTRICAL ONELINE DIAGRAM	Oneline diagram updated to reflect revised loads and/or panels This includes responses to various RFIs received during Bidding
E-600B	ELECTRICAL ONELINE DIAGRAM	Oneline diagram updated to reflect revised loads and/or panels This includes responses to various RFIs received during Bidding
E-601	FACILITY GROUND SYSTEM RISER DIAGRAM	Ground system diagram updated for shielded enclosure area
E-702	MECHANICAL CONNECTION SCHEDULE	Mechanical connection schedule updated to reflect the revised equipment loads
E-800	ELECTRICAL PANEL SCHEDULES	Associated lighting panel schedules updated in support of revised lighting plan - normal power and emergency power
E-811A	ELECTRICAL PANEL SCHEDULES	Associated lighting panel schedules updated in support of revised lighting plan - normal power and emergency power
E-811B	ELECTRICAL PANEL SCHEDULES	Associated lighting panel schedules updated in support of revised lighting plan - normal power and emergency power
E-811B	ELECTRICAL PANEL SCHEDULES	1HNH1 updated
E-811C	ELECTRICAL PANEL SCHEDULES	1HNH2 updated
E-815A	ELECTRICAL PANEL SCHEDULES	Panel 5HNM3 updated base don revised equipemtn requirments
E-815B	ELECTRICAL PANEL SCHEDULES	Panel 5HNM5 updated base don revised equipemtn requirments
E-821C	ELECTRICAL PANEL SCHEDULES	Panel 1LND1 updated base don revised equipemtn requirments
E-821E	ELECTRICAL PANEL SCHEDULES	Panel schedule added
E-821E	ELECTRICAL PANEL SCHEDULES	1LNHA, 1LNH2, & 28VDC updated
E-822D	ELECTRICAL PANEL SCHEDULES	General update to misc circuit sizing
E-822E	ELECTRICAL PANEL SCHEDULES	Added Panel PPA and PPB

PLUMBING

SHEET	TITLE	DESCRIPTION OF WORK
P-100A	FOUNDATION FLOOR SEGMENT A FLOOR PLAN - PLUMBING	Sanitary piping updated to reflect deletion of Emergency Shower/Eye Wash
P-100B	FOUNDATION FLOOR SEGMENT B FLOOR PLAN - PLUMBING	Sanitary piping updated to coordinate with new corridor Lab sink drainage added as required
P-101A	FIRST FLOOR SEGMENT A DMV FLOOR PLAN - PLUMBING	Sanitary piping updated to reflect deletion of Emergency Shower/Eye Wash
P-101B	FIRST FLOOR SEGMENT B DMV FLOOR PLAN - PLUMBING	Sanitary piping updated to coordinate with new corridor and to reflect deletion of Emergency Shower/Eye Wash
P-111A	FIRST FLOOR SEGMENT A SUPPLY & LAB GASES FLOOR PLAN - PLUMBING	Lab gases provided to new labs. Lab gas control panels indicated on plan.
P-111B	FIRST FLOOR SEGMENT B SUPPLY & LAB GASES FLOOR PLAN - PLUMBING	Compressed air to WISE3R (#170) updated Compressed air added to Rooms #154 and #156 WISE3R single module labs, and New Lab #158 New HW and CW provided to lab sinks and wall outlets
P-401	DOMESTIC WATER RISER DIAGRAMS - PLUMBING	Domestic water riser diagrams revised to include HW and CW to labs and new sinks Piping resized to account for additional loads
P-404	SANITARY RISER DIAGRAMS - PLUMBING	Sanitary riser diagram updated to reflect deletion of Emergency Shower/Eve Wash
P-405	SANITARY RISER DIAGRAMS - PLUMBING	Sanitary riser diagrams revised to reflect new sinks Piping resized to account for additional loads
P-408	COMPRESSED AIR RISER DIAGRAMS - PLUMBING	Compressed air riser diagrams revised to reflect changes to system and additional connections. Piping resized to account for additional loads
P-409	COMPRESSED AIR RISER DIAGRAMS - PLUMBING	Compressed air riser diagrams revised to reflect changes to system Piping resized to account for additional loads
P-410	NITROGEN RISER DIAGRAMS - PLUMBING	Nitrogen riser diagrams revised to reflect changes to system and additional connections.
P-411	NITROGEN RISER DIAGRAMS - PLUMBING	Nitrogen riser diagrams revised to reflect changes to system and additional connections.
P-600	SCHEDULES - PLUMBING	Plumbing Fixture Connection Schedule updated to refelct deletion of Emergency Shower/Eye Wash and to update referenced specification sections.

FIRE PROTECTION

SHEET	TITLE	DESCRIPTION OF WORK
FA-101B	FIRE ALARM FIRST FLOOR PLAN - SEGMENT B	Level 1 B fire alarm plan updated to show new background and revise layouts for new spaces.
FA-503	FIRE ALARM GRAPHIC ANNUNCIATOR	Graphic annunciator detail updated to reflect new configuration
FP-001	FIRE SUPPRESSION CODE SUMMARY	FP Code analysis updated to reflect new titles for new labs
FP-101B	FIRE SUPPRESSION FIRST FLOOR PLAN - SEGMENT B	Level 1 B fire suppression plan updated for new lab spaces.

TELECOMMUNICATION

SHEET	TITLE	DESCRIPTION OF WORK
T-001	TELECOM SYMBOLS AND ABBREVIATIONS	Removed reference to data port "CP" outlets.
T-111A	TELECOM FIRST FLOOR PLAN - SEGMENT A	Removed Gen Note reference to cable port outlets.
T-111B	TELECOM FIRST FLOOR PLAN - SEGMENT B	Plan updated to reflect the new WISE3R laboratories, layout, etc.
T-112A	TELECOM SECOND FLOOR PLAN - SEGMENT A	Updated data port design and description for labs.
T-112B	TELECOM SECOND FLOOR PLAN - SEGMENT B	Removed Gen Note reference to cable port outlets.
T-113A	TELECOM THIRD FLOOR PLAN - SEGMENT A	Removed Gen Note reference to cable port outlets.
T-113B	TELECOM THIRD FLOOR PLAN - SEGMENT B	Removed Gen Note reference to cable port outlets.
T-114A	TELECOM FOURTH FLOOR PLAN - SEGMENT A	Updated data port design and description for labs.
T-114B	TELECOM FOURTH FLOOR PLAN - SEGMENT B	Updated data port design and description for labs.

T-115A	TELECOM PENTHOUSE PLAN - SEGMENT A	Updated data port pathway design through lab & into roof
T-115B	TELECOM PENTHOUSE PLAN - SEGMENT B	Updated data port pathway design through lab & into roof
T-116A	TELECOM PENTHOUSE ROOF PLAN - SEGMENT A	Updated data port pathway design through & into roof
T-116B	TELECOM PENTHOUSE ROOF PLAN - SEGMENT B	Updated data port pathway design through & into roof
T-211B	TELECOM FIRST FLOOR CEILING PLAN - SEGMENT B	RCP updated to reflect the new WISE3R laboratories, layout, etc.
T-212A	TELECOM SECOND FLOOR CEILING PLAN - SEGMENT A	Updated data port design and description for labs. Moved cable tray.
T-212B	TELECOM SECOND FLOOR CEILING PLAN - SEGMENT B	Updated data port design and description for labs. Moved cable tray.
T-213A	TELECOM THIRD FLOOR CEILING PLAN - SEGMENT A	Updated data port design and description for labs.
T-213B	TELECOM THIRD FLOOR CEILING PLAN - SEGMENT B	Updated data port design and description for labs.
T-214A	TELECOM FOURTH FLOOR CEILING PLAN - SEGMENT A	Updated data port design and description for labs & into roof. Moved cable tray.
T-214B	TELECOM FOURTH FLOOR CEILING PLAN - SEGMENT B	Updated data port design and description for labs & into roof. Moved cable tray.
T-215A	TELECOM PENTHOUSE CEILING PLAN - SEGMENT A	Updated data port pathway design through lab & into roof
T-215B	TELECOM PENTHOUSE CEILING PLAN - SEGMENT B	Updated data port pathway design through lab & into roof
T-402	TELECOM T/D 161 ENLARGED PLANS	Updated conduit routing in the T/D room.
T-404	TELECOM T/D 261 ENLARGED PLANS	Updated conduit routing in the T/D room.
T-406	TELECOM T/D 361 ENLARGED PLANS	Updated conduit routing in the T/D room.
T-408	TELECOM T/D 461 ENLARGED PLANS	Updated conduit routing in the T/D room.
T-501	TELECOM OUTLET DETAILS	Updated details to remove detail for "CP" outlets.
T-502	TELECOM OUTLET DETAILS	Updated details to show roof penetration conduit/antenna.
T-605	TELECOM PATHWAY RISER DIAGRAM	Updated pathways to reflected all changes/additions regarding the data port routing throughout the facility.

AUDIO/VISUAL

SHEET	TITLE	DESCRIPTION OF WORK
TA-201B	AV FIRST FLOOR SEGMENT B FLOOR PLAN	Plan updated to reflect the new WISE3R laboratories, layout, etc.

SECURITY

SHEET	TITLE	DESCRIPTION OF WORK
TY-111B	SECURITY FIRST FLOOR PLAN - SEGMENT B	Plan updated to reflect the new WISE3R laboratories, layout, etc.

RESOURCE

SHEET	TITLE	DESCRIPTION OF WORK
RQ-001	RESOURCE DRAWING - C1 - COVER SHEET	Reference to HIRF removed
RQ-002	RESOURCE DRAWING - F1 - FACILITY LAYOUT	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-003	RESOURCE DRAWING - F2 - PIT LAYOUT	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-004	RESOURCE DRAWING - RF1 - RAISED FLOOR PLAN	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-005	RESOURCE DRAWING - RF2 - PLAN VIEW	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-006	RESOURCE DRAWING - RF3 - SECTION ELEVATIONS	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-007	RESOURCE DRAWING - RF4 - ELEVATIONS	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-008	RESOURCE DRAWING - RF5 - ELEVATIONS	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-009	RESOURCE DRAWING - RF6 - SECTION ELEVATIONS	Reference to HIRF removed
RQ-010	RESOURCE DRAWING - RF7 - SECTION DETAILS	Reference to HIRF removed
RQ-011	RESOURCE DRAWING - RF8 - PEDESTAL LAYOUT	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E

RQ-012	RESOURCE DRAWING - M1 - MECHANICAL PLAN	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-013	RESOURCE DRAWING - E1 - ELECTRICAL DETAILS	Reference to HIRF removed
RQ-014	RESOURCE DRAWING - E2 - ELECTRICAL LAYOUT	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-015	RESOURCE DRAWING - E3 - LIGHTING LAYOUT	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E
RQ-016	RESOURCE DRAWING - E4 - REFLECTED CEILING PLAN	Reference to HIRF removed Updated to reflect new WISE3R Laboratory - #170A, D, & E

SPECIFICATIONS

SECTION	TITLE	DESCRIPTION OF WORK
08 11 13.00 41, Page 4, section 2.1.1.3		Replace “HIRF” with “Room #170”
21 13 18.00 10, Page 4, section 1.2.2		Replace “HIRF Laboratory” with “Room #170A and Room #170E”
23 00 00, Page 21, section 2.9.9.1, paragraph 2		Replace “HIRF-1” with “AHU-1”

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Proposal No. 002-15-0086144-1664-4

June 14, 2016

Mr. Ed Weaver
AECOM
3101 Wilson Blvd,
Arlington, VA 22201
[redacted]

Reference: Langley Research Center (NASA) – Hampton, Virginia (Rev 4)

Dear Mr. Weaver,

This document is submitted to AECOM, providing a revised scope of work and pricing to implement a custom Lab at NASA's Langley Research Center in Hampton, Virginia. As a result of the revised preliminary design project, new floor plans, elevations, electrical layouts, facility layouts, raised floor layouts, pit layout, etc. will be submitted separately. This document may require modifications once the final design is completed. Final locations and configuration of connector panels are subject change once final antenna selections are made.

In order to facilitate discussion about individual project roles and responsibilities, this document also includes a list of assumptions and clarifications on which our offer is based. Currently, any resultant contract will be bound by ETS-Lindgren's Terms & Conditions and Warranty for RF-Shielded Chambers. These documents are available at the links provided in section 5. If any Plans & Specifications will apply to ETS-Lindgren's scope of work as this project progresses, they must be presented to ETS-Lindgren for review prior to a final firm-fixed proposal being issued.

Please contact me should you have any questions or require additional information. We look forward to an opportunity to discuss this solution with your team.

Sincerely,
[redacted]
ETS-Lindgren Inc.
Regional Sales Director – Americas East
[redacted]

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Cedar Park, TX 78613
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1. LAB DESIGN CONCEPT

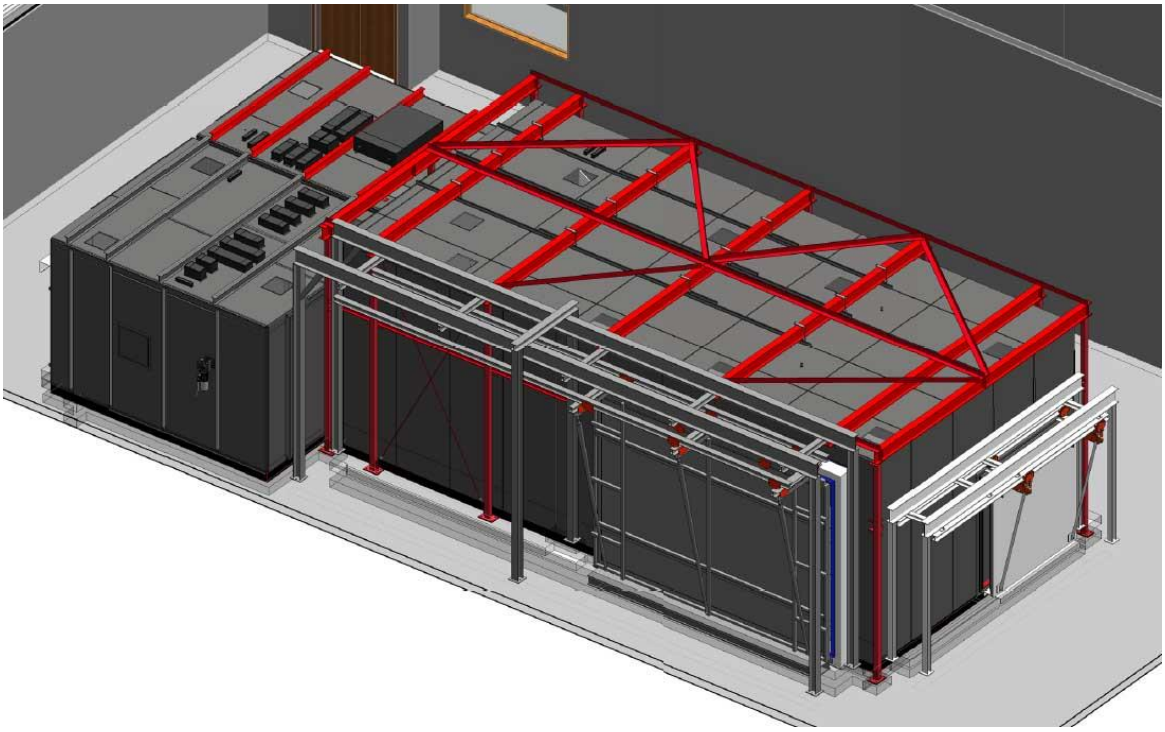
NASA intends to use the new lab primarily to subject various test objects to very high electromagnetic fields, using multiple test chambers to maximize field strength and field uniformity over specified area.

ETS-Lindgren Inc. proposes to supply a lab consisting of two RF-shielded reverberation chambers; one 80 MHz chamber and one 170 MHz chamber along with an RF-shielded control room. Each of the two reverberation chambers is configured to support testing up to 18 GHz.

ETS-Lindgren Inc. proposes all materials and labor required to design, fabricate, install (factory-trained non-union / open shop / no prevailing wage), and validate the lab as summarized in this document. This offer currently *excludes* all measurement system equipment including but not limited to instrumentation, cabling, amplifiers, antennas, tripods, positioning equipment, and software.

Preliminary Design Drawings will be submitted separately as part of the design package. These drawings illustrate the proposed facility including:

Chamber A-179:	80 MHz – 18 GHz RF-Shielded Reverberation Chamber	(section 3.1)
Chamber B-137A:	170 MHz – 18 GHz RF-Shielded Reverberation Chamber	(section 3.2)
Control Room:	RF-Shielded Enclosure	(section 3.3)



Example of ETS-Lindgren BIM Modelling Capabilities
For illustrative purposes only / Not actual facility

2. BUDGETARY PRICE SUMMARY

ETS-Lindgren's budgetary pricing for the Lab scope of work, as defined in this document, is presented below.

2.1 Baseline Pricing

DESCRIPTION	PRICE (USD)
Langley Research Center (NASA) Lab ➢ Chamber A-179: 80 MHz – 18 GHz Reverberation Chamber ➢ Chamber B-137A: 170 MHz – 18 GHz Reverberation Chamber ➢ Control Room: RF-Shielded Enclosure **Installation & Validation Services** ➢ Installation (non-union / open shop) ➢ Operational Training Services ➢ Chamber Validation Testing	
TOTAL (EXCLUDING FREIGHT & SALES TAXES):	(b) (4) [redacted]
OPTIONAL ESTIMATED FREIGHT (CPT JOBSITE – HAMPTON, VA):	[redacted]

2.2 Options

DESCRIPTION	PRICE (USD)
Door Options [redacted] DEDUCT for a 3.6m x 3.6m fully-automatic (PNL-4S) pneumatic sliding RF-shielded door in lieu of the 5.3m x 3.7m door (Chamber A) DEDUCT for a 3.0m x 3.0m fully-automatic (PNL-4S) pneumatic sliding RF-shielded door in lieu of the 5.3m x 3.7m door (Chamber A)	(b) (4) [redacted]
Signal Filter Options GPIB Filter / 24 at 3A (P/N E-LTC-24640-GPIB)	[redacted]
Reverberation Testing (Loaded Chamber) Reverberation Validation Test per IEC 61000-4-21 Annex B: Mode Tuned Calibration (80/170 MHz – 18 GHz) performed on two (2) loaded chambers	[redacted]

TOTAL price excludes freight and sales taxes. Also excluded is all measurement system equipment including but not limited to instrumentation, cabling, amplifiers, antennas, tripods, positioning equipment, and software.

All pricing is subject to the Terms & Warranty addressed in section 4.

Pricing is based on the entire scope of work being purchased on a single order and executed during a single mobilization.

Pricing based on ETS-Lindgren Inc. factory-trained non-union (open shop) labor / no prevailing wage.

3. COMPONENTS OVERVIEW

3.1 **Chamber A-179** – Components Summary

MODEL NO	DESCRIPTION	QTY
Series 81	**RF-Shielding System** • Modular RF-shielded enclosure with nominal inside shield-to-shield dimensions of 41'-0" x 19'-8" x 15'-0" (12.5m x 6.0m x 4.57m)	1 Lot
SRFSD-100	**RF-Shielded Sliding Doors** • Primary Access: ETS-Lindgren 5.3m x 3.7m (17'-4 ½" x 12'-1 ½") fully-automatic (PNL-4S) pneumatic sliding RF-shielded door. Includes a microswitch and automatic ramp (lift) system (8,000 lbs. load rating) for flush chamber access. Pure White (RAL9010) door leaf with Signal Blue (RAL5005) door support structure	1
RFSD-100	• Secondary Access: ETS-Lindgren 2.4m x 2.4m (7'-10 ½" x 7'-10 ½") fully-automatic (PNL-4S) pneumatic sliding RF-shielded door. Includes a microswitch and automatic ramp (lift) system (8,000 lbs. load rating) for flush chamber access. Pure White (RAL9010) door leaf with Signal Blue (RAL5005) door support structure Note: The required compressed air system is excluded from this proposal. GC/NASA must provide a concrete pits (9" and 14.5" deep respectively) in which to install each door's automatic lift/ramp system.	1
	Waveguide Air Vents • Waveguide 1/8" HVAC Air Vents – 18" x 18" (457mm x 457mm) installed in chamber ceiling and each including a dielectric collar for connection (by GC) to the parent-facility HVAC system ducting Note: ETS-Lindgren provides consultation during the connection process to ensure RF-shielding integrity is maintained.	9
	Power Line Filters Note: Wiring and electrical distribution are excluded from this proposal.	
LRW-2030	• 2-line 2x30A 50/60 Hz power line filter for Customer requirements	5
LRX-2030-4	• 2-line 2x30A 400 Hz power line filters for Customer requirements	2
LPC-3100-50Q	➢ Power Factor Correction Coils	2
EQ-2010-NR	• 2-line 2x10A power line filters for lighting	2
LTC-2640-600Z	• 2-line telephone line voice / analog filter	1
	• Threaded brass ground stud - ½" (M12) by 5" long (1.3cm x 12.7cm)	1
	Lighting System • LED Strip lighting system with included dimmer control Note: Wiring and electrical distribution are excluded from this proposal.	1 Lot

MODEL NO	DESCRIPTION	QTY
	Connectors, Panels & Penetrations	
	• Blank connector panels as defined in the associated submittal drawings Note: Final connectors require definition and may result in additional costs.	1 Lot
	• 1 ½" (3.8cm) standard threaded pipe penetrations with cap Note: Sizes, quantities, and locations to be determined	2
	• RF-shielded penetration for airline Note: Compressed air is Customer's responsibility	1
	Baseline Equipment	
6060	• Horizantal Z-fold aluminum paddle and mounting shafts – 60" x 60" x 19' (1.52m x 1.52m x 5.79m). Includes motor bases with rotational speeds from 1 to 16 RPM and mounting penetration hardware Note: Wiring and electrical distribution are excluded from this proposal. Customer to supply 220V single-phase power.	1
7000-010	• EMCenter™ Modular RF Platform (7-slot)	1
7006-001	➢ EMControl™ Positioning Control Plug-in Card for tuner control	1
110333	• Ceiling antenna mounts (*antennas excluded*)	2
110056	• Wall antenna mounts (*antennas excluded*)	2
	Floor System	
Series 81	• Modular 12" (30.5cm) raised ground plane with four (4) 12" x 12" (30.5cm x 30.5cm) access hatches. Floor is reinforced to support up to 8,000 lbs. (concentrated load; load must not exceed 8,000 lbs. on a single panel point between the pedestal grid).	1 Lot
	• Wedled steel basin beneath enclosure extending up sidewalls 6" Note: ETS-Lindgren recommends Customer provide and install an adequate sump pump to remove any water that may accumulate in the pit surrounding the welded basin. This helps to protect the Series 81 shielding system and equipment within the enclosure from water damage.	1 Lot
	• Recessed chamber design resulting in the raised ground plane being flush with the door sills Note: Excavation and concrete are excluded from this proposal.	
	Chamber Validation Testing	
	• Shield verification test in general accordance with the test methods of MIL-STD-285 / IEEE-299 at six (6) frequencies between 10 kHz and 10 GHz to be selected by NASA Note: The shielding performance is guaranteed prior to the installation of system components such as the antenna, RF cabling, etc.	1
	• Reverberation Validation Test per IEC 61000-4-21 Annex B: Mode Tuned Calibration (80 MHz – 18 GHz) performed on empty chamber (testing loaded chamber is optional). Note: Testing will be accomplished according to the procedure outlined in the above IEC specification unless agreed otherwise in writing. After the test is complete, a full test report will be furnished.	1

3.2 **Chamber B-137A** – Components Summary

MODEL NO	DESCRIPTION	QTY
Series 81	**RF-Shielding System** • Modular RF-shielded enclosure with nominal inside shield-to-shield dimensions of 16'-4 ¾" x 14'-0" x 11'-0" (5.21m x 3.50 x 3.35m)	1 Lot
RFSD-100	**RF-Shielded Sliding Door** • Primary Access: ETS-Lindgren 1.50m x 2.10m (h4'-11" x 6'-10 ½") manual sliding door with pneumatic RF-tight locking / unlocking system (PNL-1). Includes a microswitch and automatic ramp (lift) system (8,000 lbs. load rating) for flush chamber access. Pure White (RAL9010) door leaf Note: The required compressed air system is excluded from this proposal. GC/NASA must provide a concrete pit (estimated 7.5" deep) in which to install the door's automatic lift/ramp system.	1
	Waveguide Air Vents • Waveguide 1/8" HVAC Air Vents – 18" x 18" (457mm x 457mm) installed in chamber ceiling and each including a dielectric collar for connection (by GC) to the parent-facility HVAC system ducting Note: ETS-Lindgren provides consultation during the connection process to ensure RF-shielding integrity is maintained.	4
	Power Line Filters Note: Wiring and electrical distribution are excluded from this proposal.	
LRW-2030	• 2-line 2x30A 50/60 Hz power line filter for Customer requirements	5
LRX-2030-4	• 2-line 2x30A 400 Hz power line filters for Customer requirements	2
LPC-3100-50Q	➢ Power Factor Correction Coils	2
EQ-2010-NR	• 2-line 2x10A power line filter for lighting	1
LTC-2640-600Z	• 2-line telephone line voice / analog filter	1
	• Threaded brass ground stud - ½" (M12) by 5" long (1.3cm x 12.7cm)	1
	Lighting System • LED Strip lighting system with included dimmer control Note: Wiring and electrical distribution are excluded from this proposal.	1 Lot
	Connectors, Panels & Penetrations • Blank connector panels as defined in the associated submittal drawings Note: Final connectors require definition and may result in additional costs.	1 Lot
	• 1 ½" (3.8cm) standard threaded pipe penetrations with cap Note: Sizes, quantities, and locations to be determined	1
	• RF-shielded penetration for airline Note: Compressed air is Customer's responsibility	1

MODEL NO	DESCRIPTION	QTY
	Baseline Equipment	
3030	• Horizontal Z-fold aluminum paddle and mounting shafts – 30” x 30” x 11’-5 ¾” (76.2cm x 76.2cm x 3.50m). Includes motor bases with rotational speeds from 1 to 16 RPM and mounting penetration hardware Note: Wiring and electrical distribution are excluded from this proposal. Customer to supply 220V single-phase power.	1
7000-010	• EMCenter™ Modular RF Platform (7-slot)	1
7006-001	➢ EMControl™ Positioning Control Plug-in Card for tuner control	1
110333	• Ceiling antenna mounts (*antennas excluded*)	2
110056	• Wall antenna mounts (*antennas excluded*)	2
	Floor System	
Series 81	• Modular 12” (30.5cm) raised ground plane with two (2) 12” x 12” (30.5cm x 30.5cm) access hatches. Floor is reinforced to support up to 250 lbs. (concentrated load; load must not exceed 250 lbs. on a single panel point between the pedestal grid).	1 Lot
	• Wedled steel basin beneath enclosure extending up sidewalls 6” (15.24cm) Note: ETS-Lindgren recommends Customer provide and install an adequate sump pump to remove any water that may accumulate in the pit surrounding the welded basin. This helps to protect the Series 81 shielding system and equipment within the enclosure from water damage.	1 Lot
	• Recessed chamber design resulting in the raised ground plane being flush with the door sill Note: Excavation and concrete are excluded from this proposal.	
	Chamber Validation Testing	
	• Shield verification test in general accordance with the test methods of MIL-STD-285 / IEEE-299 at six (6) frequencies between 10 kHz and 10 GHz to be selected by NASA Note: The shielding performance is guaranteed prior to the installation of system components such as the antenna, RF cabling, etc.	1
	• Reverberation Validation Test per IEC 61000-4-21 Annex B: Mode Tuned Calibration (170 MHz – 18 GHz) performed on empty chamber (testing loaded chamber is optional). Note: Testing will be accomplished according to the procedure outlined in the above IEC specification unless agreed otherwise in writing. After the test is complete, a full test report will be furnished.	1

3.3 **Control Room** – Components Summary

MODEL NO	DESCRIPTION	QTY
Series 81	**RF-Shielding System** • Modular RF-shielded enclosure with nominal inside shield-to-shield dimensions of 16'-4 ¾" x 11'-8 ¼" x 11'-0" (4.97m x 4.0 x 3.35m) • Interior finishes include ½" vinyl covered gypsum panel walls, suspended drop ceiling, three (3) diffusers, coves, and anti-static vinyl floor tile Note: Wiremold by GC	1 Lot 1 Lot
DKE	**RF-Shielded Swing Door** • Primary Access: ETS-Lindgren dual-leaf 6'-0" x 7'-0" (≈ 1.8m x 2.1m) semi-auto latch swing door including a microswitch and two-piece removable aluminum ramp (500 lb. load rating) for bridging the door threshold / contact mechanism Note: ETS-Lindgren recommends the Customer provide a UPS for the door's semi-auto latch feature, allowing operation in case of power failure.	1
	Waveguide Air Vents • Waveguide 1/8" HVAC Air Vents – 18" x 18" (457mm x 457mm) installed in chamber ceiling and each including a dielectric collar for connection (by GC) to the parent-facility HVAC system ducting Note: ETS-Lindgren provides consultation during the connection process to ensure RF-shielding integrity is maintained.	3
LRW-2030 LRX-2030-4 LPC-3100-50Q LPRX-4x200 LRE-2030 LTC-2640-600Z	**Power Line Filters** Note: Wiring and electrical distribution are excluded from this proposal. • 2-line 2x30A 50/60 Hz power line filters for Customer requirements • 2-line 2x30A 400 Hz power line filters for Customer requirements ➢ Power Factor Correction Coils • 4-line 4x200A 50/60 Hz power line filters for Customer requirements • 2-line 2x30A 50/60 Hz power line filters for lighting • 2-line telephone line voice / analog filter • Threaded brass ground stud - ½" (M12) by 5" long (1.3cm x 12.7cm)	3 2 2 1 1 1 1
260366	**Signal Line Filters** • GigaFOIL™ 10/100/1000 Gigabit Ethernet Fiber Optic Convertor	2
	Lighting System • Recessed LED light fixtures in ceiling Note: Wiring and electrical distribution are excluded from this proposal.	12
	Connectors, Panels & Penetrations • Blank connector panels as defined in the associated submittal drawings	1 Lot

MODEL NO	DESCRIPTION	QTY
	Note: Final connectors require definition and may result in additional costs.	
	• 1 ½" (3.8cm) standard threaded pipe penetrations with cap Note: Sizes, quantities, and locations to be determined	1
	• 3" (7.6cm) standard threaded pipe penetrations with caps Note: Sizes, quantities, and locations to be determined	2
	• Waveguide penetrations for Client-supplied fire protection	2
Series 81	**Floor System**	
	• Modular 12" (30.5cm) raised ground plane with two (2) 12" x 12" (30.5cm x 30.5cm) access hatches. Floor is reinforced to support up to 250 lbs. (concentrated load; load must not exceed 250 lbs. on a single panel point between the pedestal grid).	1 Lot
	• Wedled steel basin beneath enclosure extending up sidewalls 6" (15.24cm) Note: ETS-Lindgren recommends Customer provide and install an adequate sump pump to remove any water that may accumulate in the pit surrounding the welded basin. This helps to protect the Series 81 shielding system and equipment within the enclosure from water damage.	1 Lot
	• Recessed enclosure design resulting in the raised ground plane being flush with the door sill. A minimal step up from parent facility floor to door sill will be present and can be bridged using the included two-piece removable aluminum ramp. Note: Excavation and concrete are excluded from this proposal.	
	Chamber Validation Testing	
	• Shield verification test in general accordance with the test methods of MIL-STD-285 / IEEE-299 at six (6) frequencies between 10 kHz and 10 GHz to be selected by NASA	1

4. ASSUMPTIONS

Provided below is a preliminary list of technical assumptions on which ETS-Lindgren's design is based. Our team welcomes discussion on these topics.

RESPONSIBILITY: R = Responsible C = Consultation

ITEM	DESCRIPTION	ETS-LINDGREN	ETS-LINDGREN PARTNERS	GC / NASA
A	**Parent Facility Readiness**			
1.	Parent building design and construction	-	-	R
2.	Provide a poured and cured foundation designed as agreed upon during the project design stage and including a recess (≈ 13") for the chamber, pit for the door lift / ramp systems, and footings as required per the design drawings. The nominal overall clear space required for the lab is 60' x 30'. Dimensions will be confirmed after receipt of order.	C	-	R
3.	All concrete where the enclosures are to be installed must be verified to support the loading requirements of the enclosures and be level to within 1/8" per 10' (non-cumulative).	C	-	R
4.	Provide temporary lighting, water, bathroom facilities, dumpsters for disposal of project materials, and power for tools, welding, and various construction equipment.	-	-	R
5.	Prior to receiving the RF-shielding components; the parent facility must be dried in however, temperature/humidity control are not a requirement. This is providing the materials are not delivered months prior to installation; a scenario that we would avoid.	-	-	R
6.	Provide facility availability Monday – Friday; 10-hours per day with Saturday availability upon request	-	-	R
B	**Parent Building Utilities**			
7.	All electrical distribution external to the chamber including all conduit and connectors	-	-	R
8.	Supply and connect 200-240V 50/60 Hz power supply and compressed air to the sliding doors as necessary. Also power to the tuners	-	-	R

ITEM	DESCRIPTION	ETS-LINDGREN	ETS-LINDGREN PARTNERS	GC / NASA
C	**RF-Shielded Enclosures**			
9.	All electrical distribution internal to the enclosures including all conduit and connectors	C	-	R
10.	Design and provide an HVAC system required to meet the NASA's requirements. Connect HVAC ducting to the waveguide air vent dielectric collars installed by ETS-Lindgren	C	-	R
11.	Operate the enclosures in a temperature and humidity controlled environment, maintaining a temperature of 70° ±20° F and relative humidity of 50% ±20%	-	-	R
12.	Local permit application and inspection process, plan-check fees, and taxes as required by regulators in the Client's location. Submit chamber drawings to local licensing agency / organization.	C	-	R
13.	Provide and install any required fire suppression system(s) within the enclosures (unless options fire protection is selected)	C	-	R
	Measurement Equipment & Software			
14.	Selection, purchase, and integration of all measurement system equipment including but not limited to instrumentation, cabling, amplifiers, antennas, tripods, positioning equipment, and software.	-	-	R
E	**Performance Validation Testing**			
15.	Enclosure Performance Validation and providing of a written test reports	-	R	-
G	**Training**			
16.	Basic chamber operational training	R	-	-

4.1 Additional Clarifications

- Chamber point loads will be provided with submittal drawings during the project design stage.
- Proposal includes one design review at the Client's location.
- Proposal excludes as-built drawings (can be provided for an additional cost).
- Pricing is based on ETS-Lindgren non-union labor (open shop) onsite / no prevailing wage.
- Price excludes sales taxes, freight, performance bonds, permits or fees relating to permits, plan checks, customs or other fees unless stated otherwise.
- ETS-Lindgren shall not be obligated to accept or proceed under any proposed contract resulting from this proposal prior to review and full acceptance of terms and conditions, if such terms and conditions were not provided with a Request for Proposal (RFP).
- This proposal represents ETS-Lindgren's current design concept for the contemplated effort. ETS-Lindgren reserves the right to 1) change design concepts to utilize the most current technology available at the time of design finalization and 2) to substitute components or parts that are equivalent or better in performance to those specified in this offer.
- This proposal, as drafted is all-inclusive. No prior verbal or written agreements are to be assumed included in this proposal unless identified in writing and incorporated by reference.
- ETS-Lindgren reserves the right to publicize information about the completed chamber when no non-disclosure agreement (NDA) is in place.

5. TERMS & WARRANTY

[redacted] (b) (4)

5.1 Remittance Information

Payment by Check (Mail)	ETS-Lindgren Inc. P. O. Box 841147 Kansas City, MO 64184-1147
Payment by Check (Overnight Courier)	Commerce Bank 811 Main KC LBX - 841147 Kansas City, MO 64105 Phone: 1-800-207-0886
Payment by Wire Transfer (US Dollars)	Bank: ABA: Account: Account Name: [redacted] (b) (4)

5.2 Price Validity

[redacted] (b) (4)

5.3 Standard Shipping Terms

[redacted] (b) (4)

5.4 Warranty, Terms & Conditions

Any resultant contract shall be bound by ETS-Lindgren's Terms & Conditions and Warranty for RF-Shielded Chambers. These documents are available at the links provided below.

http://www.ets-lindgren.com/pdf/ETS-Lindgren_Terms_v1.01.doc
http://www.ets-lindgren.com/pdf/ETS-Lindgren_StdWarranty_v1.01.doc

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0014	06/28/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)		(X)	9A. AMENDMENT OF SOLICITATION NO.
		☐	9B. DATED (SEE ITEM 11)
		☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
			10B. DATED (SEE ITEM 13)
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0014

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 28 June 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0014.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
273	Section 01 33 29 – Para - 1.3.1 Credit Validation and LEED Scorecard	LEED Checklist as registered by the government notes under Innovation and Design Process a LEED point for Exemplary Performance of EAc5 M&V. This point requires NASA commitment to Sharing Whole-Building Energy and Water Usage Data for 5 years after physical occupancy. Specifically states "This option aims to incentivize whole building data collection for LEED projects. Projects that choose to comply with EAc5 through this option are encouraged to enroll in USGBC's Building Performance Partnership (BPP) at certification or typical physical occupancy.	NASA will provide data for the GC to complete this LEED credit.
342	01 10 00	The response to RFI No. 43 states "Please amend specification 01 10 00 paragraph 1.14 B with the addition of the following: "Examples of work considered to be disruptive include but are not limited to noises that prevent normal conversation within adjacent buildings, vibration that might interfere with ongoing NASA experiments or testing odors that cause discomfort or disruption to Center employees; and any other activities that would adversely impact the efficient operation of the Center or Impair the Center from fulfilled its mission." Can the Government please confirm whether it views the driving of Precast/ Prestsressed Concrete Piles as disruptive? Does the Government believe the driving of piles should be performed off hours?	Pile driving operations will be permitted during normal working hours.
385	Amendment 0009 - RFI 196	There is no allowance value shown on the Base Bid tab of the Bid Form provided to us. Please provide value.	See revised bid form issued by Amendment 011.
386	Amendment 0008 - RFI 120	RFI 120 states the installation duration is to be determined by GC. Is the WISE3R lab to be installed before substantial completion?	Yes, the WISE3R is to be included in the General Contractor's overall project schedule and shall be completed by Substantial Completion.
387		Buy American Compliance: The project specifications provided does not mention if "Buy American" is a requirement. If applicable, what is the Buy American Act FAR number and please confirm it is a project requirement.	52-22511 Buy American —Construction Materials under Trade Agreements (MAY 2014). Please see C101 The Agreement.
416		Buy American Compliance: The project specifications provided does not mention if "Buy American" is a requirement. If applicable, what is the Buy American Act FAR number and please confirm it is a project requirement.	See RFI 387.
420		Please confirm whether Technical Proposal can be e-mailed or must be delivered on CD.	The techical proposal shall be provided on a CD and delivered to GSA as stated in solicitation. The price proposal may be submitted via email per the response to RFI 261 and 263.
432	RFI 43	Please advise if pile driving will be allowed during normal working hours or if will be required to be performed after hours and on weekends.	Pile driving operations will be permitted during normal working hours.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0015	07/01/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*		(X)	
		☐	9A. AMENDMENT OF SOLICITATION NO. 9B. DATED *(SEE ITEM 11)*
		☐	10A. MODIFICATION OF CONTRACT/ORDER NO. 10B. DATED *(SEE ITEM 13)*
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

INSTRUCTIONS

Instructions for items other than those that are self-explanatory, are as follows:

(a) Item 1 (Contract ID Code). Insert the contract type identification code that appears in the title block of the contract being modified.

(b) Item 3 (Effective date).

(1) For a solicitation amendment, change order, or administrative change, the effective date shall be the issue date of the amendment, change order, or administrative change.

(2) For a supplemental agreement, the effective date shall be the date agreed to by the contracting parties.

(3) For a modification issued as an initial or confirming notice of termination for the convenience of the Government, the effective date and the modification number of the confirming notice shall be the same as the effective date and modification number of the initial notice.

(4) For a modification converting a termination for default to a termination for the convenience of the Government, the effective date shall be the same as the effective date of the termination for default.

(5) For a modification confirming the contacting officer's determination of the amount due in settlement of a contract termination, the effective date shall be the same as the effective date of the initial decision.

(c) Item 6 (Issued By). Insert the name and address of the issuing office. If applicable, insert the appropriate issuing office code in the code block.

(d) Item 8 (Name and Address of Contractor). For modifications to a contract or order, enter the contractor's name, address, and code as shown in the original contract or order, unless changed by this or a previous modification.

(e) Item 9, (Amendment of Solicitation No. - Dated), and 10, (Modification of Contract/Order No. - Dated). Check the appropriate box and in the corresponding blanks insert the number and date of the original solicitation, contract, or order.

(f) Item 12 (Accounting and Appropriation Data). When appropriate, indicate the impact of the modification on each affected accounting classification by inserting one of the following entries.

(1) Accounting classification .....
Net increase $ .....

(2) Accounting classification .....
Net decrease $ .....

NOTE: If there are changes to multiple accounting classifications that cannot be placed in block 12, insert an asterisk and the words "See continuation sheet".

(g) Item 13. Check the appropriate box to indicate the type of modification. Insert in the corresponding blank the authority under which the modification is issued. Check whether or not contractor must sign this document. (See FAR 43.103.)

(h) Item 14 (Description of Amendment/Modification).

(1) Organize amendments or modifications under the appropriate Uniform Contract Format (UCF) section headings from the applicable solicitation or contract. The UCF table of contents, however, shall not be set forth in this document

(2) Indicate the impact of the modification on the overall total contract price by inserting one of the following entries:

(i) Total contract price increased by $ .....

(ii) Total contract price decreased by $ .....

(iii) Total contract price unchanged.

(3) State reason for modification.

(4) When removing, reinstating, or adding funds, identify the contract items and accounting classifications.

(5) When the SF 30 is used to reflect a determination by the contracting officer of the amount due in settlement of a contract terminated for the convenience of the Government, the entry in Item 14 of the modification may be limited to --

(i) A reference to the letter determination; and

(ii) A statement of the net amount determined to be due in settlement of the contract.

(6) Include subject matter or short title of solicitation/contract where feasible.

(i) Item 16B. The contracting officer's signature is not required on solicitation amendments. The contracting officer's signature is normally affixed last on supplemental agreements.

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0015

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 1 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0015.

2. The due date for submission of the technical proposal is extended to 7 July 2016 at 1 PM EST.

   The technical and pricing proposals are both due on 7 July 2016 by 1 PM EST.

   Note: Electronic submission via email of the technical and pricing proposal is acceptable. If sending via emails please provide one (1) copy of the technical proposal and one (1) copy of the pricing proposal as a separate file.

   If providing the technical and pricing proposal on CD through delivery via Federal Express or similar service please provide five (5) copies of the technical proposal and one (1) copy of the pricing proposal.

3. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

4. Drawing E-221-B First Floor Equipment – Segment B is incorporated with this amendment.

5. Drawing E-225-B Penthouse – Segment B is incorporated with this amendment.

6. Drawing E-503 – Electrical Power Details is incorporated with this amendment.

7. Drawing E-702 –Mechanical Connections Schedule is incorporated with this amendment.

8. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
268	23054800.4	Specification 23054800.40 states "Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers" However the point lists on the M-600 series control diagrams indicates that some equipment (Chillers, EF-16 various pumps and some fans) do not have vibration accelleromters. Please clarify, do the chillers and other listed fans and pumps require these devices or not?	All Fans are as indicated on the drawings and each one over 7HP is required to have a vibration accelerometer. All pumps are as indicated on the drawings and each one over 7 HP is required to have a vibration accelerometer. Chillers are not required to have vibration accelerometers. Cooling Towers are required to have accelerometers. All AHUs are required to have vibration accelerometers if the fans are over 7 HP. Heat exchangers are not required to have vibration accelerometers.
353	07 27 10.00 10, 07 21 13	Spec Secton 07 27 10.00 10, Paragraph 1.7 eludes to the air leakage rate as specified in Section 07 21 13. There is no air leakage rate data available in this section. Typically, NASA follows the USACE air leakage testing protocol of .25cfm/75Pa for Architectural Testing and anywhere from .30cfm/75Pa to .40cfm/75Pa for Architectural Plus HVAC Testing. Please advise.	The air barrier shall have an air permeance of 0.004 CFM/sq.ft. @ 75 Pa or less and shall be tested according to the USACE air leakage testing protocol.
365	Landscaping	Detail 1 on Drawing L202 has incorrect references. Detail 2 /L403 refers to the west Taylor courtyard bio retention planter #5 elevation, but is shown on the north side of the building. Detail 6/L403 refers to 1268 knee wall that does not seem to belong to the bioretention planter. Please confirm that these details are incorrect. Are there 1268 knee walls on the north side of the building? If so specify quantities and location.	Detail call-outs are incorrect. 2/L403 is the elevation for Planter #5. The single knee wall associated with the 1268 entry is documented with details 1/L403 and 6/L403. Refer to the plans for the details regarding the planter walls along the north side of the building.
366	Civil	On drawing CS101, key note 10 and 23 refer to a concrete walk. Note 10 refers to the landscape drawings which show a pedestrian grade concrete paving detail (detail 1 on L503). Note 23 refers to D5/CG503. This detail does not exist. Please provide detail or confirm that note 10 and 23 both refer to detail 1 on L503.	Notes 10 and 23 on CS101 should refer to 1/L501. Note 24 on sheet CS101 should refer to CG503 - D3 REINFORCED CONCRETE PANEL.
367	Landscaping	Pa (Polystichum Acrostichoides) may be mislabeled on detail 5 of sheet LP203. Should they be Pd (Phlox divaricate 'Blue Moon')? On center spacing of Pa does not match the quantity when the area is taken off, however if the Pd spacing is used in the Pa call out area, the quantities do match. Please clarify.	Quantity of Pa should be reduced to match the designated spacing of 12" o.c.
368	Landscaping	Ps (Phlox Subulata) quantities appear to be incorrect. Should they be 18" oc instead of 6" because the quantities are off significantly?	If gallon size are to be used then the spacing can be at 18" o.c., otherwise the number shown on the plant schedule shall be distributed amongst the planting areas at approximately 6" o.c. spacing.
369	Landscaping	QF (tree) shown on sheet LP202 is not listed in the plant schedule. Please provide information on what this tree is.	See response to #291.
370	Landscaping	QA (Quercus Alba) is listed in the plant schedule but not shown in the plans. Please advise.	See response to #291.
371	Landscaping	22 QP (Quercus Phellos) are taken off from the LP drawings but only 3 are listed in the plant schedule. Please advise.	Plans take precedent when showing quantities for trees and shrubs shown by individual symbols.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
372	Landscaping	Drawing L202, Detail 1 refers to 1268 Courtyard Enlargement. Drawing L403, Detail 2 refers to the West Taylor Courtyard Bioretention Planter #5 elevation, but is shown on the North side of the building. Detail 6/L403 refers to 1268 knee wall that does not seem to belong to the bioretention planter. Please confirm that these detail references are correct. Are there knee walls on the North side of the building similar to the one in 268 Courtyard? If so specify quantities and location.	See response to # 365.
373	28 20 01.11 10	Specification section 28 20 01.00 10, 1.3.1 provides information on the Central Station. 3.2.4 states [redacted] (b) (5) [redacted] a. Is the existing Central Station to be replaced? Or is this a redundant second Central Station or is this a local workstaiton in the base wide system? b. If the Central Station is to remain, What make, type and version is the existing equipment and software?	The existing Central Station is to [redacted] (b) (5) [redacted] Per paragraph 3.2.4, perform a field survey, including testing and inspection of all existing system equipment and DTS intended to be incorporated into the system. System components shall be [redacted] (b) (5) [redacted] The contactor shall verify the software and relevant hardware versions from the government during the survey.
374	28 23 23.00 10	Specification section 28 23 23.00 10m 2.8.3 indicates "software shall be compatible with existing". What make, type and version is the existing software?	Per specification 28 20 01.00 10, paragraphs 2.3 and 2.6 the existing software is (b) (5)
375	27 41 16, 2.4	Specification section 27 41 16, 2.4 references Lifesize Icon as the approved manufacturer for the VTC Codecs in Room 107A, 107B, 217, 317, 417. Is is acceptable to provide an "or equal" to the Lifesize? Would Cisco VTC or Polycom be viable options?	No, Lifesize Icon is the Government standard VTC system.
376	27 41 16, 1.2	Specification section 27 41 16, 1.2 indicates "custom programmable handheld remote controller" for Team Rooms (System A), Huddle Rooms (System D), Think Tank (System E), Corridor Display (System F). These types of remotes require additional external control processors and infrastructure to function that are not identified in the documents. a. Can the custom programmable handheld remotes be eliminated in these rooms and control be handled by the included display remotes? b. If the custom programmable handheld remotes are required, please provide additional information for a complete system.	Handheld remotes supplied with the displays for Systems A, D, E, F can be used provided they can control all intended functionality and will be user friendly.
379	Section 12 24 13	Paragraph 2.1.1.b. calls for Front Fascia. RCP General Note 13 indicates: Provide recessed roller shade and pocket at all perimeter glazing. Which is correct? Are the shades mounted below ceiling with a front fascia or above ceiling in recessed shade pocket?	See response to # 347.
380	Section 12 24 13	Paragraph 2.1.1.e. Housing: Match ceiling color. Please advise if a standard color housing is acceptable or if we will need to account for custom painting the fascia/pocket throughout the project.	See response to #348.

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381	Reflected Ceiling Plans A-111A through A-115B	General Note 13 indicates: Provide recessed roller shade and pocket at all perimeter glazing. Ceiling Legend shows a graphical representation of WT-1 and WT-2 on the RCP drawings, however, this graphical representation appears to be inconsistent and extremely illegible. 1. Can an architectural annotation be provided on the RCP drawings showing the designation (WT1, WT2) of the shade required? 2. Can the Finish Schedule be updated to provide a column/remark for each room indicating what perimeter window treatment type (WT1, WT2) is required for that space? 3. The Electrical Equipment Drawings show motorized shade locations and groups. This is the most thorough representation of this scope I have seen on the drawings. Can a similar representation of scope be provided on the Architectural Drawings? 4. Regarding ALL perimeter glazing. There are numerous rooms that do not appear to require shades. Examples: H1A, H1D, H1F, H2A, H2C, H2F, etc. Please clarify if literally “ALL” perimeter glazing is to be covered by this scope, or if there is a better way of describing this requirement on the drawings.	See responses to #349 & 350.
383	230923.132	230923.132 3.3.1 Storage Cabinets states the following: "In each project mechanical room, provide a wall-mounted metal storage cabinet with hinged doors. In addition to the number of manuals specified above, provide an additional copy of the manuals in each of these mechanical room storage cabinets. Provide cabinets large enough to hold the entire set of Controls System Operators Manuals, and the HVAC operation and maintenance manuals provided under Division 15 MECHANICAL. Locate cabinets adjacent to DDC control panels where applicable. Have each cabinet's proposed installation site approved in advance by the Contracting Officer and the BAS Owner. Prominently label each cabinet with the wording "OPERATION AND MAINTENANCE MANUALS." Prominently label each binder with the wording "MECHANICAL ROOM COPY - DO NOT REMOVE."" Please confirm this section is to remain part of the project / contract requirements.	See response to #266.
384	Amendment 0009 - RFI 223	Please provide glazing types for W1 and W2 shown on A604	W1 and W2 shall be GL-6 per SECTION 08 81 00 / 2.1.7
388	236400	Absorption Chiller: There are no domestic manufactreres of absorption chillers. If Buy American is applicable to this project, please confirm the packaged absorption chiller is exempt from compliance.	To the extent that certain equipment is not available domestically, please comply with the procedures outlined in 52-22511 Buy American —Construction Materials under Trade Agreements (MAY 2014). See C101 The Agreement.

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392	Drawing A-731, Detail 1	1. Drawing A-731, Detail 1 – One note references stainless steel reveal molding for drywall applications. All other notes in this detail and others for vertical & horizontal reveal molding refer to aluminum trim, including the note to meet or exceed trim as manufactured by Fry Reglet, who fabricates this trim in aluminum. Can all drywall trim be furnished as aluminum?	All drywall reveal trim can be furnished as aluminum.
396		Drawings M-609: Note 3. States "Provide LCP Room Controller (1 Per every 2 labs). Currently, no LCP Room Controller locations were found on the floor plans. Typically there is one LCP Room Controller per lab. Please provide locations of ALL LCP Room Controllers.	See response to # 338.
403		Please provide enlarged section and veneer/cap requirements for retaining walls shown on 3 and 4/L401 at 1268 Courtyard.	Walls shown in section on details #3 and #4/L401 are cast in place concrete, short retaining walls with 3/4" chamfered tops, refer to grading plan and structural detail #13/S-504.
404	Amendment 0006 - RFI 31	As was stated in RFI#31, Room 128 is not a clean room. The Reflected Ceiling Plan does not designate which type of ceiling this is. On the Electrical Lighting Sheet E-201A the lighting is designated to be B4 which according to the Electrical Lighting Fixture Schedule on Sheet E-700 is a clean room lighting fixture compatible with the clean room ceiling system. Is Room 128 to receive a flush grid type ceiling? Is the CRM responsible for providing this lighting fixture?	Room 128 is not a cleanroom - it is to be an exposed ceiling to structure above with type B3 light fixtures. There will be a total of (18) B3 type fixtures in Room 128 in lieu of the (15) Type B 4 fixtures currently indicated on drawing E-201.
405		Please specify the wall type 1S714S as noted in room 156 (Conditioned Storage Common) on the north and west walls. It is not specified on the partition schedule on A-611.	1S714S is to follow the same construction as 1S714, but will add a minimum of 3" of SAFB to achieve STC 56 (min).
406		Please specify the wall type 0S778S as noted in room 160A (Secure Work Area) on the west and south walls. It is not specified on the partition schedule on A-611.	This wall type is indicated on A-611 (0S, Non-Rated Steel with foil backed gyp bd), but will be adjusted to match the following: This partition is to be constructed with 6" studs with 2 layers of 5/8" foil backed gyp board on both sides of stud, 3 1/2 SAFB to achieve STC rating of 50 min (test # RAL-TL11-080). The requirement for 3/4" mesh is to be eliminated from this wall type. - This wall is to be installed at following locations: o West and south wall @ Secure Team Room 160B o West and south wall @ Secure Work Area 160A o South wall @ Secure Work Area Vestibule 160

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407		Please specify the wall type 1S778S as noted in room 160A (Secure Work Area) on the north wall. It is not specified on the partition schedule on A-611	Wall type 1S778S is to be constructed similar to 0S778S partition type (see Response to #406.), but with [redacted] (b) (5) [redacted]. This wall is to meet STC rating of 50 min (test # RAL-TL11-080) UL Listing U-407 - This wall is to be installed at following locations: o North walls @ Secure Work Area 160A o North and East wall @ Secure Team Room 160B
409	Drawing M-609	Note 3. States "Provide LCP Room Controller (1 Per every 2 labs). Currently, no LCP Room Controller locations were found on the floor plans. Typically there is one LCP Room Controller per lab. Please provide locations of ALL LCP Room Controllers.	See response to # 338.
415	23054800.4	Specification 23054800.40 states "Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers" However the point lists on the M-600 series control diagrams indicates that some equipment (Chillers, EF-16 various pumps and some fans) do not have vibration accelerometers. Please clarify, do the chillers and other listed fans and pumps require these devices or not?	See response to #268.
421	LS-001	A note under the Chemical Storage Room notes states to provide a 4" berm for spill containment. Please provide description/section of berm.	The berm is to be provided via a 4" slab depression to be 'filled' with a grating material - see A-101B for general slab depression dimensions and A-701 for grating material designation.
422	L503	Please provide more information on Detail 6 Artifact Display. The only thing defined is the 3" SS post and clips. What is the depth of the footing? What reinforcing is required? Who provides the panels/lettering/logo? What is the basis of design?	The panels are an artifact to be provided by NASA and the detail shows the intent for the display. The final design of the footings will be the Contractor's responsibility through sealed shop drawings.
425	Sheet A-519	Is there a basis of design for the removeable insulated metal panel closure w/handles and the manually operated steel interlocked sliding port door at the laser port shown in Detail 9/A-519?	The removable panels are to be custom made for the particular location. The interlocked sliding port doors are to be custom per the Laser Interlock Manufacturer as noted in 28 40 02 / 2.2.9
427	Sheet A404	Rigid insulation is only shown at the first floor level at the edge of slab (thickness transitions) in Wall Sections 3 and 5. Please confirm rigid insulation is not required at levels 2, 3 and 4.	Rigid insulation is required as indicated on detail drawings - see the A-500 series.
428	Sheets A-401 through A-404 and A-511 through A-513	Wall Sections and Enlarged Sections show rigid insulation under the slab and, in some cases in the enlarged details, show it turned down at the foundation wall. The insulation is not mentioned in the structural drawings. Please advise how far from the edge of slab to carry the rigid insulation and how far down the foundation wall. 7/A-511 is the only callout for the type of rigid insulation, calling out INS4. Section 07 21 13, paragraph 2.1.3.h. defines INS4 as Curtainwall Insulation. Is this what is to be provided under the slab? What thickness?	Insulation types are as indicated on A-301. Insulation is to be carried a minimum of 3'-0" under the slab from the inside face of the foundation or turn-down. Vertically, it is to be carried to the bottom of concrete at a turn-down condition or a minimum of 3'-0" from finished grade at all other locations.
429	Section 01 23 60	Please clarify what is to be the finish floor at the stairs if the Deduction Alternate 2 is taken.	The finish is to be as indicated.

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430	RFI 15	Please provide brick specification for the required brick to match Building 1268 at the knee walls.	Brick to match existing - samples are to be provided by the GC during construction.
431	A-740	Provide enlarged head/sill/jamb details for Interior Sections 1 and 2 to indicate what the dichronic glass panels are set into. Section 1 indicates (2) 5/8" Gyp Bd. Is gypsum board the finish material at the opening?	As indicated on 1/A-740, the dichroic panels are to be top/bottom channel set.
436	10 22 43	The sliding glass partitions are shown on 101A, 102A, 103A, and 104A. RFI 47 indicates there should be 8 panels on the first floor and 9 panels on the second-fourth floors. Please clarify the size of each panel (width, and height or height above the finish floor)	See response to #200.
437	08 91 00 and 07 42 13	Spec sections 08 91 00 and 07 42 13 reference L2-L9. Drawing A-604 and the elevations have L1-L11 Please confirm L1, L10, and L11 match the specs L2-L9. Please also confirm that these are to be metal wall screens and not a louver in the typical sense.	Confirmed. L1-L11 shall all match the specs for L2-L9 as indicated in 07 42 13 / 2.6.5.
439	Air Barrier Testing	Paragraph 1.7 of specification 072710.0010 eludes to the air leakage rate as specified in Section 07 21 13. Section 2.2.1.b. of specification 072113 calls for the air barrier membrane to have an air permeance of < 0.00001 L/Pams2s per ASTM E2178. Typically, NASA follows the USACE air leakage testing protocol of .25cfm/75Pa for Architectural Testing and anywhere from .30cfm/75Pa to .40cfm/75Pa for Architectural Plus HVAC Testing. Please confirm the air leakeage rate as this information is critical in order to prepare a correct bid.	See response to #353.
441	A-301	Under exterior wall types on sheet A-301 all the details show INS2 insulation except for deatil L1 which shows INS3. Please confirm this is an error and that insulation behind all the metal panels and terracotta is to be type INS2.	Confirmed. All insulation behind the metal panels and terracotta is to be type INS2.
443	RFI 23 Amendment 6 - Dichroic Mobile	Please confirm that per detail 3/A-433, the mobile will have 11, 6" wide clear acrylic panels with dichroic film. Also please confirm the lengths of these panels. Otherwise for pricing purposes, bidders will assume all 11 panels to be 40 feet long per the information on detail 3/A-433.	Per 3/A-433, the mobile will consist of 11 ceiling hung cables with acrylic panels of varying length. Contractors to assume 220 total acrylic panels with a mixture of dichroic film colors 1&2. Panels will be a combination of 1', 2', 3', and 4' tall panels for a total of 480LF of 6" wide acrylic with dichroic film.
446		A-610 has a detail ' "P" Modifier- Partial Height Wall'. However, no _P modifier walls could be located on architectural drawings. Please confirm no partial height walls occur in this project	Walls are as indicated on the Floor Plans

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448	Drawings: E-301 E-401 E-405 E-406	Drawing E-405 indicates [redacted] (b) (5) [redacted] Are we to assume that the transformer feeders should be sized as indicated on E-405? [redacted]	Reference Drawing E-401 - [redacted]
449	13 20 00	Will the backside of the return air chase walls (labeled as '1S812S' and '1S714S'), shown on the architectural drawings, outside of the cleanroom wall panels require to be lined with cleanroom liner wall panel system (i.e. 1/4" aluminum skins)? Or will the metal stud/drywall partitions be coated with an epoxy paint?	Backside of architectural air chase walls, shall be coated with epoxy paint.
451	A-701	Refer to sheet A-701 for the MWP-1 metal panel. The schedule calls this panel to be aluminum plate with 1/4" diameter perforations, however does not specify the percentage of perforations. Please confirm percentage as this will impact pricing. Without a response, bidders intend to bid assuming 25% perforations.	MWP-1 shall be 20% Open Area - perforations shall be in straight rows at 1/2" centers.
452	11/ A-514	Refer to detail 11/A-514 where it calls for 6" of insulation behind the metal panels in lieu of the standard 3". Please confirm what the insulation thickness needs to be at this location? Otherwise bidders will assume 3" as that is shown as the standard insulation thickness for metal panel wall and soffit assemblies on sheet A-301.	11/A-514 is a section detail - provide insulation as indicated in the detail.
455	M-609:	Drawing M-609 Note 3. States "Provide LCP Room Controller (1 Per every 2 labs). Currently, no LCP Room Controller locations were found on the floor plans. Typically there is one LCP Room Controller per lab. Please provide locations of ALL LCP Room Controllers.	See response to # 338.
458	Door Schedule	The door schedule states "minimum STC 45". Since this is a competitive bid, please confirm this is meant to be STC 45 and nothing higher.	Confirmed.

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460	05 50 13, 26 56 00, L503, E-401	Specification Section 05 50 13, 2.9 states: "Provide 8 inch galvanized and prime coated Schedule 40 steel pipe as specified in ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi." Specification Section 05 50 13, 3.10 states: "Set bollards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi." Specification Section 26 56 00, 2.2 LED Luminaires and 2.2.1, sub paragraph d General Requirements indicates "Bollards" a Luminaire Efficacy in Lumens per Watt of "35" and sub paragraph f states: "Housing finish shall be baked-on enamel, anodized, or baked-on powder coat paint. Finish shall be capable of surviving ASTM B117 salt fog environment testing for 2500 hours minimum without blistering or peeling." Drawing L503, Detail 3 refers to a "decorative bollard" which is depicted as a straight pipe bollard with a scaled diameter measuring approx. 5.75". Drawing E-401 does not indicate wiring extending to bollard locations. Please confirm which specification section should be followed as well as confirm bollard type, bollard finish, and luminaire requirements.	Only bollards utilized on project are at the cooling tower for 1268 at the MSL loading area. See response to #54.
463	Architectural, Laboratory Drawings	Detail 6 on A-731 shows a 5" zone for unistrut between column lines B and C. The structural and laboratory drawings do not show unistrut P3200 series concrete inserts or overhead structural frames between column lines B and C. Please confirm that unistrut inserts and overhead structural frames do not occur between column lines B and C.	Regularly spaced Unistrut inserts in the slabs (similar to the laboratories) are not required between column lines B and C, however, systems running in the Utility Corridors are to be Unistrut supported from the slab above as required.
464	Q-401	Please advise if the section shown in detail 3B on Q-401 is a typical section for all overhead structural frames throughout the building.	Yes. Refer to each discipline as indicated in the detail for scope of work for additional details and dimensions.
467	Section 13200	Spec 13 20 00: Will the backside of the return air chase walls (labeled as '1S812S' and '1S714S'), shown on the architectural drawings, outside of the cleanroom wall panels require to be lined with cleanroom liner wall panel system (i.e. 1/4" aluminum skins)? Or will the metal stud/drywall partitions be coated with an epoxy paint?	See response to #449.
468	P-111A	Drawing P-111A at domestic water riser symbol DW/3 there is a note #15 and this note states there is 3"CW/1-1/2"HW/3/4" HWR at this riser location. Enlarged plan drawing P-301 detail #4 has a note #8 at riser DW/3. This note states 2-1/2"CW/1-1/4'HW/3/4" HWR. On drawing P-402 at domestic water riser labeled DW/3 at this location the pipe sizes on level #1 piping sizes are 1-1/4" CW/1-1/4'HW/3/4"HWR. What drawing is correct for sizing this domestic water riser piping. Please clarify.	Note 15 on P-111A states the correct sizes of the piping that serves the entire riser, up & down. Drawing 4 on P-301 note 8 is correct. P-402 has an incorrect pipe size for the cold water, it should read 2-1/2" feeding up to level 2.
469	P-111B	Drawing P-111B at mechanical pump room 159, lower right corner shows a line exiting this room and is labeled 4" on detail #1/P-300 then 3" tees off this line and a 1-1/2' tap. Drawing P-300 detail #3 and drawing P-402 shows a 2-1/2' line. Is it safe to assume this 1-1/2' line shown on drawing P-111b is to be 2-1/2"? Please clarify.	The pipe size shown on P-402 is correct. The CW branch that serves riser DW/1 is incorrectly labeled as 1-1/2" on P-111B and should read 2-1/2".

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222	01 23 60	Deduct Alternate #8 Achieve LEED Silver. This deduct allows the Contractor to reduce LEED points shown on the LEED Scorecard, but please specify which ones are not to be deducted such as Enhanced Commissioning. We are sure the Government does not want to delete enhanced commissioning. Please clarify the credits that must remain. Also many of these credits require NASA input such as Green Power and ID: Greenguard Furn/ Green Housekeeping/ Education. Need to know if the NASA will be participating in these.	For the purposes of Deduct Alternate #8, the contractor shall limit the eliminated credits to those for which the contractor would have been responsible had the option not been awarded. The contractor is required to comply with all system performance requirements as detailed in the project drawings and specifications. Savings may be associated with reducing the administrative burden of LEED documentation for points not required to be submitted to achieve only LEED Silver certification. For example, activities associated with MRc2 Construction Waste Management may be eliminated entirely, or may be performed by the GC but not documented for LEED purposes. The contractor shall assume that NASA will provide Green Power and Greenguard Housekeeping
279	Response to RFI 09	The response to RFI 09 states that this project is subject to ISC Standard, Physical Security Criteria for (b) (5) and that the project has been designated (b) (5) Per GSA's guidelines for shatter resistant window protection for (b) (5) the assumed air blast load is (b) (5) (b) (5) While the window wall needs to be designed to resist the blast load, is it correct to also assume that the structural studs supporting the window wall system will also need to be designed (1) TO RETAIN THE WINDOWS WITHIN THE OPENING, IN THE EVENT OF A BLAST, AND (2) THAT THESE STRUCTURAL STUDS MUST BE DESIGNED TO INCORPORATE THE BLAST REACTIONS OCCURRING AT EACH WINDOW ANCHOR?	(b) (5)
346	13 20 00	Please confirm the Government owns and is responsible for all the base building design that serves and surrounds the clean rooms, including but not limited to MEP equipment located in the (b) (5); the Government also owns the user related design, including but not limited to user related electrical & telecomm., IDS, and process piping for tools & equipment provided by the Government. Please confirm that the clean room contractor owns the clean room environment design including all components of the envelope, including the filter fan units with HEPA filters, and lighting, not the epoxy flooring.	The Government does own and is responsible for all of the base building design. We believe that the question refers to the division of scope between the General Contractor and Sub-Contractors/Suppliers. The intent is for a turn-key single-source responsibility for the cleanrooms through the General Contractor. .
355	08 11 16	Reference response to RFI #9. Please confirm that the use of (b) (5) will be an acceptable method for achieving the required level of blast protection. Please also confirm that a window security film is not required if laminated glass is used.	(b) (5) as specified in the contract drawings, is acceptable for meeting the (b) (5) requirements for blast resistance of windows per the ISC Physical Security Criteria. (b) (5)

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390	236410.2.6.7	Air Cooled Chiller: The specifications call for -10F freeze protection of the air-cooled chiller, and glycol is not mentioned in either the mechanical schedules nor the mechanical specifications. Please confirm if glycol is being utilizied in the system or if the system will be protected with heat trace, electric heat, and insulation. If glycol is in the system, please confirm which type and what percentage.	No glycol shall be used. The Contractor shall provide insulation and heat tracing of the water piping outside of the building.
393	Drawing A-404, Detail 5	2. Drawing A-404, Detail 5 – Four windows, approximately 2'x26', are located at each level in an exterior lt. ga. metal framed wall. The 26' horizontal break in the wall structure does not provide the necessary support without adding structural steel framing. Will additional design information be provided for these walls?	Provide an HSS8x4x3/8 frame around the ribbon window in the toilet rooms at each level. Horizontal HSS8 girts will be located within the 8" light-gage wall which will frame to HSS8 columns at each end of the ribbon window.
400	Amendment 0012 - RFI 274	Please confirm contractor is to carry the cost of the Green Power in our pricing.	The Contractor is not required to carry the cost of green power in its bid. NASA will provide green power.
401	Amendment 0010 - RFI 356	Is the allowance for the WISE3R Lab for material only or material, taxes, freight, insurance, and labor to install?	The allowance breakdown is as follows: Base Bid is $1,535,000; Options include Estimated Freight at $56,000; Access Control Readers ($1,635 x 3 sliding doors) $4,905; Signal Filter (For FA in Control Room) ($4,550 x 1 signal filter) is $4,550. Refer to ETS proposal included in the WISE3R design package.
402		Elevations 3/L402 & 4/L402 for the Bioretention Planters 3 & 4 conflict with Section 1/L502. Please Clarify. It appears on the elevations that you have a Cast Stone Coping and Cast Stone Panels similar to what is shown on Section 3/L502 are shown. However, Section 1/L502 shows only a monolithic block with no precast panels. Please clarify.	The elevations 3/L402 and 4/L402 should show the monolithic condition similar to the detail 1/L502.
408		Booster pump detail and schedule call for horizontal pumps which look to be end suction closed coupled but spec calls for vertical multistage. Additionally, schedule calls for 475 gpm capacity…is this for each pump or the system? The schedule shows 20HP…I ask this because if they want 475 gpm split across pumps then I can provide 2 ea 10 HP. If they want each pump to be 475 gpm, I need to use the 20HP pump. Also I need a different header system (your piping connections) based on 475 gpm total or 950 gpm total.	The elevations 3/L402 and 4/L402 should show the monolithic condition similar to the detail 1/L502.
434	Response to RFI 09	Please refer to page 44 of GSA's PBS Leasing Desk Guide, Attachment 4, Security Requirements for [redacted] (b) (5) The contract documents indicate all exterior glass to have an inboard laminated glass with 0.60 interlayer. When reviewing page 44 of the above mentioned GSA document it appears that shatter resistant glass make up can be: 1. As shown on the drawings 2. Using the 7 mil security film without any laminated glass 3. Laminated glass plus the 7mil security film. Please provide clarification. Otherwise all bidders will inlcude only the glass make up as shown on the contract documents.	The laminated glass, as specified in the contract drawings, is the selected [redacted] (b) (5) .

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435	A-101B and 2/A-403	Please provide a detail for how the chain-link fence is connected to the CMU at the equipment rooms shown on A-101B	Upper most cells of the cmu walls are to be fully grouted. Provide a 1/2" magnitude crown at the centerline of the block to facilitate drainage. Chain link posts are to be embedded into the top of the CMU cells and fully grouted. Minimum embedment = 8".
440	Response to RFI 09	Please refer to page 44 of GSA's PBS Leasing Desk Guide, Attachment 4, Security Requirements for (b) (5). There appear to be two options. Option 1 is to [redacted] (b) (5) [redacted] (b) (5) [redacted].This does not affect the curtainwall framing. Option 2 is to [redacted] (b) (5) [redacted] (b) (5). Please clarify if either option can be used or if both options need to be used as this will greatly affect pricing from suppliers.	See response to #434.
445		Please Confirm the Key Personnel who will attend the Oral Presentation. The RFP required the Offeror to provide the resumes of these team members. • Offeror's Principal In Charge/Project Executive • Construction Project Manager • Construction Superintendent • Construction MEP Coordinator • Quality Control Manager • Safety Coordinator • BIM Coordinator and Document Manager • LEED Accredited Professional	The following Key Personnel at a minimum shall attend the Oral Presentation: Offereor's Principal in Charge/Project Executive; Construction Project Manager; Construction Superintendent; Construction MEP Coordinator; Quality Control Manager; BIM Coordinator and Document Manager.
450	84 40 00	There are no requirements for hurricane impact in the psecifications, however the building appears to be right on the caost. Please confirm that there is no hurricane requirement. Without a response, all bidders intend to bid based on the low level blast and exclude any hurricane requirements.	The project is not in a hurricane zone so there are no specific hurricane design requirements applicable to the building. It is, however, subject to wind design requirements which are slightly higher for projects in this area.
454		Plumbing Booster pump detail and schedule call for horizontal pumps which look to be end suction closed coupled but spec calls for vertical multistage. Additionally, schedule calls for 475 gpm capacity…is this for each pump or the system? The schedule shows 20HP…I ask this because if they want 475 gpm split across pumps then I can provide 2 ea 10 HP. If they want each pump to be 475 gpm, I need to use the 20HP pump. Also I need a different header system (your piping connections) based on 475 gpm total or 950 gpm total.	Vertical multistage pump or end suction pump may be provided as required by the application to meet the pump duty point and specified horsepower. Pump to be provided shall fit within the room and space allotted. Each pump shall meet the scheduled capacity for a 100%/100% duplex system.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
461	Structural, Laboratory Drawings	Drawing Q-301D shows an overhead structural frame in room 169. Structural drawing S-102B does not show unistrut P3200 series concrete inserts in this area. Please advise if an overhead structural frame is required in this area. If the frame is required, please advise if the P3200 insert system shall be installed in this area for attachment or provide alternate attachment details.	The overhead structural frame is required in Room 169. Inserts will be included in the structural slab, similar to the other labs, for this area.
470	P-100A & P-100B	On drawings P-100A, P-100B there is a piping system tagged SSD which on drawing P-001 states this system to be sub soil drain or footing drain. Specification 22 00 00-3.14 table I does not list this system. What material is required for this?	Subsoil drainage piping materials shall be the same as underdrain piping materials. Refer to specification 33 40 00 paragraph 2.3.1.2 for underdrain piping materials.
472	Section 096723.13	Section 096723.13 specifies a 3/16" trowelled mortar topping using walnut shell aggregate for the EP-1 finish but the Finish Schedule references Sikafloor 200 ESD product by name which is only a 15-18 mil thick coating. Do they want a 3/16" topping or the 18 mils thick coating?	The Sikafloor 200 ESD 4-part system is the Basis of Design. The total thickness will be made-up of all parts of the system, not just the top-coat.
473		There are several notes in the Resinous Terrazzo Spec section #096623 referencing "Cove" terrazzo base (parg 2.12), but all details on the plans show "Straight – stack on" (detail #9/A-610) terrazzo base, which is correct?	Terrazzo base is to be straight.
474		1. Per RFI response #61 all doors in STC rated partitions are to have a minimum STC45 rating but wall types1X914, 2X714, and 2X914 only have STC43 ratings. Do doors in these walls still need STC45 ratings?	1X914, 2X714, and 2X914 are all shaft wall assemblies. No doors should be located in these wall-types.
475		2. There are walls with doors that do not have a wall type designation. Please advise the wall type that should be used so we can determine if a STC door will be required for that location.	Please provide the door numbers or room numbers where these instances occur.
477	01 50 00.34, E Pest Control	Specification Section 01 50 00,.34 E states "Obtain extended warranty for Contracting Officer." Please provide explanation meaning of this requirement for Pest Control. It is not typical for the contractor to provide warranty of general condition item such as Pest Control.	The General Contractor will be required to address any pest control issues for one year beyond substantial completion.
485	Amendment 11	Amendment 11 was provided with a revised Base Bid GC Price Proposal Form that included a $1,600,455.00 allowance (Spec Division: 13b Drawings RQ & Spec 132754). As part of Amendment 13, ETS-Lindgren proposal002-15-0086144-1664-4 dated June 14, 2016 was included with the following clarifications: 1) Proposal excludes as-built drawings (can be provided for an additional cost), 2) Pricing is based on ETS-Lindgren non-union labor (open shop) onsite / no prevailing wage, and 3) Price excludes sales tax, freight, performance bonds, permits or fees relating to permits, plan checks, customs or other fees unless stated otherwise. Additional clarifications are included in the ETS-Lindgren proposal. Please confirm that the Base Bid allowance is inclusive of all contract requirements.	The General Contractor will be required to incorporate all as -built drawings from ETS-Lindgren into the final BIM. The allowance and ETS-Lindgren's proposal outlines their work, all to be incorporated under the Genenral Contractor's contract. All other contract terms and conditions shall apply.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
486	Amendment 11	Amendment 11 was provided with a revised Base Bid GC Price Proposal Form that included a $ 1,600,455.00 allowance (Spec Division: 13b Drawings RQ & Spec 132754). As part of Amendment 13, ETS-Lindgren proposal 002-15-0086144-1664-4 dated June 14, 2016 was included. Please confirm that the Amendment 13 drawings and specification changes take precedence over the ETS-Lindgren proposal?	ETS-Lindgren proposal dated June 14, 2016 is included in Amendment 13.
487	01 83 00.07 40	Specification 01 83 00.08 40 paragraph 3.3.1.b references specification section 01 35 40.00 20. This specification could not be located. Please provide.	The correct citation should be to specification 01 35 40.00 41.
488		Due to the amount of RFIs (over 430), please confirm that the drawings and specifications will be updated and provided upon notice to proceed.	Confirmed. A conformed set of documents will be issued to the successful bidder after contract award.
491		Is it the intent for the EP-1 finish to extend under the modular Clean Rooms of the 1st Floor prior to installation of the Clean Rooms; Rooms 100, 104, 104A, 108A, 108B, 112, 118 and 118A?	The epoxy flooring shall be completed prior to installation of the clean room walls.

(b) (5)

[redacted]

REVISIONS					REVISIONS				
Date	No.	Description	Issued By	Issued To	Date	No.	Description	Issued By	Issued To
06/17/2016	1	REVISION 1							

SEAL

(b) (6)

[redacted]

THOMAS KENT SMITH
Lic. No. 021638
COMMONWEALTH OF VIRGINIA
PROFESSIONAL ENGINEER

LANGLEY RESEARCH CENTER

3101 Wilson Boulevard, Suite 900
Arlington, Va. 22201

ISSUE DATE: -

GSA PROJECT NO. GS-03P-08-DX-D-0019

AECOM PROJECT NO. 60281742

APPROVALS				
NAME	ORGANIZATION	DATE		DATE
			DRAWN	
			DESIGNED	
			CHECKED	
			APPROVED	
			TECH. PROJ. ENG.	
			RES. PROJ. ENG.	

TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE: ANGULAR ± X.XX (2 DECIMAL PLACES) ±.02; X.XXX (3 DECIMAL PLACES) ±.005

SURFACE FINISH IN MICROINCHES RMS UNLESS SHOWN OTHERWISE

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA 23681-2199

PROJECT TITLE: MEASUREMENT SYSTEMS LABORATORY

DRAWING TITLE: FIRST FLOOR - EQUIPMENT - SEGMENT B

BUILDING NO.: B2104

SHEET SIZE: ARCH E1

DRAWING NO.: E-221B

NASA DRAWING NO.:

LATEST REV.: 1

6/28/2016 9:29:42 AM

(b) (5)

[redacted]

REVISIONS					REVISIONS				
Date	No.	Description	Issued By	Issued To	Date	No.	Description	Issued By	Issued To
06/17/2016	1	REVISION 1							

SEAL

(b) (6)

[redacted]

THOMAS KENT SMITH
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GSA

NASA
LANGLEY RESEARCH CENTER

AECOM
3101 Wilson Boulevard, Suite 900
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ISSUE DATE: -

GSA PROJECT NO. GS-03P-08-DX-D-0019
AECOM PROJECT NO. 60281742

APPROVALS				
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			DRAWN	
			DESIGNED	
			CHECKED	
			APPROVED	
			TECH. PROJ. ENG.	
			RES. PROJ. ENG.	

TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE: ANGULAR ± X.XX (2 DECIMAL PLACES) ±.02; X.XXX (3 DECIMAL PLACES) ±.005

SURFACE FINISH IN MICROINCHES RMS UNLESS SHOWN OTHERWISE √

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA 23681-2199

PROJECT TITLE: MEASUREMENT SYSTEMS LABORATORY

DRAWING TITLE: PENTHOUSE - EQUIPMENT - SEGMENT B

BUILDING NO.: B2104
SHEET SIZE: ARCH E1
DRAWING NO.: E-225B
NASA DRAWING NO.:
LATEST REV.: 1

6/28/2016 9:52:06 AM

(b) (5)

[redacted]

REVISIONS					REVISIONS				
Date	No.	Description	Issued By	Issued To	Date	No.	Description	Issued By	Issued To
06/17/2016	1	REVISION 1							

SEAL

(b) (6)

[redacted]

THOMAS KENT SMITH
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COMMONWEALTH OF VIRGINIA
PROFESSIONAL ENGINEER

ISSUE DATE
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GSA

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LANGLEY RESEARCH CENTER

AECOM
3101 Wilson Boulevard, Suite 900
Arlington, Va. 22201

GSA PROJECT NO. GS-03P-08-DX-D-0019
AECOM PROJECT NO. 60281742

APPROVALS				
NAME	ORGANIZATION	DATE		DATE
Author			DRAWN	
Designer			DESIGNED	
Checker			CHECKED	
Approver			APPROVED	
			TECH. PROJ. ENG.	
			RES. PROJ. ENG.	

TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE
ANGULAR ±
X.XX (2 DECIMAL PLACES) ±.02
X.XXX (3 DECIMAL PLACES) ±.005
SURFACE FINISH IN MICROINCHES RMS UNLESS SHOWN OTHERWISE

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA 23681-2199

PROJECT TITLE: MEASUREMENT SYSTEMS LABORATORY

DRAWING TITLE: ELECTRICAL POWER DETAILS

BUILDING NO. B2104
SHEET SIZE ARCH E1
DRAWING NO. E-503
NASA DRAWING NO.
LATEST REV. 1

6/28/2016 9:53:53 AM

(b) (5)

[redacted]

REVISIONS					REVISIONS				
Date	No.	Description	Issued By	Issued To	Date	No.	Description	Issued By	Issued To
06/17/2016	1	REVISION 1							

SEAL

(b) (6)

[redacted]

THOMAS KENT SMITH
Lic. No. 021638
COMMONWEALTH OF VIRGINIA
PROFESSIONAL ENGINEER

ISSUE DATE

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GSA

NASA

LANGLEY RESEARCH CENTER

AECOM

3101 Wilson Boulevard, Suite 900
Arlington, Va. 22201

GSA PROJECT NO. GS-03P-08-DX-D-0019

AECOM PROJECT NO. 60281742

APPROVALS				
NAME	ORGANIZATION	DATE		DATE
Author			DRAWN	
Designer			DESIGNED	
Checker			CHECKED	
Approver			APPROVED	
			TECH. PROJ. ENG.	
			RES. PROJ. ENG.	

TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE: ANGULAR ±; X.XX (2 DECIMAL PLACES) ±.02; X.XXX (3 DECIMAL PLACES) ±.005

SURFACE FINISH IN MICROINCHES RMS UNLESS SHOWN OTHERWISE √

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA 23681-2199

PROJECT TITLE: MEASUREMENT SYSTEMS LABORATORY

DRAWING TITLE: MECHANICAL CONNECTIONS SCHEDULE

BUILDING NO.: B2104

SHEET SIZE: ARCH E1

DRAWING NO.: E-702

NASA DRAWING NO.:

LATEST REV.: 1

6/28/2016 9:54:48 AM

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0016	07/01/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICITATION NO.
	☐	9B. DATED *(SEE ITEM 11)*
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED *(SEE ITEM 13)*
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

INSTRUCTIONS

Instructions for items other than those that are self-explanatory, are as follows:

(a) Item 1 (Contract ID Code). Insert the contract type identification code that appears in the title block of the contract being modified.

(b) Item 3 (Effective date).

(1) For a solicitation amendment, change order, or administrative change, the effective date shall be the issue date of the amendment, change order, or administrative change.

(2) For a supplemental agreement, the effective date shall be the date agreed to by the contracting parties.

(3) For a modification issued as an initial or confirming notice of termination for the convenience of the Government, the effective date and the modification number of the confirming notice shall be the same as the effective date and modification number of the initial notice.

(4) For a modification converting a termination for default to a termination for the convenience of the Government, the effective date shall be the same as the effective date of the termination for default.

(5) For a modification confirming the contacting officer's determination of the amount due in settlement of a contract termination, the effective date shall be the same as the effective date of the initial decision.

(c) Item 6 (Issued By). Insert the name and address of the issuing office. If applicable, insert the appropriate issuing office code in the code block.

(d) Item 8 (Name and Address of Contractor). For modifications to a contract or order, enter the contractor's name, address, and code as shown in the original contract or order, unless changed by this or a previous modification.

(e) Item 9, (Amendment of Solicitation No. - Dated), and 10, (Modification of Contract/Order No. - Dated). Check the appropriate box and in the corresponding blanks insert the number and date of the original solicitation, contract, or order.

(f) Item 12 (Accounting and Appropriation Data). When appropriate, indicate the impact of the modification on each affected accounting classification by inserting one of the following entries.

(1) Accounting classification .....
Net increase $ .....

(2) Accounting classification .....
Net decrease $ .....

NOTE: If there are changes to multiple accounting classifications that cannot be placed in block 12, insert an asterisk and the words "See continuation sheet".

(g) Item 13. Check the appropriate box to indicate the type of modification. Insert in the corresponding blank the authority under which the modification is issued. Check whether or not contractor must sign this document. (See FAR 43.103.)

(h) Item 14 (Description of Amendment/Modification).

(1) Organize amendments or modifications under the appropriate Uniform Contract Format (UCF) section headings from the applicable solicitation or contract. The UCF table of contents, however, shall not be set forth in this document

(2) Indicate the impact of the modification on the overall total contract price by inserting one of the following entries:

(i) Total contract price increased by $ .....

(ii) Total contract price decreased by $ .....

(iii) Total contract price unchanged.

(3) State reason for modification.

(4) When removing, reinstating, or adding funds, identify the contract items and accounting classifications.

(5) When the SF 30 is used to reflect a determination by the contracting officer of the amount due in settlement of a contract terminated for the convenience of the Government, the entry in Item 14 of the modification may be limited to --

(i) A reference to the letter determination; and

(ii) A statement of the net amount determined to be due in settlement of the contract.

(6) Include subject matter or short title of solicitation/contract where feasible.

(i) Item 16B. The contracting officer's signature is not required on solicitation amendments. The contracting officer's signature is normally affixed last on supplemental agreements.

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0016

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 1 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0016.

2. Correction of SF 30 for Amendment 0015. SF 30 should read 0015 in Block 2 Amendment/Modification No.

3. All other terms and conditions remain unchanged.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0017	07/04/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	
	☐	9A. AMENDMENT OF SOLICITATION NO. 9B. DATED *(SEE ITEM 11)*
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO. 10B. DATED *(SEE ITEM 13)*
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
292		Clarify existing concrete removal? (see Picture Attached) .This existing structure does not appear to be identified on the contact drawings. Please clearify what it is and if we are resonsable to remove or if it is remain in place.	This is the remaining portion of an existing grade beam from recently demolished Building 1192-E (see sheet CD101). This grade beam bridges an electrical controls duct bank. It remained in place only to prevent damage to the duct bank while still active. Duct bank and grade beam are scheduled to be demolished by the GC after relocation of controls cabling (see sheets CD105 and E-400).
344	General	Can the Government please confirm that if a Tower Crane was utilized for this project the foundation pad, as well as piles and pile caps if required, for the Tower Crane could remain in place after the completion of work?	A tower crane foundation located within the MSL building footprint, not interfering with any existing or proposed utilities/building elements, and below an elevator shaft or mechanical shaft can remain in place after project completion. A tower crane foundation in a location not meeting the criteria above would need to be removed upon completion. Location to be approved by NASA prior to installation.
394		In regards to the clean room... I'm pretty sure the walls and ceilings will be by a single sourced clean room contractor, however in doing some research on that system, they have the option to provide all related items within the clean rooms, which also includes fan filter units (there are several) and return grilles that would normally be provided by us. I'm wondering...should I exclude all clean room fan filter units (FFU) and/or Return Registers with Pre-filters (RR), as they will be provided by the clean room manufacturer? (They are scheduled on the mechanicals.)	Fan filter units shall be provided by the clean room manufacturer. All other mechanical items shall be provided by the mechanical contractor including return registers with pre-filters.
395		Booster pump detail and schedule call for horizontal pumps which look to be end suction closed coupled but spec calls for vertical multistage. Additionally, schedule calls for 475 gpm capacity…is this for each pump or the system? The schedule shows 20HP…I ask this because if they want 475 gpm split across pumps then I can provide 2 ea 10 HP. If they want each pump to be 475 gpm, I need to use the 20HP pump. Also I need a different header system (your piping connections) based on 475 gpm total or 950 gpm total.	Assuming the referenced "booster pump" is the process water pump, the schedule calls for a total of 360 GPM split between 2 pumps of equal size. The 220 feet of head is based on end user equipment usage needs. The scheduled 20 HP is the maximum acceptable.
397		Drawings M-603 through M-607: Please verify the intent of the smoke control sequence on pages M-603 through M-607. Is the FACP to open/close all fire/smoke dampers? Is the BAS system to be [redacted] (b) (5) [redacted] Typically the BAS system will be (b) (5) [redacted] (b) (5) [redacted]	[redacted] (b) (5) [redacted]

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
410	Drawings M-603 through M-607	Please verify the intent of the smoke control sequence on pages M-603 through M-607. Is the FACP to open/close all fire/smoke dampers? Is the BAS system to be [redacted] (b) (5) [redacted] ? Typically the BAS system will be [redacted] (b) (5) [redacted] (b) (5) [redacted]	See response to #397
413	Section 13 20 00 - Paragraph 2.1.1.	Will the clean room subcontractor be responsible for the provision and installation of components related to the mechanical system that serve the clean rooms (MAU-1, S/A & R/A ductwork, clean room coils, condensate/drip pans, BAS control wiring and/or components, HWR/CWR piping and components, condensate piping, etc.) ? Or is this work to be performed by the appropriate mechanical subcontractors and coordinated with the clean room subcontractor?	The mechanical contractor is responsible for providing and installing all mechanical system components that serve the clean rooms except for the fan filter units which should be provided by the clean room contractor. The clean room contractor is responsible for approving the installation of work completed by the mechanical contractor and coordinating points of connection. The clean room contractor is responsible for all controls integration and all space requirements per the specifications, including, but not limited to filtration, temperature, and humidity.
414	Section 13 20 00 - Paragraph 2.1.1.	If the provision and installation of the aforementioned mechanical components and ancillary items are the clean room subcontractor's responsibility, where are the start/stop points of connection for components entering and exiting the clean room envelope (i.e. cw/hw piping, control related wiring, etc) that are sourced from or serving other spaces and/or components outside of the clean room envelope?	See RFI 413.
417	236400	Absorption Chiller: There are no domestic manufactreres of absorption chillers. If Buy American is applicable to this project, please confirm the packaged absorption chiller is exempt from compliance.	See RFI 388.
419	236410.2.6.7	Air Cooled Chiller: The specifications call for [redacted] (b) (5) [redacted] protection of the air-cooled chiller, and glycol is not mentioned in either the mechanical schedules nor the mechanical specifications. Please confirm if glycol is being utilizied in the system or if the system will be protected with heat trace, electric heat, and insulation. If glycol is in the system, please confirm which type and what percentage.	See RFI 390.
426	Sheet A-519	Please confirm the aperture plates at the laser port are O/O.	Contractor to supply (1) solid blank aperture plate per opening, along with all manufacturer information for future procurement of aperture plates that are compatible with and fit into the installed units. All future aperture plates to be Owner supplied.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
456	M-603 - M-607	Drawings M-603 through M-607: Please verify the intent of the smoke control sequence on pages M-603 through M-607. Is the FACP to open/close all fire/smoke dampers? Is the BAS system to be [redacted] (b) (5) [redacted] (b) (5) Typically the BAS system will be (b) (5) [redacted] (b) (5) [redacted]	See response to #397
465	Structural, Laboratory Drawings	Drawings Q-202A and Q-205A show hoist points and reference the architectural drawings. However, hoist points are not shown on the architectural drawings. Can details for this work be provided as they are not shown on the referenced drawings.	See S-106B for Rooftop Lab Hoist Point. Second floor Hoist Points are to be removed from Q-202A. Owner to use Owner-supplied mobile A-frame hoist.
466	Section 13200	Section 01 23 60; Amendment 10, Reference RFI 253 response - Please confirm that any required changes to the MEP supporting systems beyond the scope of the cleanroom envelope will be handled as a change order since the full scope has not been provided or determined.	Changes to the general building systems to support Add Alternate #2 per 01 23 60 are not currently anticipated. Any changes beyond the single-source turn-key cleanroom assembly and the directives in 01 23 60 would be considered a Change Order.
471	236410.2.6.10	Please confirm capacity (gallons) of tank for air-cooled chiller tank module.	See the schedule for the expansion tank size of the chilled water system.
476	230923.132	Is the cost for the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1? The paragraph 2.1.1 states to provide a [redacted] (b) (5) [redacted] RFI#140 answer did not address what are the integration requirements of the paragraph 2.1.1. RFI#246 answer states integration is to be done after commission and functional testing - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Amendment 11 bid form option 23c states price for [redacted] (b) (5) [redacted] - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Deduct Alternate #10 states to [redacted] (b) (5) [redacted] - - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. Is the cost for the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1?	1. The cost for [redacted] (b) (5) [redacted] with the [redacted] (b) (5) [redacted] shall be itemized per deduct alternate 10. 2. Per NASA, the [redacted] (b) (5) [redacted] (b) (5) [redacted] (b) (5) [redacted] 3. Per NASA, the integration must be done prior to commissioning and functional testing, this shall supersede the response in RFI #140. 4. The cost for [redacted] (b) (5) [redacted] (b) (5) [redacted] shall be itemized per Deduct Alternate 10.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
490	230923.132	M-608 Sequence of Operation indicates that SF-14 and EF-15 are to operate in a CFM matching fashion. No Air Flow measuring stations appear to be in the plans or schedules. Please clarify how this is to be accomlished and that No Ari Flow Stations are required.	SF-14 and EF-15 setpoints shall be established durring HVAC balancing according to the control sequence on M-608. Air Flow Stations are not required.
498	09 67 23.13	Please address the discrepancy between the system shown on the finish legend which is "Sikafloor 200 ESD" (a high build electostatic dissipative epoxy coating) and the system detailed in spec 096723.13 which is a standard 3/16" thick trowel-applied epoxy system that has no ESD properties. Which system is required?	See response to #472.
505	236410.2.6.10	Please confirm capacity (gallons) of tank for air-cooled chiller tank module.	See response to #471.
506	230923.132	Is the cost for the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1? The paragraph 2.1.1 states to provide a [redacted] (b) (5) [redacted] (b) (5) [redacted] RFI#140 answer did not address what are the integration requirements of the paragraph 2.1.1. RFI#246 answer states integration is to be done after commission and functional testing - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Amendment 11 bid form option 23c states price for [redacted] (b) (5) [redacted] (b) (5) [redacted] this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Deduct Alternate #10 states to [redacted] (b) (5) [redacted] - - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. Is the cost for the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1? The paragraph 2.1.1 states to provide a [redacted] (b) (5) [redacted] (b) (5) [redacted] RFI#140 answer did not address what are the integration requirements of the paragraph 2.1.1. RFI#246 answer states integration is to be done after commission and functional testing - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Amendment 11 bid form option 23c states price for [redacted] (b) (5) [redacted] (b) (5) [redacted] - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Deduct Alternate #10 states to [redacted] (b) (5) [redacted] - - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1.	See response to #476.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
514	13 27 54	RF Shielded Room 466 is noted as NIC on the Q-403 Equipment Schedule. Meta Materials (Elec EM Shielded) Room 224 and Meta Materials (Elec Acoustic Shielded) Room 226A are not listed on the Q-403 Equipment Schedule. Please confirm whether we are to include the cost of these enclosures per Section 132754—Electromagnetic & Radio-Frequency (EM/RF) Shielding in our bid.	RF Shielded Room 466A within Room 466 is existing equipment EQ-274. Relocation of this room is NOT part of this contract. It is listed in the equipment list as NIC for coordination purposes. The only EM/RF shielded room that is part of the Contract is Room #224. Scope of work for this room is described in spec section 132754. Shielded Chamber Facility in Room 170 (170A, 170D, 170E) is handled separately per the RQ series and other documentation.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0018	07/05/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED (SEE ITEM 11)
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0018

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 5 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0018.

2. Please be advised that the due date for the submission of the Phase II pricing proposal is extended to 14 July 2016 at 4 PM EST.

The technical proposal due date shall remain unchanged with technical proposals due by 7 July 2016 by 1 PM EST.

Note: Electronic submission via email of the technical and pricing proposal is acceptable. If sending via emails please provide one (1) copy of the technical proposal and one (1) copy of the pricing proposal as a separate file.

If providing the technical and pricing proposal on CD through delivery via Federal Express or similar service please provide five (5) copies of the technical proposal and one (1) copy of the pricing proposal.

3. Department of Labor General Decision Number: VA160101 05/06/2016 VA101 is incorporated with this amendment.

4. All other terms and conditions remain unchanged.

General Decision Number: VA160101 05/06/2016 VA101

Superseded General Decision Number: VA20150101

State: Virginia

Construction Type: Building

County: Hampton* County in Virginia.

*INDEPENDENT CITY

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the solicitation was issued on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.15 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016
1	01/15/2016
2	01/22/2016
3	04/15/2016
4	04/22/2016
5	05/06/2016

BOIL0045-004 01/01/2016

	Rates	Fringes
BOILERMAKER	$ 31.92	25.21

BRVA0001-004 07/01/2013

	Rates	Fringes
BRICKLAYER	$ 19.00	8.13

CARP0613-008 05/01/2015

	Rates	Fringes
CARPENTER	$ 22.05	2%+9.56

ELEC1340-010 12/01/2015

	Rates	Fringes

ELECTRICIAN.....$ 26.00 12.15

ENGI0147-024 11/01/2013

	Rates	Fringes
Power equipment operators:		
Cranes 90 tons & over capacity; Tower & Climbing Cranes with Controls 100 ft. above ground	$ 28.30	8.69%+8.15
Cranes under 90 tons	$ 27.38	8.69%+8.15
Forklift	$ 23.58	8.69%+6.55

IRON0079-010 01/01/2016

	Rates	Fringes
IRONWORKER, STRUCTURAL	$ 25.00	14.28

LABO0351-003 06/01/2010

	Rates	Fringes
LABORER (Mason Tender Brick)	$ 13.85	5.55

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* PLUM0540-007 05/01/2016

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe & System Installation)	$ 26.75	15.38
PLUMBER	$ 26.75	15.38

SHEE0100-038 07/01/2015

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation)	$ 21.93	15.37

SUVA2010-106 09/20/2010

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 23.29	10.09
CEMENT MASON/CONCRETE FINISHER	$ 17.75	3.08
IRONWORKER, ORNAMENTAL	$ 24.00	10.16
LABORER: Common or General	$ 10.07	1.69
LABORER: Landscape	$ 10.64	0.00
LABORER: Mason Tender - Cement/Concrete	$ 12.96	3.12
LABORER: Pipelayer	$ 14.44	2.35

METAL BUILDING ERECTOR	$ 15.75	2.07
OPERATOR: Backhoe	$ 17.67	3.15
OPERATOR: Bobcat/Skid Steer/Skid Loader	$ 15.62	2.40
OPERATOR: Bulldozer	$ 21.50	4.80
OPERATOR: Excavator	$ 16.43	4.82
OPERATOR: Loader	$ 20.63	4.80
OPERATOR: Mechanic	$ 18.23	1.59
OPERATOR: Roller	$ 21.50	4.80
PAINTER: Brush and Roller	$ 17.34	5.59
PAINTER: Spray	$ 21.01	6.91
ROOFER	$ 21.55	7.01
TILE FINISHER	$ 17.32	6.72
TILE SETTER	$ 21.12	7.68
TRUCK DRIVER: Dump Truck	$ 13.25	1.80

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were

prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0019	07/06/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)		(X)	9A. AMENDMENT OF SOLICITATION NO.
		☐	9B. DATED (SEE ITEM 11)
		☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
			10B. DATED (SEE ITEM 13)
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0019

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 6 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0019.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
161	32 62 13.20	Specification Section 31 62 13.20 - 3.4.1 states that test piles are to be ordered 10 feet longer than production piles. The drawings and specifications currently do not show or indicate length of production piles other than to state in 31 62 13.20 - 1.2.1 that piles are to be driven to a minimum depth of 60 feet below existing grade. Should it be assumed that all production piles are to be a length of 60 feet or more. The length of production piles is typically determined from the results of the driving and test analysis of the test piles. The requirements of the test piles is typically derived from the Geotechnical Report. Please provide length of the production piles if available. If production length is not available please provide a copy of the Geotechnical Report so that the requirements of the test piles can be determined.	The length of production piles is to be determined by the results of the test pile program. Per the July 23, 2014 geotechnical report issued by GET, the estimated embedment depth of the piles is 60 feet below existing grades. The final order lengths and tip elevations will be adjusted based on the results of the test piles and load test programs. Reference GET geotechnical report for additional information.
354	S525	Reference detail 4/S525. This detail shows a typical pile cap including dowels in the top of the piles. Specific information regarding the dowel size, quantity per pile, embedment, grout, etc. could not be located. Please provide.	Provide (4) #7 dowels in corrugated metal sleeves cast into the top of the precast piles (at corner locations). Dowels shall have a 90 degree hook in the pile cap with a minimum embedment depth of 24" above the top of the pile into the pile cap. Dowels shall be cast into the sleeves with non-shrink, non-metallic grout with a minimum compressive strength of 7,000 psi. Dowels shall extend a minimum 6'-9" into the pile.
363	01 23 60	Based on the interpretation of the bid options and understanding of the specification the utilization of onsite cut for fill material is acceptable. Specification 31 23 00.00 41, 2.4 states "The Contractor shall obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property." Required undercutting below proposed subgrade is not part of the Base Bid and will be accounted for on a Unit Price basis (Bid Item 0001D Removal and Replacement of Unsuitable Soil with Backfill and Fill Materials). Can the Government please confirm that this interpretation is correct.	Confirmed.
364	S525	Reference detail 4/S525. Please confirm that it would be acceptable to install sleeves in the top of the precast piles for future installation of the pile cap dowels. Dowels would be installed in the sleeves and grouted as indicated in the detail on S525. Please confirm.	See response to RFI #354.
377	27 41 16	Please confirm that any furniture / tables being supplied by the governement will have connection / boxes for telecom and/or audiovisual inputs integral to the furniture. The Contractor will not have to modify or cut boxes into furniture / tables.	Confirmed.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
382	Section 31 23 00.00	Status of classified/unclassified materials onsite: Paragraph 2.4 BORROW states, "The Contractor shall obtain borrow materials required in excess of those furnished from excavations..." Bid Item 0001D indicates "Removal and replacement of unsuitable soil with backfill and fill materials" as a Unit Price distinct from the Base Bid. We interpret from our reading of the specifications and the bid form that utilization of onsite cut for fill material is acceptable as a basis for the Base Bid and undercutting below proposed subgrade is not included in the Base Bid and will be accounted for on a Unit Price adjustment if added to the contract. Please confirm if this is not the case.	See response to RFI 363.
399		236410.2.3.f: For the centrifugal water cooled chiller, the variable frequency drive references specification 262923. This specification does not match up to the variable frequency drive, integral to centrifugal chillers. Should this section be removed or a different specification provided for such? Sample Chiller Variable Frequency Specification: (b) (5) [redacted]	The chiller manufacturer shall provide a VFD that is compatible with the chiller. The chiller VFD shall include [redacted] (b) (5)

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
412	Section 23 64 10	Paragraph 2.3.f: For the centrifugal water cooled chiller, the variable frequency drive references specification 26 29 23. This specification does not match up to the variable frequency drive, integral to centrifugal chillers. Should this section be removed or a different specification provided for such?	See response to #399.
423	Section 05 52 00	This section offers a short description of the stainless steel and glass railings. Is there a basis of design the GSA wants to meet?	See the A-400 series for stainless steel and glass railing configuration. Synergi Minima Square was used as the general basis of design with some custom modifications.
424	Amendment 0002	The floor plan revisions for the WISE3R lab in Amendment 0002 are impossible to read. Please provide a replacement sheet A-101B.	Please see Amendment 0013.
433	Sheet S-105A and S-105B	Stud rails are shown on Sheet S-105B along column line D. Are the required to continue along the same column line in Segment A of the Penthouse Framing Plan? None are shown here.	Stud rails are only required at locations indicated in plan.
442	Air Barrier Testing	It is unclear if the entire building/ test envelope will be subject to Architectural Only Pressurization, Depressurization Test and Architectural Plus HVAC System Pressurization, Depressurization Test. Please clarify which areas of the building get the Architectural Only Test and which ones would get the Architectural Plus HVAC System Test.	The air barrier shall have an air permeance of 0.004 CFM/sq.ft. @ 75 Pa or less and shall be tested according to the USACE air leakage testing protocol. Architectural only testing shall be conducted on floors 1 through 4 and shall have an air leakage rate less than 0.25 CFM/sq. ft. @ 75 Pa. Architectural plus HVAC system test shall be conducted on the 5th floor and shall have an air leakage rate less than 0.30 CFM/sq.ft. @75 Pa.
453		Should the clean room fan filter units (FFU) and Return Registers with Pre-filters (RR) be provided by the mechanical contractor and not the clean room manufacturer? Some of the clean room manufacturers can also furnish them. Can this be done either way?	See response to #413.
462	Structural, Laboratory Drawings	Drawing Q-503 shows an overhead structural frame in room 564. At other locations, the frame is supported from embedded unistrut P3200 series concrete inserts. However, the roof structure in this area is concrete on metal deck. Can details for this work be provided as they are not shown on the referenced drawings?	Provide a 1-5/8" unistrut channel spanning on top of the bottom chord of the bar joists at 6'-0" on center maximum. Provide a grid of 1-5/8" unistrut hung from 1/4" threaded rods to provide required frame capacities per laboratory equipment drawings. Refer to manufacturer documentation concerning recommended attachment methodologies of unistrut system with threaded rods hung from bar joists systems.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
478	31 62 13.00 Test Pile Quantity	The response to RFI 164 states "Provide 8 test piles as indicated in the geotech report." This does not coincide with the Geotech Report Section 4.6.3 which states "The test program should involve at least five (5) test piles to provide an indication of various driving and/or installation conditions." Additionally, Specification Section 31 62 13.00 3.4.3 "Perform compressive load test on 5 test piles in accordance with ASTM D1143/D1143M (standard loading procedure) as modified herein." Specification Section 3.4.4 also states "Perform tensile load tests on 1 test piles in accordance with ASTM D3689, as modified and in paragraph LOAD TESTS. Per the Geotech Report and specifications there is a total of five (5) test piles are required for the Dynamic Load Test. Also noted in the specifications there is a total of six (6) test piles required for the static load test (i.e. 5 compressive and 1 tensile). Please confirm the total quantity of test piles required for dynamic load test (PDA). Please confirm the quantity and type of static load tests (i.e. compressive or tensile) that are to be performed on test piles. Please confirm that the static load test can be performed on the same test piles installed for the dynamic loads test (this scenario would require 1 additional test pile for the static (tensile) load test). In lieu of the scenario noted above confirm that 6 additional test piles are not required for static load test.	Provide 5 test piles per Section 4.6.3 of the geotechnical report dated July 23, 2014 and Specification Section 31 62 13.20 3.4.3 for compression load testing. Provide 1 test pile per Section Specification Section 31 62 13.20 3.4.4 for tensile load testing. Dynamic load testing shall be applied on all test piles receiving static load tests.
479	31 62 13.00 Test Pile Quantity	Please confirm that if Bid Item 0001C Pile Load Test (i.e. Static Load Test) is requested to be performed by the Contracting Officer that this test will be performed on one of the Test Pilings provided under Bid Item 0001B. Please confirm that a separate test pile will not be needed to be driven for Bid Item 0001C. Please confirm the number of test piles required.	See response to #478.
480	32 62 13.00 Test Pile Requirements	The original question submitted in RFI 166 inadvertently switched the terms Dynamic Load Test (PDA) and Static Load Test. The question should have read: "Per discussions with the precast / prestressed concrete piles subcontractors it does not appear that it is typical for a precast pile project to utilize a static load test. Static load tests are expensive and time consuming and are not applicable for precast piles. Can the requirement for a static load test be deleted from the specification requirements given that a static load test is the more applicable test for precast piles? This would appear to be in line with the recommendation of the Geotechnical Engineer per Geotech Report 4.6.4 Dynamic Testing. If the Static Load Test requirement is removed from the specifications confirm that this would delete Bid Item 0001C.	Provide static load tests per specification 31 62 13.20 Section 3.4 requirements.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
481	01 22 00 Test Pile Unit Price	Bid Item 0001B requests a unit price for Test Piling and Bid Item 0001C requests a unit price for Pile Load Test. Please confirm that the unit cost for Bid Item 0001B Test Piling shall include the cost for the test pile, driving the test pile, and performance of the dynamic load test (PDA) only. Please confirm that Bid Item 0001C shall include the cost to perform a Static Load Test only.	Bid items 0001B and 0001C shall include all costs necessary to provide foundation piling and pile load testing in accordance with the drawings and specifications per 00 22 13 paragraph 1.1.
482	01 22 00 Test Pile Unit Price	Please confirm that the cost for a geotechnical consultant is not to be included in the unit cost for Bid Items 0001B and 0001C. Please confirm that all cost for the geotechnical consultant requirements in Specification 31 62 13.00 1.6.4 is to be including in Bid Item 0001A.	Bid item 0001B shall include the cost of an independent geotechnical engineer per 31 62 13.20 paragraph 1.6.4. Bid item 0001C shall include the cost of an independent geotechnical engineer per 31 62 13.20 paragraph 3.4.3. In specification 31 62 13.20 paragraph 3.4.1, fourth sentence, delete the word "Government" so that the sentence reads: "The Contractor's Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation or necessary driving resistance."
483		Please provide detail information on the layout spacing for all "Future Owner Use" Unistrut Inserts, called for on the structural drawings, Note No. 14. This information is required to determine the quantity of inserts.	Concrete Framing Plan Note #14 reads "Provide unistrut P3200 series concrete insert system at 6'-0" o.c. in the concrete slab soffit above the laboratories. Reference lab zoning layout plans and layouts on architectural and laboratory drawings for additional information."
484		Please provide additional information on the Unistrut Series P3200 inserts. Numerous part numbers for inserts are under the Series P3200 insert.	Unistrut system shall be ordered to provide required load capacity requirements per laboratory drawing requirements.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
494	Wage Determination	The wage determination provided does not include a glazier classification. Please advise which wage classification applies to this trade.	The project wage determination does not contain a classification for a glazier. Contractors must follow FAR Part 22.406-3 -- Additional Classifications. (a) If any laborer or mechanic is to be employed in a classification that is not listed in the wage determination applicable to the contract, the contracting officer, pursuant to the clause at 52.222-6, Construction Wage Rate Requirements, shall require that the contractor submit to the contracting officer, Standard Form (SF) 1444, Request for Authorization of Additional Classification and Rate, which, along with other pertinent data, contains the proposed additional classification and minimum wage rate including any fringe benefits payments.
495	Amendment 13	Note 2 on drawing RQ-004 (ETS-Lindgren drawing RF1) states "1 1/4' fiberglass grating supported by angles around perimeter of chambers. Cut around filters as needed (by GC)" Please clarify the extent of the grating, i.e. does it occur around and between all shielded chambers. Also, please support details and section cuts.	Grating to extend full-length along the south side of Chamber A. GC to provide 2"x2"x1/8" steel angles to the south face of the shielded chamber as well as along the face of concrete to support the fiberglass grating. Grating to be 1" in lieu of 1 1/4" deep. See 06 73 01 for grating product information.
499	E-001, E-303, E-304	The three line busway located in the center of the rooms shows a [redacted] (b) (5) [redacted]	There are no "Wall Mounted" busways. All of the wall mounted systems are a surface mounted raceway housing multiple circuits and outlets. It is the intent that each Busway mounted overhead in the center of the various labs have a [redacted] (b) (5) [redacted] (b) (5) The symbol on Drawing E-001 (open square box) will be updated to reflect this intent.
501	10 14 01	Reference details 11 and 12 on drawing A-623. Please provide additional information about the laminated glass, clear outer panel, and core shown for the body of the sign i.e. what material, thickness, color, etc.	Note on detail 12/A623 referring to glass panel should read "Two (2) sheets of 1/2" thick clear acrylic with 1st surface graphics. Slides into internal track, is clipped and bolted into place, and is edge lit with LEDs set in sliding track."
503	Sheet S-555	Detail 5 show embeds in the CIP Concrete for the Glass Marker Board System. Alternate 3 deletes the Glass Marker Board System and related structure. In this alternate do we also delete the embeds in the structural slab or leave in for future use?	Yes, the embeds in the slab supporting the sliding glass markerboard structural support would also be deleted as a part of Deduct Alternate 3.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
507	Section 01 33 29	We respectfully request the price proposal due date be changed to July 14 at 4:00 p.m. ET. Should contracting not grant this request, we ask that the time of price proposal receipt be extended to 4:00 pm ET on July 7 in lieu of 1:00 pm.	Please see amendment 0018.
513		Sheet Q-203D indicates whiteboards are required at Flight Software 356 and refers to Architectural Drawings. There are no whiteboards shown on the Architectural Drawings in this area. If required, please provide elevation and/or size.	Whiteboards, as shown on Q-303E are to be the following sizes: 1/Q-303E: 24'-0" wide x 5'-0" tall 5/Q-303E: 18'-0" wide x 5'-0" tall & 6'-0" wide x 5'-0" tall Whiteboards are as specified in 10 10 00.
516		I have reviewed the bid documents including 14 amendments for the flooring and ceramic tile. The finish plans on drawings A-711A through A-715B show that the toilet rooms are to receive terrazzo floor and base with paint for the wall finishes. On drawing A-410 and A-411, the elevations show ceramic wall tile. Is the wall tile to be included in the base bid? Is the wall tile to be included as part of Deduct Alternate #2? Please advise.	See response to RFI #052.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0020	07/07/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE | FACILITY CODE

(X)	
	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED (SEE ITEM 11)
	10A. MODIFICATION OF CONTRACT/ORDER NO.
☐	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0020

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 7 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0020.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. On the Bid Form, Base tab, line 13b, change the description from "Drawings RQ & Spec 132754 (Allowance)" to "RQ Drawings & ETS Report (Allowance)".

4. All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
438	75423	Please refer to section 3.4.2 Manufacturer's Inspection of the specification 075423. 6/16/2016 (b) (3) (A) 75423 "Please refer to section 3.4.2 Manufacturer's Inspection of the specification 075423. It is unclear from the above if the manufacturer's representative is required to be present full time or is to make a site visit once a week. Please clarify as the manufacturer's fees will vary depending on what is required.	07 54 23 / 3.4.2 will be modified to read as follows: 3.4.2 Manufacturer's Inspections Manufacturer's technical representative shall visit the site a minimum of three site visits. The visits shall occur during initial commencement, at a midpoint of the installation, and at substantial completion, at a minimum, with the exception that follow-up inspection(s) of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the Roofing Contractor to the Contracting Officer within three (3) working days. The report shall note overall quality of work, deficiencies and any other concerns, recommended corrective work.
444	-	On sheet A-701, FWP note says "for performance requirements, refer to spec section..." but no spec section is given. Please provide performance requirements and specifications for FWP-1 fabric wall panels.	The following information will be added to the Specifications: 09 84 33 SOUND-ABSORBING WALL UNITS Tackable Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core. 1. Panel Shape: Flat.; 2. Mounting: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.; 3. Core: Glass-fiber board.; 4. Edge Construction: Manufacturer's standard chemically hardened core with no frame.; 5. Edge Profile: Eased (small radius).; 6. Corner Detail in Elevation: Square with continuous edge profile indicated.; 7. Facing Material: Seamless Tackable, as scheduled on Finish Legend.; 8. Nominal Overall Panel Thickness: As indicated on Drawings.; 9. Panel Width: As indicated on Drawings.; 10. Panel Height: As indicated on Drawings. Fire-Test-Response Characteristics: Units shall comply with [redacted] (b) (5) [redacted]

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
459	Sound Attenuation Blanket	The drawings reference Sound Attenuation Blanket however the specifications do not reference any requirements for this material. Please provide specification requirements for the Sound Attenuation Blanket materials that are referenced in the documents.	The following information will be added to 09 29 00 GYPSUM BOARD - PART 2 PRODUCTS: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. 1. Fire-Resistance-Rated Assemblies: Comply with [redacted] (b) (5)
489	230923.1320 237313.0040	The Sequence of Operation located on M-601 for LABs AHUs states the following: [redacted] (b) (5) Please clarify if dampers D-1 through D-5 are to be UL listed as Smoke Damper Assemblies.	[redacted] (b) (5)
493	230923.132	M-603 Note indicates Smoke Damper controls by Div. 26 FA, Sequence of operations on M603 plans are unclear as to who is cotnroling these dampers.. Please confrim Div. 26 Fire Alarm Contractor is responsible for the comand and control fo these dampers.	Fire Alarm system shall [redacted] (b) (5)
508	Section 13 20 00 - Paragraph 2.1	Para 2.1 (last para) states that the contractor is responsible for connecting FFUs, cooling coils, MUA-1, etc to the BAS system. Should this read that the cleanroom contractor is responsible for connecting these items to the cleanroom control system, which then connects to the BAS? Please confirm.	Cleanroom manufacturer is responsible for the BAS (controls) of the cleanrooms (and all integration with the building controls).
509	Section 13 20 00 - Paragraph 2.5.1	What manufacturer is the basis of design for these filters? Can find no manufacturer that uses no organic materials.	Filters in the fan filter units shall be provided by the cleanroom manufacturer.
510	Section 13 20 00 - Paragraph 2.6	Section 13 20 00, para 2.6 is confusing. This paragraph indicates "contractor" is to provide cooling coils and "manufacturer" is to provide condensate piping to nearest storm riser. Please clarify – is "contractor" referring to the cleanroom contractor and "manufacturer" to the mechanical contractor?	The cleanroom manufacturer shall provide the FFUs. The mechanical contractor shall provide the cooling coils. The cleanroom manufacturer shall approve the installation of the cooling coils. See RFI-413 response.
511	Section 13 20 00 - Paragraph 2.11	Please clarify – is "manufacturer" the cleanroom contractor? The work being performed appears to be mechanical contractor scope.	See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
512	Section 13 20 00 - Paragraph 2.11	Also, unclear as to cleanroom contractor ductwork scope. I see no indication on the ductwork drawings of where cleanroom contractor scope ends and mechanical contractor scope begins.	See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.
515		Drawing M606, Cleanroom Sequence of Operation o Item C-1 – please confirm that changing the exhaust airflow consists of adjusting flow speed of the VV unit.	The VAV for the supply and exhaust in the cleanrooms are controlled as constant volume boxes. See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.
517		Revision 13 Drawings have reissued Drawings E-221B and E-225B that contain missing information. It is like the amendment is transposed on to an incomplete design development drawing. Some of the new information in the changes is also incomplete with the symbols nomenclature. Attached drawings showing the missing information.	See Amendment 15.
518		RFI response 475 they asked for a list of door numbers where the wall type was not clearly identified. Here is the list I came up with. 119A, 127A, 127B, 157C, 159B, 163B, 169B, 170C, 170E, 190, 200-A, 200-C, 227C, 267-C, 267-E, 327C, 357, 363, 427C, 457, 463, 504-B, H1D, H1F, H20-B, H3D-B, H4D-B, H5A, H5B, H5C-A, H5C-B, S1B-B, S1B-CS1C-A, S1C-B, S1C-C, S20-B, S5B-A, S5B-B	119A, 200-C, 357, 363, 457, 463, 504-B: (0S714) 127A, 127B, 227C, 327C, 427C: (0S400) 200A: (1S812S) H2D-B, H3D-B, H4D-B: (1S714S) S1B-C, S1C-C: (0F658) S1C-A: (concrete shear wall & 0F112) S20-B: (door does not exist) S5B-A: (2S812) 157C, 159B, 163B, 169B, 170C, 170E, 190, 267-C, 267-E, H1D, H1F, H5A, H5B, H5C-A, H5C-B, S1B-B, S1C-B, S5B-B: (exterior wall – see elevations and A-301 for assemblies)

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0021	07/08/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	
☐	9A. AMENDMENT OF SOLICITATION NO.
	9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0021

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 8 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0021.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. Please be advised that the attached Steam Narrative and applicable drawings addressing the steam comments and clarifying the extent of stainless steel ductwork is incorporated with this amendment.

4. Air Supply, Distribution, Ventilation and Exhaust Systems Section 23 00 00 dated 7/7 2016 is incorporated with this amendment.

5. Pre Engineered Underground Heat Distribution System Section 33 61 13 dated 7/7 2016 is incorporated with this amendment.

6. Thermal Insulation for Mechanical Systems Section 23 07 00 dated 7/7 2016 is incorporated with this amendment.

All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
389	236410.2.6.3	Air Cooled Chiller: The basis of design air-cooled chiller is a scroll compressor model. Would an air-cooled variable screw compressor model chiller be acceptable if it meets or exceeds the efficiency scheduled?	Yes.
391	230923.132	Given the response to RFI 340 as transmitted in amendment 10 that all smoke dampers and [redacted] (b) (5)	Using the Fire Alarm system to [redacted] (b) (5)
398		236410.2.5.1: R-134a is on the 2016 EPA SNAP fact sheet for proposed change of listing status (Phase-out). Will the 2016 EPA SNAP approved lower GWP refrigerants, such as R514A, also be acceptable for this application?	Yes.
411	Section 23 64 10	Paragraph 2.5.1: R-134a is on the 2016 EPA SNAP fact sheet for proposed change of listing status (Phase-out). Will the 2016 EPA SNAP approved lower GWP refrigerants, such as R514A, also be acceptable for this application?	See response to #398.
418	236410.2.6.3	Air Cooled Chiller: The basis of design air-cooled chiller is a scroll compressor model. Would an air-cooled variable screw compressor model chiller be acceptable if it meets or exceeds the efficiency scheduled?	See RFI 389.
457	236410	236410.2.5.1: R-134a is on the 2016 EPA SNAP fact sheet for proposed change of listing status (Phase-out). Will the 2016 EPA SNAP approved lower GWP refrigerants, such as R514A, also be acceptable for this application?	See response to RFI 398.
497	01 35 40.41	Given the amount of work that is required through the tree protection zone designated on the bid documents, is it required for the Contractor have a certified arborist onsite to evaluate and inspect the tree protection and tree preservation measures.	Tree maintenance, including that of the existing trees to remain and the corresponding review and maintenance of the tree protection measures, is highly recommended to be supervised if not performed by a certified member of the International Society of Arboriculture (ISA). Any tree pruning is required to be supervised by a certified member of ISA.
500	Plumbing and Q Drawings - Vented Cylinder Cabinet	The Plumbing and Q drawings do not show the process pipe runs which would transition from the connection point on each vented cylinder cabinet to the usage point in the lab. Please confirm that this work will be performed by the Owner and is not included in this pricing.	The pipe runs are to be provided by the Owner on an as-needed basis.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
504	230923.132	Given the response to RFI 340 as transmitted in amendment 10 that all smoke dampers and [redacted] (b) (5)	See response to #391.

SHEET / TASK	TITLE	DESCRIPTION OF WORK
MECHANICAL		
Drawings		
M-001	MECHANICAL SYBMOLS, ABBREVIATIONS AND GENERAL NOTES	Added general note 10. Added new LPC symbol
M-101A	FIRST FLOOR SEGMENT B - DUCTWORK	Cleanroom exhaust duct added
M-200	SITE PLAN	Revised notes for delegated design
M-201B	FIRST FLOOR SEGMENT B - PIPING	Revised steam pipe sizes
M-202B	SECOND FLOOR SEGMENT B - PIPING	Revised steam pipe sizes
M-203B	THIRD FLOOR SEGMENT B - PIPING	Revised steam pipe sizes
M-204B	FOURTH FLOOR SEGMENT B - PIPING	Revised steam pipe sizes
M-205A	PENTHOUSE SEGMENT A - PIPING	Added steam line to humidifiers
M-205B	PENTHOUSE SEGMENT B - PIPING	Added steam line to humidifiers
M-301B1	ENLARGED STEAM ROOM SEGMENT B1 - HVAC	Revised steam pipe sizes
M-503	STEAM WATERSIDE RISER DIAGRAM	Added drip trap note and added LPR line in the penthouse
M-602	CONTROLS DIAGRAM	Added pipe sizes and removed run time control point for PPCP-1
M-707	MECHANICAL DETAILS	Details 4, 5, 6, 7, and 8 updated with steam trap revisions.
M-802	MECHANICAL SCHEDULES	Revised PPCP-1 receiving tank volume
M-805	MECHANICAL SCHEDULES	Revised steam trap schedule, safety relief valve schedule, flash tank schedule, and steam humidifier schedule.
Specifications		
23 00 00	AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS	Refer to strikeouts and underlined text for revision 2
23 07 00	THERMAL INSULATION FOR MECHANICAL SYSTEMS	Refer to strikeouts and underlined text for revision 2
33 61 13	PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM	Refer to strikeouts and underlined text for revision 2

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2007) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2008) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(1990; INT 2007) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2012) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 350	(2008) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
AHRI 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 440	(2008) Room Fan-Coils and Unit Ventilators
AHRI 880 I-P	(2011) Performance Rating of Air Terminals
AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 2008) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2008) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 130	(2008) Method of Testing for Rating Ducted

	Air Terminal Units
ASHRAE 52.2	(2012; Errata 2013) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	(2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 90.1 - IP	(2010; Errata 1-4 2011; INT 1-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI and DS 2012; Errata 5-9 2012; INT 13-16 2012; Errata 10-12 2013; INT 17-18 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007; R 2013) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2013) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B766	(1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C1071	(2012) Standard Specification for Fibrous

	Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM C553	(2011) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C665	(2012) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D3359	(2009; E 2010; R 2010) Measuring Adhesion by Tape Test
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM E2016	(2011) Standard Specification for Industrial Woven Wire Cloth
ASTM E84	(2013a) Standard Test Method for Surface Burning Characteristics of Building Materials

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY (IEST)

IEST RP-CC-001	(2009) HEPA and ULPA Filters

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 10	(2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	(2010) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
NFPA 90A	(2012) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1819	(2002) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 5th Edition
SMACNA 1966	(2005) HVAC Duct Construction Standards

	Metal and Flexible, 3rd Edition
SMACNA 1972 CD	(2012) HVAC Air Duct Leakage Test Manual - 2nd Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 181	(2013) Factory-Made Air Ducts and Air Connectors
UL 1995	(2011) Heating and Cooling Equipment
UL 555	(2006; Reprint May 2012) Standard for Fire Dampers
UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 705	(2004; Reprint Mar 2012) Standard for Power Ventilators
UL 723	(2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials
UL 900	(2004; Reprint Feb 2012) Standard for Air Filter Units
UL 94	(2013) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL Bld Mat Dir	(2012) Building Materials Directory
UL Electrical Constructn	(2012) Electrical Construction Equipment Directory
UL Fire Resistance	(2012) Fire Resistance Directory

See specification section 01 10 00 for contractor personnel requirements.

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. Provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Air handling unit Number	AHU - #
Control and instrument air	CONTROL AND INSTR.
Exhaust Fan Number	EF - #
VAV Number/VAV w/Reheat Number	VV - #/VVR - #
Fan Coil Unit Number	FCU - #

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes	
for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

1.2.3 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and Section 43 02 00.00 41:

SD-02 Shop Drawings

Detail Drawings
Delegated Design Drawings for Duct Supports in Chases

SD-03 Product Data

Metallic Flexible Duct; G
Insulated Nonmetallic Flexible Duct Runouts; G
Duct Connectors; G
Laboratory Fume Hood Exhaust Ductwork; G
Duct Access Doors
Fire Dampers; G
Manual Balancing Dampers; G
Sound Attenuation Equipment; G
Diffusers; G
Registers and Grilles; G
Louvers; G
Air Vents, Penthouses, and Goosenecks; G
Centrifugal Fans; G
In-Line Centrifugal Fans; G
Centrifugal Type Power Roof Ventilators; G
Filters; G
Dust Collector; G
Fan-Coil Units; G
Variable Volume, Single Duct Terminal Units; G
Laboratory VV/VVR Air Terminal Units; G
Hydronic Duct Mounted heating coils; G
Test Procedures; G
Diagrams; G

Fume Hood Exhaust Fan; G
Supply Fans; G
Return Fans; G
Exhaust Fans; G

SD-06 Test Reports

Performance Tests
Damper Acceptance Test
Duct Leakage Test

SD-07 Certificates

Bolts
Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals
Fire Dampers
Manual Balancing Dampers
Centrifugal Fans
In-Line Centrifugal Fans
Fan-Coil Units
Variable Volume, Single-Duct Air Terminal Units
Laboratory VV/VVR Air Terminal Units
Hydronic Duct Mounted Heating Coils

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer shall provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations. Provide written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. Include illustrations of product markings, and the number of each type of bolt to be furnished in the certification.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Used as Refrigerants

Minimize releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following:

a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.

b. Do not open appliances without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.

c. Only persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification, can conduct work on appliances containing refrigerant.

In addition, provide copies of all applicable certifications to the Contracting Officer at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

a. Proof of Technician Certification

b. Proof of Equipment Certification for recovery or recycling equipment.

c. Proof of availability of certified recovery or recycling equipment.

1.4.4 Use of Ozone Depleting Substances, Other than Refrigerants

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

a. Any plastic party spray streamer or noise horn which is propelled by a

chlorofluorocarbon

b. Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays.

c. Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial cabling.

d. Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

Request a waiver if a facility requirement dictates that a prohibited material is necessary to achieve project goals. Submit the waiver request in writing to the Contracting Officer. The waiver will be evaluated and dispositioned.

1.4.5 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.6 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment

under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.2 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Metal Ductwork" and "Plenums and Casings for Field-Fabricated Units",
provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment, including diffusers, registers, fire dampers, and balancing dampers.

a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

b. Prior to this two year period, these standard products shall have been sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures shall have been copyrighted documents or have been identified with a manufacturer's document number.

c. Provide equipment items that are supported by a service organization. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.3 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

2.4 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire

hazard.

2.5 ELECTRICAL WORK

Provide all motors in compliance with specification section 26 60 13.00 40 LOW VOLTAGE MOTORS.

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

2.5.1 Motors

Provide all motors in compliance with specification section 26 60 13.00 40 LOW VOLTAGE MOTORS.

a. For single-phase motors, [redacted] (b) (5) (b) (5) [redacted]

b. For polyphase motors, provide [redacted] (b) (5) (b) (5) [redacted]

c. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for [redacted] (b) (5) [redacted] (b) (5) [redacted] Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

d. Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS. Each motor shall be equipped with a shaft grounding ring to prevent electrical bearing damage that can be caused by voltages induced on the shafts of motors that are controlled by Variable Frequency Drives (VFDs).

2.6 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.7 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.8 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.9 DUCT SYSTEMS

2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification .

a. Ductwork shall be constructed meeting the requirements for the duct system static pressure specified in APPENDIX D of Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

b. Provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.

c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant.

d. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.9.1.1 Fittings Construction

Manufacture as separate fittings, not as tap collars welded or brazed into duct sections.

Provide two-piece type miter elbows for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Ensure centerline radius of elbows is 1-1/2 times fitting cross section diameter.

Provide conical type crosses, increasers, reducers, reducing tees, and 90-degree tees.

Ensure cutouts in fitting body are equal to branch tap dimension or, where smaller, excess material is flared and rolled into smooth radius nozzle configuration.

2.9.1.2 Reinforcement

Support inner liners of both duct and fittings by metal spacers welded in position to maintain spacing and concentricity.

2.9.1.3 Fittings

Submit offset fitting configurations for approval.

Make divided flow fittings as separate fittings, not tap collars into duct sections, with the following construction requirements:

a. Sound, airtight, continuous welds at intersection of fitting body and tap

b. Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches

c. Pack insulation around the branch tap area for complete cavity filling.

d. Carefully fit branch connection to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Continuously braze seams in the pressure shell of fittings. Protect galvanized areas that have been damaged by welding with manufacturer's standard corrosion-resistant coating.

Construct two-piece type elbows for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

Provide conical type crosses, increasers, reducers, reducing tees, and 90-degree tees.

2.9.1.4 Turning Vanes

Provide double-wall type turning vanes, commercially manufactured for high-velocity system service.

2.9.1.5 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of 2 inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round duct length that does not exceed 5 feet. Secure connections by applying adhesive for 2 inches over rigid duct, apply flexible duct 2 inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of 1 inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.9.1.6 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.9.1.7 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.9.1.8 Aluminum Ducts

ASTM B209, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.9.1.9 Copper Sheets

ASTM B152/B152M, light cold rolled temper.

2.9.1.10 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167

2.9.1.11 Laboratory Fume Hood Exhaust Ductwork

Longitudinal seam round duct, minimum 18 gauge A316 stainless steel, all welded, smooth radius elbows(not mitered) for the entire length of the run ~~for the first ten (10) feet extending past the fume hood. Past the first ten feet, the fume hood exhaust ductwork shall be galvanized steel~~.

2.9.1.12 Vented Cylinder Cabinet Exhaust Ductwork

Shall be stainless steel round duct for the entire length of the run.

2.9.1.13 Flame Hood Exhuast Ductwork

Shall be stainless steel round duct for the first ten (10) feet past the flame hood. Past the first ten feet the flame hood exhaust ductwork shall be galvanized. Above the roof the flame exhaust shall be stainless steel.

2.9.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.9.3 Fire Dampers

(b) (5)

[redacted]

2.9.4 Manual Balancing Dampers

a. Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators.

b. Unless otherwise indicated, provide opposed blade type multileaf

dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide access doors or panels in hard ceilings, partitions and walls for access to all concealed damper operators and damper locking setscrews. Coordinate location of doors or panels with other affected contractors.

c. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.4.1 Square or Rectangular Dampers

2.9.4.1.1 Duct Height 12 inches and Less

2.9.4.1.1.1 Frames

Width	Height	Galvanized Steel Thickness	Length
Maximum 19 inches	Maximum 12 inches	Minimum 20 gauge	Minimum 3 inches
More than 19 inches	Maximum 12 inches	Minimum 16 gauge	Minimum 3 inches

2.9.4.1.1.2 Single Leaf Blades

Width	Height	Galvanized Steel Thickness	Length
Maximum 19 inches	Maximum 12 inches	Minimum 20 gauge	Minimum 3 inches
More than 19 inches	Maximum 12 inches	Minimum 16 gauge	Minimum 3 inches

2.9.4.1.1.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

Width	Height	Material	Square Shaft
Maximum 19 inches	Maximum 12 inches	Galvanized Steel	Minimum 3/8 inch
More than 19 inches	Maximum 12 inches	Galvanized Steel	Minimum 1/2 inch

2.9.4.1.1.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings. Shaft

bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

Width	Height	Material
Maximum 19 inches	Maximum 12 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
More than 19 inches	Maximum 12 inches	oil-impregnated bronze

2.9.4.1.1.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.4.1.1.6 Finish

Mill Galvanized

2.9.4.1.2 Duct Height Greater than 12 inches

2.9.4.1.2.1 Dampers

Provide dampers with multi-leaf opposed-type blades.

2.9.4.1.2.2 Frames

Maximum 48 inches in height; maximum 48 inches in width; minimum of 16 gauge galvanized steel,
minimum of 5.5 inches long.

2.9.4.1.2.3 Blades

Minimum of 16 gauge galvanized steel; 6 inch nominal width.

2.9.4.1.2.4 Blade Axles

To support the blades of round dampers, provide galvanized square steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

2.9.4.1.2.5 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

2.9.4.1.2.6 Blade Actuator

Minimum 1/2 inch diameter galvanized steel.

2.9.4.1.2.7 Blade Actuator Linkage

Mill Galvanized steel bar and crank plate with stainless steel pivots.

2.9.4.1.2.8 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.4.1.2.9 Finish

Mill Galvanized

2.9.4.2 Round Dampers

2.9.4.2.1 Frames

Size	Galvanized Steel Thickness	Length
4 to 20 inches	Minimum 20 gauge	Minimum 6 inches
22 to 30 inches	Minimum 20 gauge	Minimum 10 inches
32 to 40 inches	Minimum 16 gauge	Minimum 10 inches

2.9.4.2.2 Blades

Size	Galvanized Steel Thickness
4 to 20 inches	Minimum 20 gauge
22 to 30 inches	Minimum 16 gauge
32 to 40 inches	Minimum 10 gauge

2.9.4.2.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

Size	Shaft Size and Shape
4 to 20 inches	Minimum 3/8 inch square
22 to 30 inches	Minimum 1/2 inch square
32 to 40 inches	Minimum 3/4 inch square

2.9.4.2.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

Size	Material
4 to 20 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
22 to 30 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
32 to 40 inches	oil-impregnated bronze, or stainless steel sleeve bearing

2.9.4.2.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.4.2.6 Finish

Mill Galvanized

2.9.5 Automatic Balancing Dampers

Provide dampers as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.9.6 Air Supply And Exhaust Air Dampers

Where outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including maximum Damper Leakage for:

a. The maximum damper leakage at 1.0 inch w.g. is 10 cfm per square foot and for non-motorized dampers is 20 cfm per square foot of damper area.

Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per square foot.

2.9.7 Air Deflectors and Branch Connections

Provide air deflectors at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors, except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors. Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors, also called turning vanes, in 90 degree elbows.

2.9.8 Plenums and Casings for Field-Fabricated Units

2.9.8.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in SMACNA 1966, as applicable. Construct system casing of not less than 16 gauge galvanized sheet steel. Furnish cooling coil drain pans with 1 inch threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304, welded and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.9.8.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

2.9.8.3 Access Doors

Provide access doors in each section of the casing. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 36 by 18 inches and locate them 18 inches above the floor. Where the space available does not accommodate doors of this size, use doors as large as

the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

2.9.8.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.9.8.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.9.9 Sound Attenuation Equipment

2.9.9.1 Sound Attenuators

Provide sound attenuators on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Provide sound attenuators elsewhere as indicated. Provide factory fabricated sound attenuators, tested by an independent laboratory for sound and performance characteristics. Provide a net sound reduction as indicated. Construct traps to be airtight when operating under an internal static pressure of 10 inch water gauge. Provide air-side surface capable of withstanding air velocity of 10,000 fpm. Certify that the equipment can obtain the sound reduction values specified after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Provide sound absorbing material conforming to ASTM C1071, Type I or II and ASTM E477-06a. Provide sound absorbing material that meets the fire hazard rating requirements for insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For connection to ductwork, provide a duct transition section.

1. The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will reduce mechanical fan noise to NC 30 an office area and NC 45 Lab area. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations. In the absense of specified background sound level criteria, the guidelines as expressed in Table 34 of Chapter 47, "Sound and Vibration Control" of the ASHRAE Handbook - HVAC Applications, shall be used.

2. The silencer manufacturer shall guarantee that silencer provided will not exceed NC 30 level on areas served by AHU-5, 6, and 7 and NC 45 level on area served by MAU-1, HIRF-1, AHU-2, AHU-3, AHU-4 and AHU-4B and pressure drop will be achieved as scheduled. If after the installation, the expected result is not acheived, it wil be the

silncer manufacturer's responsibility to replace the silencers. This condition applies if the units installed are the same as used at the design stage, there is no significant change on the duct lay-out and silencers installed per manufacturer recommendation.

3. Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E477-06a test standard with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.

4. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

5. Install silencer according to manufacturer's written installation instructions.

A. General Requirements:

1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.

2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.

3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.

4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.

5. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.

6. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, Vibar™ film liner, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

B. Rectangular Silencers including models RD, RFL and EXRFL: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, 22 gauge.

C. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.

1. Rectangular Silencers: 26 gauge.

D. Principal Sound-Absorbing Mechanism:

1. Dissipative and Film Lined silencers:

a. Models RD, RFL and EXRFL type with acoustic media. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.

E. Media Protection:

1. Film Lined silencers, including models RFL and EXRFL: The acoustic media shall be completely wrapped with Vibar™ film to help prevent shedding, erosion and impregnation. If noted on the schedule, the wrapped acoustic media shall be separated from the perforated metal by a factory installed ½" thick acoustically transparent spacer. The spacer shall be flame retardant and erosion resistant. A mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

F. Capacities and Characteristics:

1. See duct silencer performance schedule on mechanical drawings.

2.9.10 Diffusers, Registers, and Grilles

Provide factory-fabricated units of aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.9.10.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Constructn for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between

ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.9.10.2 Perforated Plate Diffusers

Provide adjustable four-way air pattern controls as indicated. Provide diffuser faceplates that do not sag or deflect when operating under design conditions.

2.9.10.3 Linear Diffusers

Make joints between diffuser sections that appear as hairline cracks. Provide alignment slots for insertion of key strips or other concealed means to align exposed butt edges of diffusers. Equip with plaster frames when mounted in plaster ceiling. Do not use screws and bolts in exposed face of frames or flanges. Metal-fill and ground smooth frames and flanges exposed below ceiling. Furnish separate pivoted or hinged adjustable air-volume-damper and separate air-deflection blades.

2.9.10.4 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of, horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.9.10.5 Registers

Double-deflection supply registers. Provide exhaust and return registers as specified for supply registers, except provide exhaust and return registers that have a single set of nondirectional face bars or vanes having the same appearance as the supply registers.

2.9.10.6 Egg Crate Grilles

Provide units that are aluminum or painted steel with 1/2 by 1/2 by 1/2 inch grid providing 90% free area. Provide heavy extruded aluminum frame with countersunk screw mounting. Unless otherwise indicated, blades and frame shall have factory applied white finish. Grilles shall be suitable for duct or surface mounting as indicated on drawings. Provide all necessary appurtenances to allow for mounting.

2.9.11 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 08 91 00 METAL WALL LOUVERS.

2.9.12 Air Vents, Penthouses, and Goosenecks

Fabricate air vents, penthouses, and goosenecks from galvanized steel sheets with galvanized structural shapes. Provide sheet metal thickness, reinforcement, and fabrication that conform to SMACNA 1966. Accurately fit and secure louver blades to frames. Fold or bead edges of louver blades for rigidity and baffle these edges to exclude driving rain. Provide air vents, penthouses, and goosenecks with bird screen.

2.9.13 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.10 AIR SYSTEMS EQUIPMENT

2.10.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans shall not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.10.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 30 inches. Provide

backward-inclined airfoil design fan blades for wheels over 30 inches in diameter. Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have totally enclosed enclosures.

2.10.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide motors with totally enclosed enclosure.

2.10.1.3 Centrifugal Type Power Roof Ventilators

Provide V-belt driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, motorized dampers, roof curb, and extended base. Provide dripproof type motor enclosure. Provide centrifugal type kitchen exhaust fans according to UL 705, fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, with motor and power transmission components located in outside positively air ventilated compartment. Use only lubricated bearings.

2.10.1.4 Dilution Exhaust Fans (Fume Hood and VCC)

A. Mixed - flow induced dilution fan:

1. Direct drive arrangement 4 with impellers mounted directly on motor shaft. Motors shall be isolated from the primary exhaust air stream.

2. Mix flow impellers shall be a combination of axial/backward curved blades and shall be welded steel. Fan shall be non-stall and non-overloading with stable operation at any point on the fan curve.

3. Guide vanes shall be provided to increase fan efficiency.

4. Fan dynamic balance shall not exceed 0.5 mil peak-to-peak at the blade pass area when operating at fan frequency. Rubber-in-shear pad type vibration isolators.

5. Designed for mounting without need for guy wires.

6. FRP discharge.

7. Non-ferrous inlet bell.

8. Modular construction capable of rooftop assembly.

9. 316 stainless steel fasteners.

10. Bolted access door.

11. Drain.

12. Motors to have 1.15 service factor and an L-50 bearing life of 200,000 hours. Efficiencies shall comply with U.S. Energy Policy Act 1992 requirements and Section 23 05 12 requirements.

13. Accessories:

a. Inlet mixing plenums shall be provided by fan manufacturer. Each plenum shall be sized to support weight and performance requirements of number of fans scheduled. Multiple fan plenums shall be double wall construction with structural stiffeners or shall be continuously welded heavy gauge single wall construction. Plenums shall be suitable for mounting on roof curbs.

b. Stainless stall safety screens over air inlets.

c. Bypass dampers for mixing of outside air with primary exhaust.

d. Imposed blade low leakage epoxy coated aluminum air foil control dampers with extended shaft for connection to damper operator. Rain hoods shall be provided over each damper. Actuators shall be electric.

e. Provide low leakage isolation dampers constructed of epoxy coated aluminum. Operators shall be two position spring return for 100% standing application. Each fan shall be provided with a variable frequency drive.

f. Roof curb shall be provided by the fan manufacturer.

2.10.1.5 Axial Sidewall Fans

Direct drive, axial type sidewall fans
Propellers shall be constructed with fabricated steel, fabricated aluminum, or cast aluminum blades and hubs. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft. All propellers shall be statically and dynamically balanced to AMCA Standard 204-05. Motors shall be permanently lubricated, heavy duty type, carefully matched to the fan load and furnished at the specified RPM, voltage, phase, and enclosure. Motor drive frame assemblies and fan panels shall be galvanized steel or painted steel. Drive frame assemblies shall be welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges, and a deep formed inlet venturi. The axial exhaust or supply fans shall bear the AMCA Certified Ratings Seals for Sound and Air Performance.

2.10.2 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.10.2.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.10.2.2 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.10.2.3 Replaceable Media Filters

Provide the dry-media type replaceable media filters, of the size required to suit the application. Provide filtering media that is not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Enclose pad in a holding frame of not less than 16 gauge galvanized steel, equipped with quick-opening mechanism for changing filter media. Base the air flow capacity of the filter on net filter face velocity not exceeding 300 fpm, with initial resistance of 0.13 inches water gauge. Provide MERV that is not less than 8 when tested according to ASHRAE 52.2.

2.10.2.4 High-Efficiency Particulate Air (HEPA) Filters

Provide HEPA filters that meet the requirements of IEST RP-CC-001 and are individually tested and certified to have an efficiency of not less than or more stringent percentage as scheduled, and an initial resistance at 250 fpm that does not exceed 1.3 inches water gauge. Provide filters that are constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by corrugated aluminum or mineral-fiber inserts, strips of filter medium, or by honeycomb construction of the pleated filter medium. Provide interlocking, dovetailed, molded neoprene rubber gaskets of 5-10 durometer that are cemented to the perimeter of the upstream face of the filter cell sides. Provide self-extinguishing rubber-base type adhesive or other materials conforming to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Provide overall cell side dimensions that are correct to 1/16 inch, and squareness that is maintained to within 1/8 inch. Provide holding frames that use spring loaded fasteners or other devices to seal the filter tightly within it and that prevent any bypass leakage

around the filter during its installed life. Provide air capacity and the nominal depth of the filter as indicated. Install each filter in a factory preassembled side access housing or a factory-made sectional supporting frame as indicated. Provide prefilters of the type, construction and efficiency indicated.

2.10.2.5 Holding Frames

Fabricate frames from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.

2.10.2.6 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, with white dials with black figures, and graduated in 0.01 inch of water, with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

Ductwork serving dust collector shall be minimum 18 gauge hard round G90 galvanized steel. Die-stamped 1.5 minimum radius elbows; wye-fittings(not tie); tapered reducers/increasers(not abrupt). Provide cleanouts at all changes in directions. Provide blast gates at all tools locations.

2.11 DUST COLLECTOR - MECH SHOP

Furnish a complete pulse-jet dust collector system as shown on the plans and/or listed in the equipment schedule. The system shall be capable of providing continuous on-line cleaning.

Each module shall be of bolted and welded construction using 10, 12, or 14 gauge HRS and designed for ±20" water gauge. It shall be complete with pulse-jet pipework, diaphragm valves, venturis, and pilot solenoid valves in a control box, 3" square x 1/8" wall tubing compressed air manifold, structural support legs with crossbracing, and an optional hopper with an 8" x 8" inside dimension flanged discharge opening. The compressed air reservoir shall be provided with 1" NPT pipe coupling for attachment of clean and dry compressed air supply at 90-100 PSIG and at a temperature not exceeding 150°F.

The filter cartridges shall be arranged in a vertical configuration, serviced through a side access door.

Dust-laden air will enter the collector through the side of the collection hopper or at the base of the collector. Dust will be directed down by an air distribution baffle in the center of the dust hopper for even dust loading and minimized abrasion. Heavy dust particles will fall into the collection hopper and small, light particles will be collected on the media surface. Clean air will pass through the media, enter the clean air chamber, and exit from the top of the collector.

2.12 TERMINAL UNITS

2.12.1 Fan-Coil Units

Provide base units that include galvanized coil casing, coil assembly drain pan, secondary galvanized steel drain pan and water sensor with provisions for remote BAS alarm, valve and piping package, air filter, fans, motor, fan drive, motor switch, an enclosure for cabinet models and casing for concealed models, leveling devices integral with the unit for vertical type units, and sound power levels as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Fasten each unit securely to the building structure. Provide units with capacity indicated. Provide room fan-coil units that are certified as complying with AHRI 440, and meet the requirements of UL 1995.

2.12.1.1 Enclosures

Fabricate enclosures from not lighter than 18 gauge steel, reinforced and braced. Provide enclosures with front panels that are removable and have 1/4 inch closed cell insulation or 1/2 inch thick dual density foil faced fibrous glass insulation. Make the exposed side of a high density, erosion-proof material suitable for use in air streams with velocities up to 4,500 fpm. Provide a discharge grille that is adjustable and that is of such design as to properly distribute air throughout the conditioned space. Plastic discharge and return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant according to UL 94 and the material complies with the heat deflection criteria specified in UL 1995. Provide galvanized or factory finished ferrous metal surfaces with corrosion resistant enamel, and access doors or removable panels for piping and control compartments, plus easy access for filter replacement. Provide duct discharge collar for concealed models.

2.12.1.2 Fans

Provide steel or aluminum, multiblade, centrifugal type fans. In lieu of metal, fans and scrolls could be of non-metallic materials of suitably reinforced compounds with smooth surfaces. Dynamically and statically balance the fans. Provide accessible assemblies for maintenance. Disassemble and re-assemble by means of mechanical fastening devices and not by epoxies or cements.

2.12.1.3 Coils

Fabricate coils from not less than 3/8 inch outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Provide coils with not less than 1/2 inch outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 300 psi or under water at 250 psi air pressure. Provide coils suitable for 200 psi working pressure. Make provisions for coil removal.

2.12.1.4 Drain Pans

Size and locate drain and drip pans to collect all water condensed on and dripping from any item within the unit enclosure or casing. Provide condensate drain pans designed for self-drainage to preclude the buildup of microbial slime and thermally insulated to prevent condensation and constructed of not lighter than 21 gauge type 304 stainless steel or noncorrosive ABS plastic. Provide insulation with a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and of a waterproof type or coated with a waterproofing material. Design drain pans so as to allow no standing water and pitch to drain. Provide minimum 3/4 inch NPT or 5/8 inch OD drain connection in drain pan. Extend insulation at control and piping connections 1 inch minimum over the auxiliary drain pan.

2.12.1.5 Manually Operated Outside Air Dampers

Provide manually operated outside air dampers according to the arrangement indicated, and parallel airfoil type dampers of galvanized construction. Provide blades that rotate on stainless steel or nylon sleeve bearings.

2.12.1.6 Filters

Provide disposable type filter that complies with ASHRAE 52.2. Filters in each unit shall be removable without the use of tools. Filters shall be a minimum of 2" thick.

2.12.1.7 Motors

Provide all motors in compliance with specification section 26 60 13.00 40 LOW VOLTAGE MOTORS.

Provide motors of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Provide motor switch with two or three speeds and off, manually operated, and mounted on an identified plate inside the unit below or behind an access door. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent is allowed. Provide motors with permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Provide a motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity that does not exceed the following values:

Free Discharge Motors			
Unit Capacity (cfm)	Maximum Power Consumption (Watts)		
	115V	230V	277V
200	70	110	90
300	100	110	110

Free Discharge Motors			
Unit Capacity (cfm)	Maximum Power Consumption (Watts)		
	115V	230V	277V
400	170	150	150
600	180	210	220
800	240	240	230
1000	310	250	270
1200	440	400	440

High Static Motors	
Unit Capacity (cfm)	Maximum Power Consumption (Watts)
200	145
300	145
400	210
600	320
800	320
1000	530
1200	530

2.12.2 Variable Volume, Single-Duct Air Terminal Units

2.12.2.1 Configuration

Provide a volume-damper assembly inside unit casing with control components located inside a protective metal shroud.

2.12.2.2 Casing

Room air terminal units shall be industrial grade and constructed of 22 gauge galvanized steel with mechanically locked and gasketed seams and shall meet the mechanical standards of and be in compliance with UL 181 and UL 723, NFPA 90A, ASTM E84 and bacteria standard ASTM C665.

2.12.2.2.1 Casing Lining

Air terminal unit casings shall have 3/4" thick fiber-free closed cell foam insulation. Provide 1 inch thick, coated, fiber free duct casing

lining complying with ASTM C1071. Secure with adhesive. Cover liner with nonporous foil and perforated metal.

Attach a 1 inch matte faced insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with NFPA 90A approved seal.

For the air inlet provide round stub connection for duct attachment. For the air outlet provide s-slip and drive connections. Provide removable panels for access to diverter and other parts requiring service, adjustment, or maintenance; with airtight gasket.

2.12.2.3 Volume Damper

Damper shafts shall be solid 1/2" diameter zinc-plated steel with self-lubricating polyethylene bushings and with external indication of the damper position. Damper blades shall be 22 gauge steel with a polyurethane foam gasket to enable tight shutoff for smoke control applications. Air terminal Units shall be controlled by the BAS. Provide a galvanized steel volume damper with peripheral gasket and self-lubricating bearings.

Perform a Maximum Damper Leakage Test (MDLT)in conformance to AHRI 880 I-P, for 2 percent of nominal airflow at 3 inch wg inlet static pressure, when tested in accordance with ASHRAE 130.

Select Damper Position, normally closed.

2.12.2.4 Hot-Water Heating Coil

Reheat coils shall be factory installed on the Air terminal units. Air terminal units shall be provided with integral hot water reheat coils comprised of copper tubing of 0.017. Provide a copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

2.12.2.5 DDC Controls

Provide bidirectional damper operators and microprocessor-based controller. Provide with room sensor that is compatible with temperature controls specified.

2.12.2.5.1 Damper Actuators

See Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.12.2.5.2 Terminal Unit Controllers

See Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.12.2.5.3 Room Sensor

Provide a wall mounting room sensor per Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.12.2.6 Static Pressure

Air terminal unit leakage shall not exceed 1% @ 6 inches W.C. positive static pressure of the airflow corresponding to 2000 fpm inlet duct velocity. Dampers 16" diameter and less shall be capable of a total shut off of room supply airflow (leakage to be less than 1% of airflow corresponding to 2000 fpm inlet duct velocity). Supply air terminal units shall be provided with an averaging pitot tube array type of airflow sensor located upstream from all other air terminal components. The Air terminal units shall be certified under AHRI 880 I-P and display the ARI label Make suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure. Provide a factory-mounted and -piped, 5-micron filter; velocity-resetting, adjustable, high-limit control, with amplifying relay. Provide a system-powered, wall-mounting thermostat.

2.12.3 Source Quality Control

2.12.3.1 Identification

Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

2.12.3.2 Verification of Performance

Rate air terminal units according to AHRI 880 I-P.

2.12.4 Laboratory VV/VVR Air Terminal Units

Single Blade Damper or Venturi type Air Valves are acceptable per the following requirements

1. Single Blade Damper

a. Provide industrial grade Terminal Units with construction, leakage, and performance as stated herein. Commercial grade terminal units are not acceptable. Units not conforming to all construction and performance criteria listed herein will be rejected.

b. Laboratory Terminals shall have a single blade damper for airflow adjustment and shall provide the individual airflow capacities indicated in the project airflow schedules. Terminal airflow shall be pressure independently controlled using actual independent airflow measurement feedback as an integral part of a closed loop control process.

c. Minimum airflow sensor measurement accuracy shall be +/- 5% of actual airflow over the entire design airflow range of each air terminal. Airflow measurement accuracy substantiation by a qualified independent test agency shall be available upon request.

d. Airflow transmitter shall be factory mounted on the terminal and shall include the necessary signal conditioning/transmitter instrumentation to provide an output proportional to the velocity pressure. Transmitter shall have an accuracy of at least +/- 0.5% of the transmitter range and a drift no greater than 0.5% full scale/year Transmitter ranges shall not exceed 0 to 1.00 inches W.C. High and low limits shall be fully adjustable. Transmitters not meeting the drift requirements shall be provided with an

auto-zero solenoid that connects to the air velocity pressure transducer's inlet ports for enabling automatic periodic re-calibration to ensure drift-free airflow measurement. Automatic re-calibration shall occur at a minimum every 24 hours without airflow disruption to the space.

e. All single blade damper air terminals shall have a wide open pressure drop less than 0.25"wc at airflow equivalent to 2000 fpm inlet duct velocity.

f. Room supply air terminals shall be industrial grade and constructed of 22 gauge galvanized steel with mechanically locked and gasketed seams and shall meet the mechanical standards of and be in compliance with UL 181 and UL 723, NFPA 90A, ASTM E84 and bacteria standard ASTM C665. Air terminal casings shall have 3/4" thick fiber-free closed cell foam insulation. Damper shafts shall be solid 1/2" diameter zinc-plated steel with self-lubricating polyethylene bushings and with external indication of the damper position. Damper blades shall be 22 gauge steel with a polyurethane foam gasket to enable tight shutoff for smoke control applications. Air terminal leakage shall not exceed 1% @ 6 inches W.C. positive static pressure of the airflow corresponding to 2000 fpm inlet duct velocity. Dampers 16" diameter and less shall be capable of a total shut off of room supply airflow (leakage to be less than 1% of airflow corresponding to 2000 fpm inlet duct velocity) . Supply air terminals shall be provided with an averaging pitot tube array type of airflow sensor located upstream from all other air terminal components. Supply terminals shall be provided with integral hot water reheat coils comprised of copper tubing of 0.017" wall thickness and have heavy gauge sine wave coil fins for efficient heat transfer meeting scheduled capacities. The supply terminals shall be certified under AHRI 880 I-P, and display the ARI label. Reheat coils shall be factory installed on the supply terminal unit.

g. Room general return air terminals including the damper blades shall be industrial grade and constructed of 22 gauge galvanized steel. Damper shafts shall be 1/2" diameter stainless steel with self-lubricating Teflon bushings and with external indication of the damper position. Terminal air leakage shall not exceed 1% of design airflow@ 6 inches W.C. positive static pressure. Room general return air terminals shall be provided with an orifice ring type of airflow sensor located upstream of the damper.

2. Venturi type Air Valve

a. Provide industrial grade Terminal Units with construction, leakage, and performance as stated herein. Commercial grade terminal units are not acceptable. Units not conforming to all construction and performance criteria listed herein will be rejected.

b. Laboratory Terminals shall have a factory calibrated spring and cone assembly for airflow adjustment and shall provide the individual airflow capacities indicated in the project airflow schedules. Terminal airflow shall be pressure independently controlled by its mechanical spring and cone assembly over a static pressure range of 0.6" W.C. to 3.0" W.C.

c. Airflow feedback accuracy shall be +/- 5% of actual airflow over the entire design airflow range of each air terminal. Airflow measurement accuracy substantiation by a qualified independent test agency shall be available upon request.

d. Airflow feedback potentiometer shall be factory mounted on the terminal and shall include the necessary signal conditioning/transmitter instrumentation to provide an output proportional to the velocity pressure. Airflow feedback potentiometer shall have an accuracy of at least +/- 0.5% of the transmitter range and a drift no greater than 0.5% full scale/year.

e. Room supply air terminals shall be industrial grade and constructed of 316 stainless steel or 16 gauge aluminum and shall meet the mechanical standards of and be in compliance with UL 181 and UL 723, NFPA 90A, ASTM E84 and bacteria standard ASTM C665. Air terminal casings shall have 3/4" thick fiber-free closed cell foam insulation. All shafts and bearings shall be made of a Teflon, polyester, or polyphenylene sulfide composite. Pressure independent springs shall be spring-grade stainless steel. Pivot arm and internal linkages shall be aluminum or stainless steel. Air terminal leakage shall not exceed 1% @ 6 inches W.C. positive static pressure of the airflow corresponding to 2000 fpm inlet duct velocity. Supply air terminals shall be capable of a total shut off of room supply airflow (leakage to be less than 1% of airflow corresponding to 2000 fpm inlet duct velocity). Terminal shall externally indicate factory calibrated airflow range and terminal orientation (horizontal or vertical). Supply terminals shall be provided with duct mounted hot water reheat coils comprised of copper tubing of 0.017" wall thickness and have heavy gauge sine wave coil fins for efficient heat transfer meeting scheduled capacities. The supply terminals shall be certified under AHRI 880 I-P, and display the ARI label. Reheat coils shall be factory installed on the supply terminal unit.

f. Room general return air terminals shall be industrial grade and constructed of 316 stainless steel or 16 gauge aluminum. All shafts and bearings shall be made of a Teflon, polyester, or polyphenylene sulfide composite. Pressure independent springs shall be stainless steel. Terminal air leakage shall not exceed 1% of design airflow@ 6 inches W.C. positive static pressure. Terminal shall externally indicate factory calibrated airflow range and terminal orientation (horizontal or vertical).

2.12.5 Hydronic Duct Mounted Heating Coils

Provide fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 16 gauge, galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive pressure drop and are drainable where required or indicated. At the factory, test each coil at not less than 250 psi air pressure and provide coils suitable for 200 psi working pressure. Install drainable coils in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils shall conform to the provisions of AHRI 410.

2.13 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Factory painting that has been damaged prior to acceptance by the Contracting Officer shall be field painted in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices)and an additional 3 feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00.00 10.00 10 CAST-IN-PLACE CONCRETE.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Exposed Ductwork

Provide exposed ductwork in laboratories serving fume hoods that are fabricated from minimum 18 gauge, Type 304L or 316L, stainless steel with continuously welded joints and seams. For exposed ductwork serving flame hoods, provide minimum 18 gauge, Type 304L or 316L, stainless steel for 10 foot duct section directly downstream of flame hood and for exposed duct above roof. Provide galvanized steel exposed ductwork for span of duct

starting 10 feet above flame hood to roof line. Pitch ducts to drain at hoods and low points indicated. Match surface finish to hoods. Provide exposed ductwork in offices and laboratories (non-fume hoods) that is galvanized steel.

3.2.7 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.8 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums up to the point where the outdoor air reaches the conditioning unit.

3.2.9 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.10 Power Roof Ventilator Mounting

Provide foamed 1/2 inch thick, closed-cell, flexible elastomer insulation to cover width of roof curb mounting flange. Where wood nailers are used, predrill holes for fasteners.

3.2.11 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 28 calendar days before being loaded.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean. Clean inner surfaces of lab supply ductwork downstream of filters prior to startup and acceptance.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.6.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.6.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with

minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6.5 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. Provide fire, smoke or combination smoke/fire dampers as indicated on drawings. For fire damper installation, comply with UL listing.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.7.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.7.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.7.3 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.9 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils, filters, etc. Provide test procedure, apparatus, and report that conform to SMACNA 1972 CD. Complete ductwork leak test with satisfactory results prior to applying insulation to ductwork exterior.

3.10 DUCTWORK LEAK TESTS

The requirements for ductwork leak tests are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.11 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.12 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.13 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Provide tests that cover a period of not less than 30 days for each system and demonstrate that the entire system is functioning according to the specifications. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

Submit test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

3.14 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of fan-coil units air terminal units, unit

ventilators, thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.15 OPERATION AND MAINTENANCE

3.15.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.15.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 8 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

SECTION 33 61 13

PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.11	(2011) Forged Fittings, Socket-Welding and Threaded
ASME B16.9	(2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2012; INT 2-6, 8-10, 13, 15, 17-25, 27-31 and 42-46) Power Piping
ASME B40.100	(2005; R 2010) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M	(2011) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A234/A234M	(2011a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA MC96.1	(1982) Temperature Measurement Thermocouples

1.2 DEFINITIONS

The following definitions shall apply to the work.

1.2.1 Heat Distribution System

A complete pre-engineered, underground heat distribution and condensate

return system including all required components such as carrier pipes, steam pipe, condensate return pipe, and fittings, anchors, pipe supports, insulation, protective casing, and cathodic protection, for the system supplied. The pre-engineered system shall include all piping and components to a point at least [redacted] (b) (5) [redacted] The under ground heat distribution system (UHDS) shall not use any part of the building or valve manhole structure as an anchor point.

1.2.2 UHDS Types

1.2.2.1 Precast Concrete Trench

Provide water-tight factory fabricated precast concrete trench with concrete lid.

1.3 SYSTEM DESCRIPTION

1.3.1 Summary

The work includes the design and fabrication; furnishing; installing, and testing of a underground insulated steam pipe, insulated steel condensate return pipe, consisting of piping as indicated, [redacted] (b) (5) [redacted] protection system (where required by this specification), together with fittings and appurtenances necessary for a complete and operable system. Gland type end seals will not be permitted. Drainable-Dryable-Testable (DDT) systems with fiberglass casings will not be allowed.

1.3.2 UHDS Design

Submit a Certificate of Satisfactory Operation certifying that at least 3 systems installed by the UHDS manufacturer within the previous 5 years are operating satisfactorily, not later than 14 days after notice to proceed. The UHDS manufacturer shall be responsible for the complete design of the UHDS, the product to be supplied, fabrication, witnessing installation and testing of the system within the design parameters established by the contract drawings and specifications, and in compliance with the detailed design. The complete design of the UHDS shall be sealed by a Professional Engineer in the employ of the UHDS manufacturer.

1.3.3 [redacted] (b) (5) [redacted] Protection

[redacted] (b) (5) [redacted] protection shall be provided for systems with [redacted] (b) (5) [redacted] in accordance with paragraph [redacted] (b) (5) [redacted]

1.3.4 Operating Characteristics

The steam supply system shall have an operating temperature of [redacted] (b) (5) [redacted] degrees F and an operating pressure of [redacted] (b) (5) [redacted] psig. eCondensate return system shall have an operating temperature of [redacted] (b) (5) [redacted] degrees F and an operating pressure of [redacted] (b) (5) [redacted] psig.

1.3.5 Rated Characteristics

Furnish thermal expansion calculations for the supply and return piping using the following design characteristics and installation temperature. The system design conditions for steam condensate supply and/or return shall be a temperature of [redacted] (b) (5) [redacted] degrees F and a pressure of [redacted] (b) (5) [redacted] psig. For calculation purposes, the installation temperature shall not be higher than the ambient temperature at the site: [redacted] (b) (5) [redacted] degrees F.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and Section 43 02 00.00 41:

SD-02 Shop Drawings

Heat Distribution System; G
Precast concrete trench and lid; G
Steel reinforcing drawings with anchors and guides inserts/locations; G
Locations and details of anchors and guides; G

SD-03 Product Data

Expansion Loops and Bends; G
[redacted] (b) (5) Protection Installation; G
Work Plan; G
Quality Assurance Plan
UHDS Manufacturer's Representative Reports
Connecting to Existing Work; G
Precast Concrete Trench With Lid; G
Cover hoisting hooks; G
Waterproofing concrete trench and lid; G
Waterproofing Seals; G

SD-06 Test Reports

Thermal Performance Testing; G
Operational Test; G
Tests; G
Test of Water Spread Limiting (WSL) Systems for Steam Service; G
Test of WSL Systems for Condensate Return Service; G
Test of WSL System for Domestic Hot Water Service; G

SD-07 Certificates

Manufacturer; G
Manufacturer's Representative; G
UHDS Design; G
Certificate of Compliance; G
Testing Firm
Welding

SD-10 Operation and Maintenance Data

Heat Distribution System; G

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer

The UHDS manufacturer is the company responsible for the design and manufacture of the pre-engineered system. The Contractor shall submit certification of past experience stating that the UHDS manufacturer regularly and currently manufactures buried systems, and that the designs

of the system and equipment to be provided for this project conform to specification requirements. This certification shall be an original signed by a principal officer of the UHDS manufacturer and shall be submitted at least 2 weeks prior to the start of work; the certificate shall indicate the location, type of system, size of system, point of contact (POC) including phone number, for information verification. The UHDS manufacturer directs the installation of the system and has a representative on the jobsite. The manufacturer shall submit a Work Plan indicating when various items of work and tests are to be carried out and when its representative will be present at job site. The Contractor shall submit a proposed schedule of activities, not later than 14 days after notice to proceed. The manufacturer shall submit a list of characteristics indicating what defects or damage will necessitate replacement. The manufacturer shall submit a Quality Assurance Plan not later than 14 days after notice to proceed for fabrication, delivery, storage, installation and testing of the system. The manufacturer shall submit data sheets for all coatings and indicating thicknesses of insulation for carrier pipes.

1.5.2 Manufacturer's Representative

Submit a letter from the system manufacturer, at least 2 weeks prior to the start of work, listing the experience and training of the manufacturer's representative, who shall be a person who regularly performs the duties specified, is certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified. The UHDS manufacturer's representative shall be under the direct employ and supervision of the UHDS manufacturer.

1.5.3 Corrosion Engineer

Corrosion engineer refers to a person who, by knowledge of the physical sciences and the principles of engineering and mathematics acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control. Such person may be a licensed professional corrosion engineer or certified as being qualified by the National Association of Corrosion Engineers (NACE), if such licensing or certification includes 3 years experience in corrosion control on underground metallic surfaces of the type under this contract. NACE certification shall be technologist, corrosion specialist, or cathodic protection specialist. The corrosion engineer shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the corrosion engineer shall revisit the site to ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The corrosion engineer shall supervise, inspect, and test the installation and performance of the cathodic protection system.

1.5.4 Testing Firm

Submit a Certificate of Qualification from the independent testing firm or firms, not later than 14 days after notice to proceed. The Testing Firm

must be able to certify that: weld examination methods and procedures, and the interpretation of radiographic films will be performed in accordance with ASME B31.1; the firm intends to utilize the proper film exposure, techniques, and penetrameter to produce density and geometric sharpness in sufficient clarity to determine presence of defects; and that all radiographic films will be reviewed and interpreted, and reading reports signed, by not less than a Certified American Society for Nondestructive Testing Level III Radiographer.

1.5.5 Contract drawings

The contract drawings accompanying this specification provide information on:

a. The approximate minimum inside clear dimension size of the concrete trench and location and elevation.

b. The size of carrier pipes, approximate length, and site location of the system.

c. The routing and elevation of the ~~piping~~concrete trench along the route.

~~d. Location and design of manholes.~~

~~e~~d. The obstacles that must be avoided along the path.

~~f. Location of piping anchors (anchors will be no closer than 3 feet or further than 5 feet from entrance to manholes or buildings) at manholes and/or buildings. The UHDS manufacturer shall incorporate anchors as needed for the system.~~

~~g. Operating pressure and temperature of system.~~

1.6 DELIVERY, STORAGE, AND HANDLING

Equipment and material placed on the job shall remain in the custody of the Contractor until final acceptance whether or not the Contractor has been reimbursed for the equipment and material by the Government. The Contractor is solely responsible for the protection of the equipment and material against damage from any source while stored or during installation. Protect materials against damage from UV light, and entry of water and mud, by installing watertight protection on open ends at all times. Immediately replace sections of the casing or carrier piping found to have been subjected to full or partial submergence in water (which would allow the insulation to become wet). Materials awaiting installation shall be covered to protect from UV degradation.

1.7 SITE CONDITIONS

Classification of the site conditions for the UHDS shall be based on ASTM D2487.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide for this project a designed system and equipment which is of current production and that essentially duplicate systems that have been

in satisfactory use for at least 5 years prior to bid opening at 3 locations. Provide systems that have been operated under pressure, temperature and site characteristics which are equal to or more severe than the operating conditions in this specification and that have distributed the same medium. The system shall be supported by a service organization that can reach the site after a service call within 48 hours.

2.2 PRECAST CONCRETE TRENCH WITH LID

2.2.1 Precast Concrete Trench With Lid

Provide precast concrete trench and lid, manufactured for use with steam and water distribution piping for underground installations.

Precast Concrete: Trench and lid system engineerd for H20 loading

Size precast concrete trench with lid to accomodate all piping, pipe insulation, pipe movement, anchors and guides. Provide minimum clear inside dimension of 24 inch wide by 48 inch high interlocking precast trench sections and matching precast lid sections with waterproof seals between sections and between trench and lid units.

~~Provide 24 inch by 48 inch by 120 inch interlocking precast trench sections and 48 inch wide by 144 inch long lid sections with waterproof seals between sections and between trench and lid units~~

Provide to accomodate steam, condensate, domestic hot water, domestic hot water return, and comressed air piping. Provide pipe supports within each trench section, spaced at not greater than 8 feet on center. Do not place pipe support within one foot of joint in trench system.

Engineered trench and lid system shall be similar to Tindall Model TB2448-120 trench with TS48-144 lids or similar products by CR Barger, Crest Precast, or approved equal.

2.3 PIPE INSULATION TYPE AND MINIMUM THICKNESS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS. Materials containing asbestos will not be permitted. The minimum thickness of insulation for the heat distribution system shall be in accordance with Tables 1 and 2 in which the insulations listed have passed the 96 hour boiling water test.

TABLE 1
MINIMUM PIPE INSULATION THICKNESS (inches)

For Steam (16 to 408 psig) (250 to 450 degrees F)

	INSULATIONS For Drainable/Dryable Systems			INSULATIONS For other Pre-Engineered Systems	
Nominal Pipe Diameter (inches)	Delta	Thermo-12 Super Caltemp	MPT-PF MPT-PC	Calcium Silicate	WSL Polyurethane
1.0	2.5	4.0	2.0	N/A	N/A
1.5	2.5	4.0	2.0	N/A	N/A
2.0	3.5	4.5	2.5	N/A	N/A
2.5	3.5	4.5	2.5	N/A	N/A
3.0	4.0	5.0	3.0	1.0	+1.23
4.0	4.0	5.0	3.0	1.0	+1.22
5.0	4.0	5.0	3.0	N/A	N/A
6.0	4.5	5.5	3.5	1.5	+1.34
8.0	4.5	5.5	3.5	2.0	+1.21
10.0	5.0	6.0	4.0	2.5	+1.31
12.0	5.0	6.0	4.0	2.0	+1.29
14.0	5.0	6.0	4.0	N/A	N/A
16.0	5.0	6.0	4.0	N/A	N/A
18.0	5.0	6.0	4.0	N/A	N/A

NOTE: 1) Delta is available from Rockwool in Leeds, Alabama.
2) MPT is available from Mineral Products of Texas in Houston, TX
3) Thermo-12 and Super Caltemp are available from Johns Manville in Denver, Colorado.

TABLE 2
MINIMUM PIPE INSULATION THICKNESS (inches)
CONDENSATE RETURN

	INSULATIONS For Drainable/Dryable Systems			INSULATIONS For other Pre-Engineered Systems
Nominal Pipe Diameter (inches)	Delta	Thermo-12 Super Caltemp	MPT-PF MPT-PC	Polyurethane
1.0	2.0	3.0	1.5	N/A
1.5	2.0	3.0	1.5	N/A
2.0	2.0	3.0	1.5	0.77
2.5	2.0	3.0	1.5	N/A
3.0	2.5	3.5	2.0	1.05
4.0	2.5	3.5	2.0	N/A
5.0	2.5	3.5	2.0	N/A

TABLE 2
MINIMUM PIPE INSULATION THICKNESS (inches)
CONDENSATE RETURN

	INSULATIONS For Drainable/Dryable Systems			INSULATIONS For other Pre-Engineered Systems
Nominal Pipe Diameter (inches)	Delta	Thermo-12 Super Caltemp	MPT-PF MPT-PC	Polyurethane
6.0	3.0	4.5	2.5	1.32
8.0	3.0	4.5	2.5	N/A
10.0	4.0	5.0	3.0	N/A
12.0	4.0	5.0	3.0	N/A
14.0	4.0	5.0	3.0	N/A
16.0	4.0	5.0	3.0	N/A
18.0	4.0	5.0	3.0	N/A

NOTE: 1) Delta is available from Rockwool in Leeds, Alabama.
2) MPT is available from Mineral Products of Texas in Houston, TX
3) Thermo-12 and Super Caltemp are available from Johns Manville in Denver, Colorado.

2.4 HEAT DISTRIBUTION PIPING

2.4.1 Steam

Pipe material shall be steel; seamless ASTM A53/A53M, Grade B or ASTM A106/A106M, Grade B; or electric resistance welded ASTM A53/A53M, Grade B; Schedule 40. Standard weight will be permitted for pipe sizes 12 inches and above. ASTM A53/A53M, Type F furnace butt welded pipe will not be allowed. Joints will not be allowed in factory fabricated straight section of carrier pipes. Factory fabricated piping sections, as part of an expansion loop or bend, shall have all welded joints 100 percent radiographically inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing (ASNT) Level III radiographer, employed by the testing firm, who shall sign the reading report.

2.4.1.1 Condensate Pipe

Pipe shall be steel; seamless ASTM A53/A53M, Grade B or ASTM A106/A106M, Grade B, schedule 80; electric resistance welded ASTM A53/A53M, Grade B; Schedule 80. ASTM A53/A53M, Type F furnace butt welded pipe will not be allowed. Joints will not be allowed in the factory fabricated straight section of the carrier pipe. Factory fabricated piping sections, as part of an expansion loop or bend shall have all welded joints 100 percent radiographically inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.

Domestic Water pipe and insulation shall match building piping specifications.

Compressed air pipe shall match building piping specifications.

2.4.1.2 Joints

Joints shall be butt-weld except socket-weld joints will be permitted for pipe sizes 2 inches and smaller. Dye penetrant may be used in place of 100 percent radiographic inspection for pipe sizes 2 inches and below. Location and elevation of all field joints shall be indicated on detailed design layout drawings. Split-ring welding rings may be used.

2.4.2 Fittings

Welds in factory fittings shall be radiographically inspected. Radiographs shall be reviewed and interpreted by a Certified ASNT Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer may review all inspection records, and if any welds inspected are found unacceptable in accordance with ASME B31.1, the fitting shall be removed, replaced, and radiographically reexamined at no cost to the Government.

2.4.2.1 Butt-Welded

Fittings shall be steel; ASTM A234/A234M, Grade B or ASME B16.9, same schedule as adjoining pipe. Elbows shall be long radius unless otherwise indicated. Tees shall be full size or reducing as required, having interior surfaces smoothly contoured. Split-ring welding rings may be used.

2.4.2.2 Socket-Welded

Fittings shall be forged steel ASME B16.11; 2000 pound class shall be used for pipe sizes 2 inch and below. Dye penetrant inspection may be used in lieu of radiographic inspection of welded fittings for pipe sizes 2 inches and below.

2.5 EXPANSION LOOPS AND BENDS

Stresses shall be less than the maximum allowable stress from the Power Piping Code (ASME B31.1). Submit pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated 3 dimensional analysis, not later than 7 days after notice to proceed. Demonstrate with calculations that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and that the anchors and the guides will withstand the resultant forces. Detailed design layout drawings shall include all analysis node points. As a minimum, computer analysis results shall include node stresses, forces, moments and displacements. Calculations shall be stamped by a registered Professional Engineer in the employ of the UHDS manufacturer. Detailed design layout drawings and stress and anchor force calculations shall be provided for all loops and bends. Locations of all anchors, guides and supports shall be shown. The calculations shall be based on design characteristics (pressures and temperatures) specified for both the supply and return lines.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Job Conditions

Phasing of demolition and construction shall be as shown on contract drawings.

3.1.2 Interruption of Existing Service

Submit schedule of proposed outages and interruptions of existing services, 14 days in advance. Arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to ensure adequate heat distribution service for existing installations at all times. Only necessary interruptions required for making connections will be permitted, and only at times when approval is obtained from the Contracting Officer. Set all interruptions to be as approved by the Contracting Officer.

3.1.3 Grading

Unless otherwise shown on the contract drawings or the detailed design layout drawings, steam/condensate and high temperature hot water supply/return lines shall be graded uniformly downward not less than 5.0 inches in 100 feet to the lower point of entry between manholes and/or building entries.

3.1.4 Connecting to Existing Work

Submit changes required to the UHDS design due to interferences or conflicts, upon realization of interferences or conflicts. Connect new work to existing work in a neat and workmanlike manner. Make connections only in manholes. Where an existing structure must be cut or existing utilities interfere, such obstructions shall be bypassed, removed, replaced or relocated, restored and repaired. Any changes required to the UHDS design as a result of interferences or conflicts shall be approved by the UHDS designer and the Contracting Officer. Work disturbed or damaged shall be replaced to its prior condition.

3.1.5 Coordination

The location of all items of equipment and work of all trades shall be coordinated. Operability and maintainability of the equipment and systems shall be maintained.

3.1.6 Variations

Any variations from the approved, detailed design layout drawings shall be submitted to the Contracting Officer for approval. Variations shall be signed and sealed by the UHDS manufacturers' professional engineer responsible for the complete design of the UHDS.

3.2 DEMOLITION

3.2.1 Demolition Procedures

Work shall be performed in accordance with requirements for phasing. Pipe, valves, fittings, insulation, and hangers, including the connection

to the structure and any fastenings, shall be removed. Openings in manhole or building walls shall be sealed after removal of piping. Material and equipment removed shall become the property of the Contractor and shall be removed from Government property within 1 week and shall not be stored in operating areas. Flame cutting shall be performed with adequate fire protection facilities available as required by safety codes and Contracting Officer.

3.2.2 Asbestos Removal

Asbestos removal shall conform to NASA requirements.

3.3 PIPE, PIPING JOINTS AND FITTINGS

3.3.1 Joint Preparation

Pipe and fittings shall be cleaned inside and outside before and after assembly. Dirt, scale, and other foreign matter shall be removed from inside the piping by use of a pipe swab or pipe pig before connecting pipe sections, valves, equipment or fittings. Eccentric connectors shall be used as needed between casing sections to provide drainage of casing section between manholes and between manholes and buildings.

3.3.2 Direction Changes

Changes in direction shall be made with factory-built reinforced fittings. Field-fabricated fittings and miters will not be permitted.

3.4 WELDING

Submit Certification of Acceptability of all welds made in the field, upon completion of the project. This certification shall consist of a letter, signed by an official of the independent testing firm or firms examining welds, stating that all provisions of this specification have been complied with, and that all welds inspected radiographically have met the specified acceptability standards. The Contractor will be responsible for welding quality and shall:

a. Conduct tests of the welding procedures used in the work, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and determine that the welding operators have the ability to make sound welds under standard conditions.

b. Comply with ASME B31.1.

c. Perform all welding operations required for construction and installation of the heat distribution system.

3.4.1 Qualification of Welders

Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, and as outlined below.

3.4.2 Examining Welders

Examine each welder to determine the ability of the welder to meet the required qualifications. Welders shall be tested for welds in all

positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall:

a. Weld only in positions in which they have qualified.

b. Identify welds with the specific code marking signifying name and number assigned.

3.4.3 Examination Results

Furnish a list of welder's names and corresponding code markings. Welders which fail to meet the prescribed welding qualifications shall be retested. Welders who fail the second test shall be disqualified for work on this project.

3.4.4 Beveling

Field and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding.

3.4.5 Alignment

Split welding rings shall be used for field joints on carrier pipes above 2 inches to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Field joints 2 inches and smaller shall be made with welding sockets.

3.4.6 Erection

Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. Where the pipe temperature falls to 32 degrees F or lower, the pipe shall be heated to approximately 00 degrees F for a distance of 1 foot on each side of the weld before welding, and the weld shall be finished before the pipe cools to 32 degrees F.

3.4.7 Defective Welds

Defective welds shall be replaced and reinspected in accordance with ASME B31.1. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds shall be tested for qualification.

3.4.8 Electrodes

Electrodes shall be stored in a dry, heated area, and shall be kept free of moisture and dampness during fabrication operations. Electrodes that have lost part of their coating shall not be used.

3.4.9 Radiographic Testing

An approved independent testing firm regularly engaged in radiographic testing shall perform radiographic examination of 100 percent of the field welds in the carrier piping of buried systems in accordance with ASME B31.1. The following shall be furnished: a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to installing casing field joints, backfilling and hydrostatic testing. All radiographs shall be reviewed

and interpreted by a Certified American Society for Nondestructive Testing Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer may review all inspection records, and if any welds inspected are found unacceptable they shall be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.5 HEAT DISTRIBUTION SYSTEM INSTALLATION

Submit a complete description of the design and assembly of the system, materials of construction and field installation instructions, not later than 21 days prior to the start of field measurements. Include sufficient system details to show that the specified minimum insulation thickness has been met. A detailed design layout of the system (plan and elevation views) showing size, type, elevations and location of each component to be used in the system, the design and location of anchors, pipe guides, pipe supports, expansion loops, Z-bends, L-bends, end seals, leak plates, joint locations, pipe and insulation thickness and sizes, types, and movements, connection to manhole and building wall penetrations, and including, if applicable, details of transition point to aboveground or other type systems. Also, if applicable, type and details of the cathodic protection system to be used. Detailed design layout drawings shall be stamped by a registered Professional Engineer. The UHDS manufacturer's representative shall oversee the delivery, storage, installation and testing of the system. Work shall be in accordance with the requirements specified and with the printed instructions of the manufacturer. These specifications shall take precedence over the printed instructions if conflicts arise. Printed instructions shall be submitted to the Contracting Officer prior to system installation. Submit operation and maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, procedures for recording conduit temperatures biannually, and troubleshooting guides, before completion of work. Include in the Manual as-built piping layout of the system with final elevations.

3.5.1 Verification of Final Elevations

For the PIPI system, prior to covering the top of the pipe with PIPI, measure and record the elevation of the top of each pipe at each field joint, 1/3 points along each pipe section, and the top of each elbow. For the PIPI system, elevations of the top of each pipe shall be measured and recorded. Elevations shall be taken at every completed field joint, 1/3 points along each pipe section and top of elbows. These measurements shall be checked against the contract drawings and shall confirm that the conduit system has been installed to the elevations shown on the contract drawings. Slope shall be uniform to within 0.1 percent. These measurements shall be recorded by the Contractor, included in the UHDS manufacturer's representative daily report, and given to the Contracting Officer prior to covering the casing with backfill material.

3.5.2 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be performed as required by the UHDS manufacturer's design and as specified in Division 31. Pipe shall lay on a [redacted] (b) (5) minimum sand bed and shall be backfilled with sand on all sides to a minimum of [redacted] (b) (5) as measured from outside of casing. This sand bedding requirement does not apply to the PIPI system. Foundation for system shall be firm and stable. Foundation and backfill shall be free from rocks or substances which could damage the system coating. Concrete anchor and thrust blocks shall be installed in

undisturbed earth. Backfilling shall not commence until system has been satisfactorily pressure tested (both hydrostatic test of carrier and air test of casing). Minimum depth of burial to the top of the casing (or PIPI envelope) shall be [redacted]. Maximum depth of burial to the top of the casing (or PIPI envelope) shall be [redacted].

3.5.3 UHDS Manufacturer's Representative Responsibilities

The UHDS Manufacturer's representative shall be present at the job site and witness when the following types of work are being performed:

a. Inspection and unloading (not applicable to PIPI).

b. Inspection of trench prior to commencing installation of system.

c. Inspection of concrete anchors and thrust blocks.

d. Pneumatic and Hydrostatic testing.

e. Field joint closure work (not applicable to PIPI).

f. Air test of casing (not applicable to all WSL systems).

g. Holiday test of conduit coating (not applicable to all WSL systems).

h. Repair of any coating (not applicable to all WSL systems).

i. Installation of cathodic protection system (not applicable to all WSL systems).

j. Initial backfill up to 10 inches above the top of the casing.

k. Verification of final elevations. Elevation readings shall be witnessed and recorded.

l. Testing of cathodic protection system (not applicable to all WSL systems).

m. Operational tests.

The UHDS manufacturer's representative shall notify the Contractor immediately of any problems. The UHDS manufacturer's representative shall notify the Contracting Officer of problems requiring immediate action; otherwise, the daily reports shall note any problems encountered and indicate the corrective actions taken.

3.5.4 UHDS Manufacturer's Representative Reports

The UHDS manufacturer's representative shall: prepare and sign a written daily report; present the original daily report to the Contracting Officer no later than one working day after it is prepared; and forward 1 copy to the manufacturer's main office. The report shall state whether or not the condition and quality of the materials used and the delivery, storage, installation and testing of the system are in accordance with the drawings, specifications, and manufacturer's printed instructions and are satisfactory in all respects. When any work connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the UHDS manufacturer's

recommendations for corrective action. The report shall identify any condition that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper manhole entries. The daily reports shall be reviewed, signed and sealed, on a weekly basis, by the registered engineer responsible for the system design. Signed and sealed copies of the daily reports shall be submitted with the payment request. Requests for payment will be denied if the weekly review is not accomplished. Upon completion of the work and before final acceptance, a notarized Certificate of Compliance, signed by a principal officer of both the manufacturing and the contracting firms, stating that the installation is satisfactory and in accordance with drawings, specifications, and manufacturer's instructions shall be delivered to the Contracting Officer. The UHDS manufacturer shall retain a copy of all daily reports and the Certificate of Compliance for 5 years after final acceptance of the system by the Government.

3.5.5 Protection

Casing coating shall be protected from damage during unloading, storage, rigging and installation. Casing and carrier pipe ends shall be protected from water intrusion during unloading, storage, rigging and installation. Piping and accessories shall be protected from damage due to exposure to UV light.

3.5.6 Defective Material

The UHDS manufacturer's representative shall take prompt action to remove from the site all damaged or defective material, subject to rejection in accordance with the quality assurance provisions included in the manufacturer's submittals and printed instructions, and shall order prompt replacement of such material.

3.5.7 (b) (5) Protection Installation

Provide (b) (5) protection for all (b) (5) (b) (5) Assume that (b) (5) (b) (5) Submit design life calculations for the (b) (5) protection system, not later than 7 days after notice to proceed. Calculations shall be stamped by an NACE qualified corrosion engineer. (b) (5) protection systems shall have a minimum design life of (b) (5) (b) (5) shall be provided at all points necessary. Test stations at grade shall be provided on each section of the piping system. (b) (5) (b) (5)

3.6 TESTS

Submit a proposed test procedure and proposed samples of test data sheets for each required test, 30 days prior to the proposed test date. The procedure shall contain a complete description of the proposed test with calibration curves or test results furnished by an independent testing laboratory of each instrument, meter, gauge, and thermometer to be used in the tests. The test shall not commence until the procedure has been

approved. Leak-tightness of all piping systems shall be demonstrated by performing pressure tests (hydrostatic, pneumatic) and operational tests. Heat distribution system shall be pressure tested in conformance with specified requirements and printed instructions for the system supplied; tests shall include carrier piping and casing. The carrier pipe shall be hydrostatically tested. Casings of DDT systems shall be pneumatically tested. Casing and end seals of WSL system shall be tested for intrusion of water into the casing and insulation. Mercury shall not be used in thermometers required for the tests.

3.6.1 Holiday Testing of Buried System Steel Casings

Entire exterior surface of the casing, including the bottom exterior surface, shall be tested for faults in coating after installation in trench, prior to backfilling, using test method and voltage recommended by coating manufacturer. If any holidays are found, they shall be repaired and the coating retested. System shall not be backfilled until all holidays are eliminated.

3.6.2 Pneumatic, Hydrostatic and Operational Tests

Before conducting heat distribution system tests, lines shall be flushed with high pressure water until the Contracting Officer, after examining the discharge, stops the flush.

3.6.2.1 Pneumatic Test

The casing of DDT systems shall be pneumatically tested after welding and before field coating using air as the test medium. The test pressure shall be 5 psig. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the casing has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2) = T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial (1) and final (2) readings. Pressure shall be measured with a pressure gauge conforming to ASME B40.100. A throttling type needle valve or a pulsation dampener and shutoff valve may be included. The diameter of the face shall be at least 4.5 inches with a measurable range of 0 to 15 psig and graduations of at least 0.5 psig. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested while under test pressure by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. Maintain proper safety precautions for air pressure testing at all times during the tests.

3.6.2.2 Hydrostatic Test

Carrier piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1.5 times the heat distribution supply pressure of 125 psig for 2 hours. There shall be no indication of reduction of pressure during the test. Pressure shall be measured with a device calibrated to be read in increments not greater than 0.1 psi.

3.6.2.3 Operational Test

Prior to acceptance of the installation, subject system to operating tests simulating actual operating conditions to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than 6 hours for each portion of system tested. Submit for approval a schedule of the tests to be performed 14 days in advance. Provide calibrated instruments, equipment, facilities and labor, at no additional cost to the Government. When failures occur, problems shall be repaired and test repeated.

3.6.3 Deficiencies

Deficiencies discovered shall be corrected at the Contractor's expense. Major deficiencies, or failure to correct deficiencies, may be considered cause for rejecting the entire installation.

~~3.7 VALVE MANHOLES~~

~~Valve manholes, piping, and equipment in valve manholes shall be in accordance with the contract drawings.~~

3.7 BURIED UTILITY WARNING AND IDENTIFICATION

3.7.1 Plastic Marking Tape

Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines shall be supplied and installed. Tape shall be buried above the pipe during the trench backfilling operation and shall be buried approximately 12 inches below grade. Tape shall be 0.004 inch thick polyethylene. Tape shall be acid- and alkali-resistant and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. The tape shall be of a type specifically manufactured for marking and locating metallic underground utilities. Tape shall be 6 inches wide and printed with a caution and identification of the piping system over the entire tape length. Tape shall be yellow with bold black letters. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

3.7.2 Markers for Underground Piping

Markers for underground piping shall be located along the distribution and service lines. Markers shall be placed as indicated approximately 2 feet to the right of the distribution system when facing in direction of flow in the supply line. The marker shall be concrete 6 inch square or round

section 2 feet long. The top edge of the marker shall have a minimum 1/2 inch chamfer all around. The letters STEAM CONDENSATE shall be impressed or cast on the top, and on one side of the markers to indicate the type of system that is being identified. Each letter shall be formed with a V-shaped groove and shall have a width of stroke at least 1/4 inch at the top and depth of 1/4 inch. The top of the marker shall protrude not more than 1 inches above finished grade.

3.8 THERMAL PERFORMANCE TESTING

The equipment and procedures specified shall be used to ensure acceptable thermal performance of the installed system. Submit manufacturer's data sheets on all UHDS components and the instrumentation required for thermal performance testing, 14 days after notice to proceed. Because of its geometry, the PIPI system is exempt from the thermal performance test requirement; the test results shall be submitted for approval. All materials and procedures described for this test shall be included as deliverables of the construction contract for the system, unless otherwise noted. Due to its geometry, the PIPI system is exempt from this requirement.

3.8.1 Equipment

3.8.1.1 Casing Temperature Measurement

Before backfilling, and after field joint closures have been welded to the casing and the coating has been applied and cured, temperature sensors shall be attached to the exterior of every other field joint closure. The sensors shall be attached with epoxy suitable for use at 500 degrees F. A sensor shall be adhered with epoxy to the coated casing near the midpoint of every other pipe section between field joints. The sensor shall not be located closer than 5 feet from any guide in the interior of the casing. After the sensors have been adhered to the casing, 2 complete wraps of duct tape shall be used to secure and protect the sensor. The radial position of the sensors shall be located 45 degrees from the top center of the casing, at either the 1:30 or 10:30 position, away from the adjacent heat distribution system pipe if present. All sensors shall be type T thermocouples in accordance with ISA MC96.1 copper constantan 20 gauge thermocouples, made from special limits grade thermocouple wire, 0.5 degrees C or 0.4 percent maximum error, with each conductor insulated and an overall jacket on both conductors. Insulation on the thermocouple wires shall be suitable for service at 500 degrees F. The thermocouple wire between sensor location and termination point shall be continuous with no splicing or other connections. Each sensor shall be shown with a special symbol on the detailed design layout drawings and shall be identified by a number and/or letter code, starting from the upstream manhole.

3.8.1.2 Carrier Pipe Temperature Measurement

Carrier pipe temperature shall be measured within the manhole where the panel box is located. Carrier pipe temperature shall be measured by a sensor adhered with epoxy directly to the exterior of the carrier pipe. All sensors shall be type T thermocouples in accordance with ISA MC96.1 copper constantan 20 gauge thermocouples, made from special limits grade thermocouple wire, 0.5 degrees C or 0.4 percent maximum error, with each conductor insulated and an overall jacket on both conductors. Insulation on the thermocouple wires shall be suitable for service at 500 degrees F. The thermocouple wire between sensor location and termination point shall

be continuous with no splicing or other connections. The location of this sensor shall be at either the 1:30 or 10:30 position. At the location of the sensor, the carrier pipe shall be insulated with calcium silicate insulation at least 5 inches thick. This insulation shall extend at least 6 inches on each side of the actual sensor location and shall be clad with an aluminum jacket.

3.8.1.3 Terminals

The wires from each casing or carrier pipe temperature sensor shall be extended into [redacted] (b) (5) The [redacted] (b) (5) sensors shall be labeled at their termination within [redacted] (b) (5) a drawing showing the location of each temperature sensor shall be laminated and attached to the [redacted] (b) (5) All temperature sensors shall be verified as operational by an independent laboratory, hired by the Contractor, after backfilling is complete but before the system is accepted.

3.8.2 Thermal Performance Test

After the system construction is complete, including backfilling, and the system has reached operating condition for at least 30 days, all of the temperature sensors shall be read by an independent laboratory with experience and equipment appropriate for the sensors used. The temperature shall be recorded for each sensor. The temperatures shall be tabulated and submitted in accordance with specified requirements. If temperatures exceed values in Table 3, that portion shall be repaired and temperatures again measured and recorded.

TABLE 3

Carrier Pipe Temperat. TP (degrees C)	Carrier Pipe Temperat. TP (degrees F)	Acceptable Casing Temperature TC (degrees C)	Acceptable Casing Temperature TC (degrees F)
121	250	43	110
135	275	47	116
149	300	50	123
163	325	54	129
177	350	58	136
204	400	65	149
218	425	68	155
232	450	72	162

The following equations were used to calculate the above values:

T@ <(0.261) X (TP) + 44.3 (for English units)
T, <(0.261) X (TP) + 11.5 (for Metric units)

For carrier pipe temperatures between those given in Table 3, the maximum acceptable casing temperature may be either interpolated from the values in Table 3 or calculated using the equations above.

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
02/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2010; Errata 1-4 2011; INT 1-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI and DS 2012; Errata 5-9 2012; INT 13-16 2012; Errata 10-12 2013; INT 17-18 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A240/A240M	(2013a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A580/A580M	(2013a) Standard Specification for Stainless Steel Wire
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C1126	(2013) Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C1136	(2012) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1290	(2011) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts

ASTM C1710	(2011) Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
ASTM C195	(2007; R 2013) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C450	(2008) Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C533	(2013) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534/C534M	(2013) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	(2012) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2012b) Standard Specification for Cellular Glass Thermal Insulation
ASTM C585	(2010) Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
ASTM C610	(2011) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C612	(2010) Mineral Fiber Block and Board Thermal Insulation
ASTM C647	(2008) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C795	(2008; R 2013) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	(1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D2863	(2012) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of

	Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting
ASTM (b) (5)	(b) (5) [redacted]
ASTM (b) (5)	(b) (5) [redacted]
ASTM E96/E96M	(2012) Standard Test Methods for Water Vapor Transmission of Materials

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2758	(2001) Paper - Determination of Bursting Strength

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2012) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	(2012) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS) Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-24179	(1969; Rev A; Am 2 1980; Notice 1 1987) Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-A-3316	(1987; Rev C; Am 2 1990) Adhesives, Fire-Resistant, Thermal Insulation
MIL-PRF-19565	(1988; Rev C) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier

UL ENVIRONMENT (ULE)

ULE Greenguard	UL Greenguard Certification Program

UNDERWRITERS LABORATORIES (UL)

UL 723	(2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials
UL 94	(2013) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.2.2 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet all other requirements of this section. The minimum recycled material content of the following insulation are:

Rock Wool	75 percent slag of weight
Fiberglass	20-25 percent glass cullet by weight
Rigid Foam	9 percent recovered material

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Division 01 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates; G
Pipe Insulation Systems and Associated Accessories
Duct Insulation Systems and Associated Accessories
Equipment Insulation Systems and Associated Accessories

SD-03 Product Data

Certification
Pipe Insulation Systems; G
Duct Insulation Systems; G
Equipment Insulation Systems; G

SD-04 Samples

Thermal Insulation; G

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G
Duct Insulation Systems; G
Equipment Insulation Systems; G

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.4.2 Sustainable Design Certification

Product shall be third party certified in accordance with ULE Greenguard, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog

cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Insulation shall be CFC and HCFC free.

2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation shall have a maximum flame spread index of [redacted] (b) (5) and a maximum smoke developed index of [redacted] (b) (5) when tested in accordance with [redacted] (b) (5) Flame spread, and smoke developed indexes, shall be determined by [redacted] (b) (5) Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Test specimens shall be prepared and mounted according to [redacted] (b) (5)

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 - IP. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos free. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame

spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall

have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested

in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be 0.013 perms or less at 43 mils dry film thickness as determined according to procedure B of ASTM E96/E96M utilizing apparatus described in ASTM E96/E96M. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be in accordance with ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of [redacted] (b) (5) and a maximum smoke developed index of [redacted] (b) (5) when tested in accordance with [redacted] (b) (5) Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of

[redacted] and a maximum smoke developed index of [redacted] when tested in accordance with [redacted]

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet [redacted] flame and [redacted] smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with ISO 2758. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.10 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of [redacted] and a maximum smoke developed index of [redacted] when tested in accordance with [redacted]

2.2.11 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of [redacted] and a maximum smoke developed index of [redacted] when tested in accordance with [redacted]

2.3 PIPE INSULATION SYSTEMS

Insulation materials shall conform to Table 1. Insulation thickness shall be as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - IP. Insulation thickness shall be 1 inch. Comply with EPA requirements in accordance with Division 01 RECYCLED/RECOVERED/BIOBASED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

2.3.1.1 Cellular Glass

ASTM C552, Type II, and Type III. Supply the insulation from the fabricator with (paragraph WHITE VAPOR RETARDER ALL SERVICE JACKET (ASJ)) ASJ vapor retarder and installed with all longitudinal overlaps sealed and all circumferential joints ASJ taped or supply the insulation unfaced from the fabricator and install with all longitudinal and circumferential joints sealed with vapor barrier mastic.

2.3.1.2 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Type I and II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

2.3.1.3 Mineral Fiber Insulation with Integral Wicking Material (MFIWM)

ASTM C547. Install in accordance with manufacturer's instructions. Do not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

2.3.2 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.2.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.2.2 Calcium Silicate

ASTM C533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.2.3 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.2.4 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II to 220 degrees F service. Type I for tubular materials. Type II for sheet materials.

2.3.2.5 Phenolic Insulation

ASTM C1126 Type III to 250 degrees F service shall comply with ASTM C795. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.2.6 Perlite Insulation

ASTM C610

2.3.3 Below-ground Pipeline Insulation

For below-ground pipeline insulation, use cellular glass, ASTM C552, type II.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

Provide factory-applied ASTM C552, cellular glass thermal insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier, with identification of installed thermal resistance (R) value and out-of-package R value.

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB, II, III, and IV. Alternately, minimum thickness may be calculated in accordance with ASHRAE 90.1 - IP.

2.4.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C585, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C1290 Type III may be used. Alternately, minimum thickness may be calculated in accordance with ASHRAE 90.1 - IP.

2.4.2 Duct Insulation Jackets

2.4.2.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.2.2 Metal Jackets

2.4.2.2.1 Aluminum Jackets

ASTM B209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.2.2.2 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands,

minimum width of 1/2 inch.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied while piping and equipment is unheated and uncooled. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests and heat tracing specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

See Sections 26 for electrical coordination.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with [redacted] (b) (5) [redacted] All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is

listed by UL, FM, or a NRTL.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.4.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified

otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

An aluminum jacket or vapor barrier/weatherproofing Jacket or Vapor Barrier/Weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket rom below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and caulk the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-69, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the

bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

3.2.1.3.4 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

3.2.1.5 Pipes in High Abuse Areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, welded PVC, aluminum or flexible

laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Chilled Water (Supply & Return, Piping, 40 F nominal)					
	Cellular Glass	ASTM C552	II	2	Yes
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		Yes
Heating Hot Water Supply & Return, (Max 250 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552	II	2	No
	Faced Phenolic Foam	ASTM C1126	III		ASJ
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping					
	Cellular Glass	ASTM C552	II	2	Yes
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		Yes
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
	Faced Phenolic Foam	ASTM C1126	III		Yes
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		Yes
	Cellular Glass	ASTM C552	II	1	Yes

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Compressed Air Discharge, Steam and Condensate Return (201 to 250 Degrees F					
	Cellular Glass	ASTM C552	II		No
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Faced Phenolic Foam	ASTM C1126	III		ASJ
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		Yes
	Faced Phenolic Foam	ASTM C1126	III		ASJ
	Cellular Glass	ASTM C552	III		ASJ
Condensate Drain Located Inside Building					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Medium Temperature Hot Water, Steam and Condensate (251 to 350 Degrees F)					
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552	I or II		No
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
Steam (351 to 700 Degrees F)					
	Mineral Fiber	ASTM C547	I	2	No
	Calcium Silicate	ASTM C533	I		No

TABLE 1

Insulation Material for Piping

Service

	Material	Specification	Type	Class	VR/VB Req'd
	Perlite	ASTM C610			No
	Cellular Glass	ASTM C552			No

Note: VR/VB = Vapor Retarder/Vapor Barrier

TABLE 2

Piping Insulation Thickness (inch)
Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

Service

	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Chilled Water (Supply & Return, Piping, 40 Degrees F nominal) Condenser Water (Supply and Return Piping 90 degrees F nominal)						
	Cellular Glass	1.5	1.5	1.5	1.5	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Mineral Fiber with Wicking Material	1	1.5	1.5	2	2
Heating Hot Water Supply & Return, (Max 250 F)						
	Mineral Fiber	1.5	1.5	2	2	2
	Calcium Silicate	2.5	2.5	3	3	3
	Cellular Glass	2	2.5	3	3	3
	Perlite	2.5	2.5	3	3	3
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping						

TABLE 2

Piping Insulation Thickness (inch)
Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)						
	Mineral Fiber	1	1	1	1.5	1.5
	Cellular Glass	1.5	1.5	1.5	2	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
Compressed Air Discharge, Steam and Condensate Return (201 to 250 Degrees F						
	Mineral Fiber	1.5	1.5	2	2	2
		1.5*	2*	2.5*	3*	3.5*
	Calcium Silicate	2.5	3	4	4	4.5
	Cellular Glass	2	2.5	3	3	3
	Perlite	2.5	3	4	4	4.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel						
	Flexible Elastomeric Cellular	0.5	0.5	0.5	0.5	0.5
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)						

TABLE 2						
Piping Insulation Thickness (inch) Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Faced Phenolic Foam	1	1	1	1	1
Condensate Drain Located Inside Building						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Steam and Condensate (251 to 350 Degrees F)						
	Mineral Fiber	1.5	3	3	4	4
		2.5*	*	3.5*		
	Calcium Silicate	2.5	3.5	4.5	4.5	5
	Perlite	2.5	3.5	4.5	4.5	5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Steam (351 to 700 Degrees F)						
	Mineral Fiber	2.5	3	3	4	4
	Calcium Silicate	4	4.5	6	6	6
	Perlite	4	4.5	6	6	6

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Horizontal and vertical portions of interior roof drains.

c. Refrigerant suction lines.

d. Chilled water.

e. Air conditioner condensate drains.

h. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, shall be provided for pipe insulation to the 6 ft level.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

3.2.2.3.4 Staples

coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Coat all seams, except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness,

and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'. Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

(1) The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.

(2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation

jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

b. Steam.

c. Condensate & compressed air discharge.

d. Hot water heating.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR

INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.5 Below Ground Pipe Insulation

Below ground pipes shall be insulated in accordance with Table 2, except as precluded in subparagraph Pipe Insulation in PART 3. This includes, but is not limited to the following:

a. Domestic hot water.

b. Heating hot water.

c. Steam.

d. Condensate.

3.2.5.1 Type of Insulation

Below ground pipe shall be insulated with Cellular Glass insulation, in accordance with manufacturer's instructions for application with thickness as determined from Table 2 (whichever is the most restrictive).

3.2.5.2 Installation of Below ground Pipe Insulation

a. Bore surfaces of the insulation shall be coated with a thin coat of gypsum cement of a type recommended by the insulation manufacturer. Coating thickness shall be sufficient to fill surface cells of insulation. Mastic type materials shall not be used for this coating. Note that unless this is for a cyclic application (i.e., one that fluctuates between high and low temperature on a daily process basis) there is no need to bore coat the material.

b. Stainless steel bands, 3/4 inch wide by 0.020 inch thick shall be used to secure insulation in place. A minimum of two bands per section of insulation shall be applied. As an alternate, fiberglass reinforced tape may be used to secure insulation on piping up to 12 inches in diameter. A minimum of two bands per section of insulation shall be applied.

c. Insulation shall terminate at anchor blocks but shall be continuous through sleeves and manholes.

d. At point of entry to buildings, underground insulation shall be terminated 2 inches inside the wall or floor, shall butt tightly against the aboveground insulation and the butt joint shall be sealed with high temperature silicone sealant and covered with fibrous glass tape.

e. Provision for expansion and contraction of the insulation system shall be made in accordance with the insulation manufacturer's recommendations.

f. Flanges, couplings, valves, and fittings shall be insulated with factory pre-molded, prefabricated, or field-fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Insulation sections shall be secured as recommended by the manufacturer.

g. Insulation, including fittings, shall be finished with three coats of asphaltic mastic, with 6 by 5.5 mesh synthetic reinforcing fabric embedded between coats. Fabric shall be overlapped a minimum of 2 inches at joints. Total film thickness shall be a minimum of 3/16 inch. As an alternate, a prefabricated bituminous laminated jacket, reinforced with internal reinforcement mesh, shall be applied to the insulation. Jacketing material and application procedures shall match manufacturer's written instructions. Vapor barrier - less than 0.0000 permeability self adhesive (minimum 2 mils adhesive, 3 mils embossed) jacket greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty, white or natural). Application procedures shall match the manufacturer's written instructions.

h. At termination points, other than building entrances, the mastic and cloth or tape shall cover the ends of insulation and extend 2 inches along the bare pipe.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Duct insulation shall be omitted on exposed supply and return ducts in air conditioned spaces where the difference between supply air temperature and room air temperature is less than 15 degrees F unless otherwise shown. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. Relief air ducts

d. Flexible run-outs (field insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil-headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes.

l. Supply fans.

m. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.5 Duct Exposed to Weather

3.3.5.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.5.2 Round Duct

Laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - Less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply, heavy duty, white and natural) membrane shall be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with metal jacketing sealant to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with metal jacketing sealant.

3.3.5.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.5.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws or vapor barrier/weatherproofing jacket less than 0.0000 permeability greater than 3 ply, standard grade, silver, white, black, and embossed or greater than 8 ply, heavy duty white and natural. Membrane shall be applied overlapping material by 3 inches. No bands or caulking needed-see manufacturing recommend installation instructions.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Pumps.

b. Refrigeration equipment parts that are not factory insulated.

c. Drip pans under chilled equipment.

d. Water softeners.

e. Cold and chilled water pumps.

f. Roof drain bodies.

g. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

TABLE 5		
Insulation Thickness for Cold Equipment (inches)		
Equipment handling media at indicated temperature		
	Material	Thickness (inches)
35 to 60 degrees F		
	Cellular Glass	1.5
	Flexible Elastomeric Cellular	1
1 to 34 degrees F		
	Cellular Glass	3
	Flexible Elastomeric Cellular	1.5
Minus 30 to 0 degrees F		
	Cellular Glass	3.5
	Flexible Elastomeric Cellular	1.75

3.4.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Flashing sealant shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.

d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

e. Exposed insulation corners shall be protected with corner angles.

f. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Flashing sealant or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Converters.

b. Heat exchangers.

c. Water heaters.

d. Pumps handling media above 130 degrees F.

e. Hot water storage tanks.

f. Air separation tanks.

g. Flash tanks.

h. Condensate receivers.

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table 6:

TABLE 6		
Insulation Thickness for Hot Equipment (inches)		
Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)
15 psig or 250 degrees F		
	Rigid Mineral Fiber	2
	Flexible Mineral Fiber	2
	Calcium Silicate/Perlite	4
	Cellular Glass	3
	Faced Phenolic Foam	1.5
	Flexible Elastomeric Cellular (<200 F)	1
200psig or 400 degrees F		
	Rigid Mineral Fiber	3
	Flexible Mineral Fiber	3
	Calcium Silicate/Perlite	4
	Cellular Glass	4

3.4.3.2 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To

ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

e. Exposed insulation corners shall be protected with corner angles.

f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 6 by 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.

g. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.

h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Exposed to Weather

3.4.4.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.4.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover

sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

3.5 FUME HOOD, FLAME HOOD, VENTED CYLINDER CABINET AND PAINT SPRAY BOOTH EXHAUST DUCTWORK INSULATION

Provide UL-listed 2-hour fire rated protective wrap for fume hood, flame hood, vented cylinder cabinet and paint spray booth exhaust duct 10 feet before point of entry penetration into shaft, continuous (individually) within shaft and continuous upon shaft exit through to roof penetration. Shall be a zero clearance to combustible product. Install product in full accordance with manufacturer's UL-listed requirements.

-- End of Section --

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0022	07/11/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)			
		(X)	9A. AMENDMENT OF SOLICITATION NO.
		☐	9B. DATED (SEE ITEM 11)
		☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
			10B. DATED (SEE ITEM 13)
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0022

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 11 July 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0022.

2. In response to questions submitted to date the NASA MSL Project RFI log is provided to supplement information contained in the solicitation. Additional information may be provided at a later date via another amendment. Questions left unanswered are due to the fact that the information is either unavailable, not releasable, or is already identifiable in the solicitation package.

3. The final NASA MSL Project RFI log is incorporated with this amendment.

All other terms and conditions remain unchanged.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
233		Other equipment manufacturers can provide [redacted] (b) (5) [redacted] meters in their equipment to meet project GSA requirements; however, spec section 260913 Power Monitoring System is extensive and will be a large portion of the project value. Is this section required to be provided by [redacted] (b) (5) [redacted] or can independent vendors provide? Will the Power Monitoring System upgrade be part of the same bid /contract? If this section is a separate bid, it enables other manufactures beside (b) (5) to provide a competitive package. Paragraph 2.4 says: "Contractor shall provide the latest upgrade to the existing campus power monitoring system software." Unless 260913 is separated from the rest of the bid package – provided under a separate contract, this is essentially a sole-source project.	Vendors: Independent vendors can provide all of the "Basic Intelligent Electronic Devices (IEDs)". The three Enhanced IED devices must be (b) (5) as specified on drawing E-603 Power Monitoring System: The only upgrades to the existing campus power system is to upgrade the software per paragraph 2.4 to the latest version. There is no intent to do a general upgrade of the Campus power system monitoring as part of this project. Manufactures beside (b) (5) It is the discretion of the general contractor as to whether this is a separate bid package or part of the electrical sub-contractors bid package. Sole source: The existing campus monitoring system is a (b) (5) system. Any software upgrades will be required to be (b) (5) to maintain functionality of the balance of the system. It is not the intent to limit the integration of the MSL systems into the existing package by (b) (5)
244	23 09 23.13 20	Paragraph 3.4.1 through 3.4.11 (Page 50 to 55) – There are numerous requirements in this section that duplicate items that will be tested during our functional performance testing. However, there are no requirements for the CxA to be involved in the Performance Verification Testing (PVT). Please confirm that this Government-witnessed testing is distinct and separate from any CxA functional performance or integrated systems testing and the CS is not responsible for generating any PVT documents nor attending.	See RFI 496.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
326	Sheet Q-001	Sheet Q-001, Casework types: "T" – indicates ESD bench top. Please provide a specification for this worksurface. Does it need to include a wrist strap and grounding plug?	All instances of T-01 and T-02 in the Q drawings are to be provided with the following, with the exception of Flight Software D207 - Room #356 (Tables in #356 are NIC): The following information will be included in 12 36 10 / 2.1.14: Electro Static Dissipative Laminate Worksurfaces: 1. Basis of Design: Bally (Nevamar Static Dissipative Laminate) 2. Product Description: a. Static Dissipative Laminate, suited for a variety of electronically sensitive applications. b. Laminate performance properties shall meet or exceed NEMA LD 3-2000 standards for grade HGP. c. Laminate sheets, shall be available in post formable grade within ½" to ¾" radius, shall be designed for permanent lamination to workstation furniture surfaces and shall be individually certified and labeled to meet the specific electrical property requirements. d. Color: White. e. Surface Finish: Textured finish. f. Properties: >105 to < 109 for surface resistance g. Chemical Resistance: Resistant to common solvents such as Acetone; III Trichloroethylene; Solder flux; Isopropyl; Alcohol; Naphtha. h. Use standard contact or white glue adhesives and standard (NEMA) application procedures for High Pressure Decorative Laminates. i. Provide an upper shelf for equipment (where indicated), surge protected outlets integral to the work bench, drawers, and continuous wrist strap monitoring.
327	Section 123610	Section 123610 – specs indicate the type and size of the caster required for the table but doesn't detail the material used to manufacture the table. What is the load capacity required? What is the minimum thickness of the steel legs and cross members?	Table frame shall consist of a 12 gauge welded tubular frame and leg assembly. The following pertain: a. Provide a self-supporting moveable workstation table design. b. Top of countertops shall be adjustable to 30 IN and 36 IN high, above finished floor. c. Each unit shall be complete so that units can be relocated at any subsequent time without requiring field application of finished ends or other such parts. d. Provide integral, adjustable leveling device in steel leg with non-marring foot cap. e. Adjustable module shelving shall attach to the structural module upright with height adjustability on 1 inch increments.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
378	27 41 16	What will be the contractor's responsibility or government process for any codec settings/configurations that will need to be done to the codec after a classification switch?	The subcontractor/vendor will be responsible to provide professionally trained and experienced installers to setup and configure the codec system according to government specifications. Once the codec is integrated with the audio and video systems and is ready to connect to the data network, the contractor will contact Ed Scaife or Nancy Shevlin, as alternate, to obtain data network configuration settings and to arrange testing with NASA video conferencing services for operational validation.
447	RFI-240 RFI-233	The response to RFI-240 references the answer supplied in RFI-233. RFI-233 has not been included in the amendment packages (1 through 12). Please provide the question and response for RFI-233.	See response to #233
492	All Bid documents	Please indicate if there is any expecatation to provide Anti-Terrorist / Force Protection control equipment of sequences of operation for this project?	The GC is responsible for providing all the systems, equipment, controls and interface requirements per the contract documents.
496	01 91 00.00 40	What are the requirements of the Commissioning Specialist in regard to the following specifications? 01 83 00.07 40 Reliability Centered Acceptance for Facility Shells 01 86 12.07 40 Reliability Centered Acceptance for Mechanical Systems 01 86 26.07 40 Reliability Centered Acceptance for Electrical Systems In paragraph 1.5.3.2 Responsibilities (of the Commissioning Specialist) in 01 91 00.00 40 Commissioning there is a requirement to perform all commissioning work specified herein and in related sections under the direct guidance of the Commissioning Team Supervisor. In paragraph 1.5.3.3 Building Systems indicates the equipment and the sections. Item (6) lists the Reliability Centered Acceptance sections listed above. In those sections there is no requirement for the Commissioning Specialist to witness any of those tests. In researching of the RCBEA Guide, no specific requirements for the Commissioning Specialist in regard to the testing was found. Does the Commissioning Specialist have to witness all the tests listed in the Reliability Centered Acceptance specifications, or does he just need to verify that the testing was completed? If witnessing is required can sampling method be used (i.e. witness a percentage of tests). If so, what would the percentages be?	Please refer to specification section 01 91 00.00 40 (Commissioning) for commissioning requirements. In the case of conflicts between the specification section 01 91 00.00 40 and the Reliability Centered Acceptance specifications, section 23 09 23.13 20, or others, the Commissioning specifications shall govern, as the RCM sections, section 23 09 23.13 20 and others are referenced within that specification. Regarding the specific question about the Commissioning Specialist, the Commissioning Specialist shall verify that the testing was completed, but does not need to witness every test.
502		Amendment # 9, RFI answer # 221 – does not clear up the confusion. Please review Sheets Q001 and Q203D for tables T01 and Tables T02. These are not listed on Sheet Q401 per RFI answer # 221. Tables T01 and T02 are shown on Q001 to have ESD worksurfaces, please provide the specifications for this material or advise if this is to be black epoxy resin.	See response to RFI 326.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
01		Please advise what the deadline is for RFIs.	The deadline for the submission of RFI's is 13 June 2016
02	00 22 13 Supplementary Instructions to Bidders and 01 23 60 Options	The bid items listed in Section 00 22 13 indicate 0001A Price for the entire work, complete, but excluding 0001B, 0001C, and 0001D which are listed as unit prices. Section 01 23 60 list ten (10) deductive alternates and seven (7) additive alternates. Please advise if we are to create our own bid form to provide pricing for the alternate options or will GSA provide a revised bid form.	A new bid form specifically for Bid Items is provided.
03	LS-001 and Q-201E	Please provide specifications for Paint Spray Booths	See Specification 11 53 00 - Section 2.2.2
04	Q-201F	Drawing refers to RQ Drawing Series for the HIRF consultant drawings. Amendment 0002 revises this floor plan. Please confirm there are no RQ Drawings.	The RQ drawings are included in the set, but they will be revised.
05	CD101 and CD104	Will demolition of Buildings 1192, 1192C, 1192D, 1192E and 1213 be complete prior to award of this contract	All facilities have been demolished under separate contract as stated.
06	G-004	If the parking option/alternate is not awarded, will the contractor still have access to existing parking lot for construction use during the contract?	Based on the General Contractors proposed plan NASA will consider the use of the back 3rd of Parking Lot 1268/grassed area to within 30' of the Power Station fenceline.
07	Phase II RFP	How should changes in proposed personnel from Phase I be addressed in Phase II?	Refer to Appendix A, Techical Evaluation Factors/Minimum Standards for Phase I, Factor II, Project Team Qualifications. "In the event that any substitutions in key personnel are proposed, the Offeror shall provide to the Contracting Officer the information required for that position as stated in the Key Personnel Minimum Requirements and Phase I Submittal Requirements. Written notification and submittal of a change in the Offeror's Key Personnel must be identified timely to allow for proper evaluation by the Government." The changes in personnel and requisite documentation shall be submitted with the Phase II Technical Proposal.
08	C101 The Agreement and FAR 52.219-9	This Small Business Subcontracting Plan FAR is incorporated by reference. Please advise if a plan is required to be submitted with the proposal. If so, will GSA provide an example or template?	A subcontracting plan is required per the project solicitation. Please see C201 The Solicitation. The subcontracting methodology form was provided in the C201 The Solicitation package posted to FedBizOpps.
09	08 11 16	Specification section 08 11 16 references ASTM F2248 for Blast Resistant Glazing. Could you tell us the standoff distance? Level of protection? Is this project subject to DOD requirement and if so, what version?	Per GSA/NASA direction, this project is not subject to DOD requirements. It is following the Interagency Security Committee (ISC) Standard, Physical Security Criteria for Federal Facilities dated 4/12/2010. The project has been designated as Facility Security Level [redacted] (b) (5) [redacted].
10	General	If project team members have changed since the phase 1 proposal how would the GSA like this documented?	Please see response to RFI #07
11	General	What is the deadline for submitting RFIs?	Please see response to RFI #01
12	01 23 60	The specifications and drawings reference a number of deduct and add bid options. However, the bid form provided in amendment 0003 does not list the bid options. Please confirm that the options are to be provided and clarify how they shall be included in the price form.	See the "Options" tab in the Excel file that was sent.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
13	Civil Dwgs	Drawings CG102 and 103, CD 106 and 107, CS102 and 103 reference the parking lot add alternate. Please provide a more specific delineation of what is to be included in the base bid and what is the add alternate	The Base Bid is shown on sheet CS104. The Add Alternate is as shown on sheets CD106, CD107, CS102, CS103, CG102 and CG103 and as described in the Parking Lot Add Alternate note.
14	Dwg L403, L502	Detail 7/L403 calls for precast veneer and coping for bioretention planter #5. Detail 5/L502 calls for cast stone. Please clarify if this is cast stone or precast.	The precast/cast stone is meant to be the same product, consistent with the building façade material.
15	Dwg L403	Detail 6/L403 calls for a brick veneer on knee wall. Please confirm if this is correct and if it should be installed on both sides of the knee wall.	Correct, the knee wall at the entrance to Bldg. 1268 is to be brick veneer, both sides, as shown on detail #6 on L403.
16	Dwg L503	On detail 1/L503 the concrete subbase foundation for the benches is labelled concrete pavers. Please clarify.	Label is incorrect. Benches are to have a concrete foundation in the minimum size shown if no slab is provided below the bench location condition otherwise. Bench locations where concrete subslabs are present only require anchor bolts embedded the depth shown. Bench foundations within brick mulch should be slightly subsurface (1") as to not be expressed at the surface.
17	Dwg A202	Detail 2/A202 calls out the façade as IGU3F. Please confirm that the façade should be TRP1 in this area.	The façade should be TRP1 in this area, not IGU3F.
18	Dwg CG501	The sequence of construction on drawing CG501. Sequence #3 seems to be erroneously added since it is already included as #12. Please confirm #3 is to be deleted from the sequence of construction.	Yes, sequence of construction note #3 should be deleted.
19	Dwg CD101, CD104, CD108	Drawings CD101, CD104, and CD108 indicates that demolition of Buildings 1192, 1192C, 1192D, 1192E, and associated site and utility features will be performed by others under separate contract. Should it be assumed that the foundations for these buildings and associated site features will be demolished and removed by others as well? If removal of foundations is to be included as part of this bid please provide as-builts so scope or work can be determined.	The drawings for the demolition of Buildings 1192, 1192C, 1192D, 1192E and associated site and utility features are provided in the Bid Set as Reference Drawings RC-003 – RC-006. No as-builts were provided.
20	Dwg CD101	Drawing CD101 indicates existing underground foundation limits West of Building 1192E. Will these foundations be demolished and removed by others as well? If removal of foundations is to be included as part of this bid please provide as-builts so scope or work can be determined.	The drawings for the demolition of Building 1168 are provided in the Bid Set as Reference Drawings RC-001 and RC-002. No as-builts were provided.
21	Dwg S040	Drawing S040 indicates and notes two existing foundation that are not clearly shown on the Existing Conditions Plan. It is noted that these underground foundations are to be demolished prior to building construction and grading. Will the removal of the these foundations with 24" of finish grade outside MSL building footprint and within 15' of the MSL building face be by others? If removal of foundations is to be included as part of this bid please provide as-builts so scope or work can be determined.	The drawings for the demolition of Buildings 1192, 1192C, 1192D, 1192E and associated site and utility features are provided in the Bid Set as Reference Drawings RC-003 – RC-006. No as-builts were provided.
22	Dwg A433	Detail 3 on drawing A433 references a ceiling hung cable supported custom dichroic mobile. Please provide more information on this custom dichroic mobile, such as manufacturer used in basis of design, for accurate pricing purposes.	As stated on 3/A433, the mobile is to be a custom-made piece for the space. The components are as indicated on 3/A433 as well as in detail 14/A541

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
23	Dwg A711A, A735, A740	On drawing A711A, in between row line G.6 and G.8, on column line 7, there is a dichroic glass blade display. This is also shown on detail 15 on page A735 and on detail 6 on page A740. Drawings state "blade display signage… length to be determined with final graphic". Please provide more information on final graphic, length, and basis of design.	Blades are NASA-provided aluminum wind-tunnel artifacts - GC to provide and coordinate the base, mounting, installation, and display signage. Final display signage information is to be provided by NASA - the height and construction of the signage is as indicated on 6/A740.
24	083419.10 20	Door (b) (5) is listed as fire rated, drawn as standard coiling fire door; however the specification calls for accordion folding door. Please clarify door type.	Door (b) (5) is a fire-rated overhead coiling door as indicated on the door schedule. The specification section indicated in the question is in reference to the accordion folding fire doors at (b) (5)
25	Dwg A503	Detail 10 on A503 does not show sufficient side room to allow the guide rail cover plate to be installed at the top of the jamb. The interior tube steel and wall can not be tight against the guide rail at the top of the door.	Documents indicate design intent. It is the responsibility of the GC to coordinate construction/field conditions.
26	Floor Plans	Note 19 on the floor plans identifies tie-off points. Details or descriptions of the tie-off points could not be located. Please provide information regarding this item.	Tie-off points are as indicated on A102B, A105A, A106A, and A106B. Provide OSHA compliant roof tie off system for use by workers on the roofs.
27	01 35 26	Specification Section 01 35 26 – 1.19 discusses the requirements of asbestos abatement. Please confirm if any asbestos containing materials are anticipated to be encountered? Please provide location, type, and quantity that may be encountered?	No asbestos containing materials are anticipated to be encountered on this project.
28	01 35 26	Specification Section 01 35 26 – 1.19 discusses the procedures for the removal and/or reinstallation of transite panels. Please confirm if any transite panels are expected to be encountered? Please provide location and/or services that may be affected.	No transite panels are anticipated to be encountered on this project.
29	13 20 00	Please verify that the following specification is a requirement of this RFP: Section 13 20 00 page 29 paragraph 3.6.3.2 "All Type A clean areas shall be maintained to a level that can pass a felt test inspection by the Owner, or his representative. Where such inspection detects contamination, the work shall be stopped until satisfactory clean-up is completed."	Confirmed - work is to be as specified.
30	13 20 00	Please describe the "post-installation support services" referenced in section 13 20 00 page 6 paragraph 1.6.	Refer to part 3 of specification section 12 30 00 for all close out and training requirements.
31	Dwg E221A	Please verify that the statement on E-211A is correct RM 128 Common Electronics Fabrication (column 9-11 & C-D) "COORDINATE WITH CLEAN ROOM MANUFACTURER FOR ALL REQUIRMENTS WITHIN THIS AREA". All other documents do not state this is a Cleanroom. If this is a Cleanroom, please send updated documents indicating the contract requirements.	Room 128 Common Electronics Fabrication is NOT a cleanroom. The note on E211A will be revised.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
32	07 81 00	Steel fireproofing note 1 on the S-100 series drawings states that "all steel designated with a "FP" designation shall be fireproofed as required to achieve a (b) (5) rating. Reference architectural and life safety plans for requisite UL assemblies…." The fire protection notes on drawing G-002 state "Provide (b) (5) spray on fire proofing for all structural supports…." Please clarify.	Roof structures shall be fire rated as follows: [redacted] (b) (5)
33	Dwg A601	The Door Schedule General Notes on A601 states for door manufacturer to paint exterior portion of door and frame and field paint the interior portion. This is not a typical application. Can this requirement be changed to field paint entire door and frame.	All doors are to be finished per the Door Schedule Notes on A-601 and as noted in 08 11 13 section 2.8.
34	Dwg Q-001	Q-001 Lab Casework, General Information – Paint: States Architect to select color. Confirm colors to be selected will be a standard color and not custom.	Refer to specification section 12 36 10, Paragraph 2.2.1 "…Color of finish shall be as selected by the Contracting Officer from the manufacturer's standard colors."
35	Dwg Q401	On drawing G401, various finishes are noted to be selected by architect or contracting officer. Please confirm colors will be selected from manufacturer's standard colors and that custom colors are not required.	Refer to specification section 12 36 10, Paragraph 2.2.1 "…Color of finish shall be as selected by the Contracting Officer from the manufacturer's standard colors."
36	Dwg G403	Please confirm NIC under Spec. No. column means Not in Contract for the General Contractor.	Refer to Legends and Abbreviations, drawing No. Q-0001.
37	Dwg S001	S001 Notes state that up to 2 feet of existing fill may be required to be removed to achieve stable subgrade. Please confirm that this note applies to the unsuitable fill unit price cost for unsuitable soil included on the bid form?	Confirmed. The unit price "0001D" in the Bid Items table applies to the removal and replacement of such soils.
38	Structural Dwgs	The structrual drawings are missing section information throughout. Please provide.	Please provide an RFI requesting specific information that you feel is lacking. Structural sections have been provided as a part of the Structural drawing set.
39	Dwg A711B	Please provide information for the heavy duty steel floor plate shown around the HIRF lab on drawings A711B.	Please see Amendment 0002. Area to be revised.
40	01. 01 33 00	Specification 01. 01 33 00, 1.10e Submittal Review Period: Requires Contracting Officer to have 30 working days for approval of submittals. Due to the nature of the project, we request to reduce this approval time to 15 working days.	The timeframe specified in section 01 33 29, paragraph 1.10.e for submittal review by the Contracting Officer is reduced from thirty (30) working days to fifteen (15) working days.
41	01 23. 60, 01 33 29	Specification 01 33 29 LEED Documentation, Section 1.3 states project designed for LEED Silver. 01 23 60 Options, deduct alternate 8 requests credit to achieve LEED Silver. Please clarify that the base bid requires LEED Silver be obtained.	Specification 01 33 29, paragraph 1.3 is in error. The LEED rating in the first sentence should state "GOLD" and not "SILVER".
42	31 23 19	The geotechnical report does not appear to be provided in the RFP documents per Specification 31 23 19, 1.4.1. Can a copy of the geotechnical report be provided?	A Report of Subsurface Investigation and Geotechnical Engineering Services was prepared for this project by GET Solutions, Inc. dated July 23, 2014. The information contained in this report is being provided as information only. The government accepts no responsibility or liability for the analysis or conclusions contained in this document.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
43	01 10 00	Spec Section 01 10 00, 1.14 Work Restrictions state to perform work that results in disruption to operations after hours, weekends, …. Please define the work considered to be disruptive to operations so it can be priced accordingly.	Please amend specification 01 10 00 paragraph 1.14.B with the addition of the following: "Examples of work considered to be disruptive include but are not limited to noises that prevent normal conversation within adjacent buildings; vibrations that might interfere with ongoing NASA experiments or testing; odors that cause discomfort or disruption to Center employees; and any other activities that would adversely impact the efficient operation of the Center or impair the Center from fulfilling its mission."
44	01 10 00	At the end of section 01 10 00 there is a section 2.14 Site Signage. Please confirm the only purpose of this is to define the requirements of the construction sign.	Confirmed.
45	01 31 10	Section 01 31 10, 1.5,F,4.e Time Impact Analysis. Please consider making the TIA due 15 work days from the beginning of a delay caused by unforeseeable circumstances in lieu of the 5 work days specified.	The timeframe specified in section 01 31 10, paragraph 1.5.F.4.e.iii for submission of a TIA in the event of an unforeseeable delay is extended from five (5) days to fifteen (15) days, provided that written notification to the Contracting Officer is provided as soon as practicable after the delay begins and in no case more than the five (5) days originally specified.
46	Structural Dwgs, Laboratory Dwgs	Various details in the Laboratory drawings (2/Q201A, 3/Q201C, 2/Q205A, etc.) show a powder coated or pre-finished overhead structural frame and references the architectural and structural drawings. Information about the overhead structural frame could not be located. Please provide information on this system. Additionally, detail 3 on Q401 shows the structure 3' OC, however, concrete framing plan note 14 on the S100 drawings states 6' OC. Please clarify.	Information regarding the structural frame is located on the structural drawings, including a basis of design, as well as in Specification Section 05 50 13. The structural drawings indicate the insert system spacing into the concrete, the spacing of the grid elements suspended below is as indicated on the A and Q drawings.
47	10 22 43	Please provide a basis of design for the ceiling supported frosted glass marker board sliding panels. Please provide the number of panels and configuration for the system.	Configuration is as indicated in 10 22 43 and 1/A541. Assume the following panel quantities: First Floor: 8 panels Second - Fourth Floors: 9 panels/floor

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Master RFI #	Spec Reference	Bidder Question	GSA Response
48	CD108	Contractor Parking -Work Note states "Mill asphalt and Provide Asphalt overlay on Parking Lot at the completion of the project. Maintain Current grades, Adjust Rim of existing catch basin as necessary. Re- stripe parking lot to current condition. Replace broken or damaged curb". Please clarify scope – the existing lot is concrete not asphalt and milling is not practical. Please quantify extent of existing curb that is considered broken or damaged.	The intention of the note is to restore the parking lot to its condition prior to using it as a staging area. Please revise the note as shown below. SHEET CD108 DELETE NOTE: "MILL ASPHALT AND PROVIDE ASPHALT OVERLAY ON PARKING LOT AT THE COMPLETION OF THE PROJECT. MAINTAIN CURRENT GRADES, ADJUST RIM OF EXISTING CATCH BASIN AS NECESSARY. RE- STRIPE PARKING LOT TO CURRENT CONDITION. REPLACE BROKEN OR DAMAGED CURB" REPLACE WITH NOTE: "PROVIDE PRE-CONSTRUCTION PHOTOGRAPHS OF THE STAGING AREA IN ACCORDANCE WITH SECTION 01 32 33 "PHOTOGRAPHIC DOCUMENTATION". UPON COMPLETION OF WORK, THE STAGING AREA SHALL BE CLEANED OF ALL DEBRIS, INCLUDING CATCH BASIN STRUCTURES LOCATED IN THE AREA. CLEAN THE PAVEMENT USING A POWER SWEEPER AND VACUUM. RE-ESTABLISH (PAINT) ALL PAVEMENT MARKINGS WITHIN THE STAGING AREA AT THE LOCATIONS EXISTING PRIOR TO THE USE OF THE AREA. MATERIALS AND CONSTRUCTION MUST BE IN ACCORDANCE WITH SECTION 32 17 23.00 20 "PAVEMENT MARKINGS", EXCEPT MARKING SHALL NOT BE RETROREFLECTIVE. ALL CONSTSTRUCTION WITHIN THE STAGING AREA SHALL BE SATISFACTORILY REPAIRED OR REPLACED PER SECTION 01 50 00 'TEMPORARY FACILITIES AND CONTROLS'.
49	CS101 Benches #38	Draw show a total of 4. Note say typical of 3. Please advise?	Note should read Typical of 4 - see also L202.
50	CS101	Rectangular on North West corner of site is not identified – please clarify what is required?	Rectangle is the Building ID Sign - see L101.
51	CS101	Note #10 identifies as concrete sidewalk. This conflicts with drawing LP201 which call area to be Lawn- please advise?	Area is to be as indicated on LP201.
52	Architectural Dwgs	Please clarify the floor base type to be used at all restrooms. There is a conflict between the restroom elevation and finish floorplans. Restroom plans (A-410 & A-411) show ceramic tile floor base at all locations. The finish plans (A-711A – A-715B) show terrazzo base at all locations.	In the Base Bid, the wall base is to be terrazzo at all restrooms. For Deduct Alternate 2, provide ceramic tile wall base at all restrooms.
53	Architectural Dwgs	Please clarify which material is to be used at the base of the building. The elevations show granite in the material legend but the arrows label that same material as cast stone cladding (See detail 7 on A-511 as a reference). There is also no mention of granite in the specification.	The base of the building is to be a cast stone base per the details, and per Specification Section 04 20 00. All references to granite should read 'CAST STONE'.
54	L503	Please provide a basis of design or finish and dimension information for the decorative bollards shown in detail 3/L503.	See 05 50 13 / 2.9 for structure sizing. Bollards to be finished with High Performance Coating - Color to be selected by Architect from Manufacturer's full range.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
55	Architectural Dwgs, Structural Dwgs	Drawing A105A shows an MPL 4 screen wall on column line G.6. Please provide a section through this screen wall. Additionally, the MPL 4 detail on A301 references the structural drawings for information on the screen wall post supports. This information could not be located. Please provide.	Screenwall construction to be similar to 6/A-504 & 12/S-553.
56	Architectural Dwgs	The lens display area shown in detail 4/A740 references the structural drawings for information on the structural steel support. This information could not be located. Please provide.	Sizing for the steel members shown in 4/A740 shall be HSS5x5x1/4.
57	01 35 26.00 41, 09 90 00, 21 13 00.00 40	The specifications are contradicting regarding the painting of sprinkler pipe throughout different sections where it is referenced. Please clarify the color (red or match adjacent) and number of coats for the painting of sprinkler pipe according to its location (concealed or unconcealed). Section 01 35 26.00 41 Paragraph 1.18.11 states "Sprinkler piping that is concealed does not have to be painted. Unconcealed sprinkler piping shall be painted RED." Section 09 90 00 Paragraph 3.7.1.a "Piping in Unfinished Areas" states "Provide primed surfaces with one coat of red alkyd gloss enamel…" Section 09 90 00 paragraph 3.7.1.b "Piping in Finished Areas" states "Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems." Section 21 13 00.00 40 paragraph 3.1.1 states "apply two coats of enamel paint to all fire protection piping, valves, and appurtenances, excluding Siamese connections. Use paint color No. 11105 (red) in accordance with section 09 90 00." Therefore, in this section is it calling for all (concealed and unconcealed) fire sprinkler piping to be painted red.	Comply with the statements in Specification Section 21 13 00.00 40. Provide priming as required, and two coats of red paint to all fire protection piping, valves and appurtenances, whether concealed or exposed.
58	Architectural Dwgs	What is the required finish on the lab side of the partitions surrounding the clean rooms on level 1 between columns 1-8/C-D? Per the partition schedule, these walls are shown as [redacted] rated, which will require the drywall seams to be taped and finished. Please clarify whether the lab side of these partitions will require a primed or painted finish.	The lab side of these partitions are to be painted PT-2 like all other laboratory partitions - see Finish Plans.
59	Architectural Dwgs	Are the concrete floors within the clean rooms on level 1 between columns 1-8/C-D required to be sealed? Per deduct alternate #9, providing a warm lit shell at the clean room locations will require the floors to be sealed concrete. Please clarify whether the concrete floor will still need to be sealed if deduct alternate #9 is not exercised.	If deduct alternate #9 is not exercised, the floors for the cleanrooms are to be as specified in 13 20 00.
60	Architectural Dwgs	Details 2 and 3 on A511 show the exterior horizontal sun shading devices. The details call for a perforated infill panel to match the curtainwall. Please advise if there is a basis of design for the sun shading devices or provide information on the size, shape, and density for the perforations.	The sun shading devices are as indicated in 08 44 00 section 2.1.13. The perforation pattern is to be selected by the Architect from the Manufacturer's full range of round hole perforations.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
61	Architectural Dwgs	Please confirm the only STC Rated door assemblies are the ones noted in the Comments column on A-601/A-602/A-603 (Door Schedule). Per A-601, Door Schedule General Note #8 states, "All Doors in a STC Rated Partition shall have a minimum STC 45 rating". Per the Door Schedule comments column, there are 3 STC 45 and 1 STC 50 rated door assemblies called out. However, per the Partition Schedule, there are many more STC Rated Partitions that do not have STC Rated Door Assemblies as part of the door schedule.	All doors in STC rated partitions are to have a minimum STC 45 rating per Door Schedule General Note #8. The doors specifically called-out with STC ratings on the Door Schedule are part of the Secure Work Area.
62	Amendment 0002	Revised Technical Evaluation Factors for Phase II still require a narrative on the contractor's approach to procuring and installing the HIRF laboratory even though the same amendment replaced the HIRF lab with the WISE3R space. Please clarify.	For the purposes of the Technical Evaluation, please assume that the WISE3R will be substantially similar to the HIRF and will be furnished by the same vendor.
63	Amendment 0002	Technical Evaluation Factors for Phase II state there is a maximum of five (5) pages allowed for Factor 1 PROJECT MANAGEMENT/DELIVERY PLAN (PMDP). There are no less that fourteen (14) sub-factors to respond to in Factor 1. Five (5) pages will not be enough to properly address each sub-factor. Request at least fifteen (15) pages be allowed. Would prefer thirty (30) page maximum.	The page limits remain as stated. Please note that a schedule and staging plan do not count against the stated page limit.
64	Sheet A441	Detail 5/A441 shows a precast terrazzo tread/riser based on Wausau E-31. Wausau E-31 ranges in thickness from 1/2" to 1". This tread riser/thickness appears to be 1-1/2" thick. The Wausau rep recommends 3/4" thick. Please advise if you want the thickness shown in 5/A-441 (approximately 1-1/2") or a size that is available using E-31.	Wausau E-31 ranges in thickness from 3/4" to 2". Precast terrazzo tread/rise thickness is shown as design intent - final thickness will be based on the final product selected to meet the requirements of 09 66 23 Section 2.11.
65		Please provide the missing section designations (section bubbles with no reference in it) on S101-A, S101-B, S-102A, S-102B, S-103A, S-103B, S-104A, S104B, S-105A, S-105B, S106A, and S-106B.	A printing error has resulted in working view sections in the Revit model. These section marks do not represent intended documentation views
66		WD-1 is utilized on the finish floor plans, but not provided for on A-701 finish legend. Please identify the wood material on the walls around the Elevator 1 & 2 core areas.	All WD-1 references should read WW-1. See A-701 for WW-1 information.
67		RB-3 resilient base is utilized on the floor plan, but not provided for on A-701 finish legend. Please identify the material.	RB-3 references are in error. RB-3 will be removed from A-701. RB-2 is to be provided within all laboratories. RB-1 is to be provided at all other locations noted with resilient base on the finish plans.
68		EP-2 flooring is utilized on the floor plan, but not provided for on A-701 finish legend. Please identify the material.	EP-2 references are in error. Replace all EP-2 references with SC-1. The finish plans will be updated.
69		EP-3 flooring is utilized on the floor plan, but not provided for on A-701 finish legend. Please identify the material.	EP-3 references are in error. Replace all EP-3 references with EP-1. The finish plans will be updated.
70		PT-5 wall finish designation is used in the restrooms, however, PT-5 on A-701 finish legend is flat black paint to be used above Unistrut in the labs. Please advise.	Finish Plans will be revised to the following: Rooms 101, 103, 113, 115, 129, 131, 201, 203, 213, 215, 229, 231, 301, 303, 313, 315, 329, 331, 401, 403, 413, 415, 429, 431 wall paint is to be PT-1
71		SP-1 flooring is utilized in the large Elevator 3, but is not provided for on A-701 finish legend. Please identify the material.	Finishes for Elevator 3 are to be provided per 14 21 13 Section 2.1.1

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Master RFI #	Spec Reference	Bidder Question	GSA Response
72	316213.20 - Precast/Prestsressed Concrete Piles 2.1.10 Pile Driving Points	Is $100,000 waste of money, not normally used or needed in Tidewater-Hampton Roads area of Virginia?	The design team takes no exception to the elimination of the pile driving points provided the contractor's geotechnical engineer and the pile subcontractor have no concerns that the piles will be damaged during the driving operations.
73	230923.132	The contract documents do not appear to provide the level of participation required for BAS Controls.What is the level of BIM coordination and participation required for DDC Controls Contractor? Please indicate the minimum trade size conduit, conduit rack system widths devices, panels etc., which will be required by your BIM manager / Contract for BAS controls. Typically we provide the following, "BIM participation as provided by JCI: We will attend weekly coordination meetings with all trades. Drawing of all models in BIM software will be done by others. JCI will provide input and required device dimensions/revits where appropriate."	The type of objects required to be modeled and coordinated are indicated in Vol 1, Section 01 78 25 BIM, Level Of Development (LOD) section. If the object types are specified in the LOD then they must be modeled and coordinated regardless of their size. For instance, see page 591 of the Vol 1 PDF, section D5020.30 Power Distribution, that indicates which types of objects are required and to what Level Of Development they should be modeled. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.
74	E-301, E-600A, E-600B	Confirm the equipment tags shown on Drawing E-301 for XFMR B and XFMR A are incorrectly noted and should be switched.	Equipment tags for XFMR "A" and XFMR "B" on drawing E-301 are incorrect, and should be switched. Also, it shall be noted that Switchboard "A" was incorrectly specified on the Switchboard schedule on drawing E-800. Switchboard "A" shall increase in size from 2500A to 3000A.
75	E-600A, E-800	Confirm the circuit designations shown on drawing E-600A are to correspond to the CKT number on Drawing E-800	Circuit numberings on drawing E-600A are to correspond with circuit numbering on drawing E-800.
76	E-600A, E-600B, E-800	Confirm (b) (5) (designated for a Surge Protective Device) on (b) (5) was been moved to (b) (5)	The Surge Protective Device (SPD) on (b) (5) of (b) (5) has been moved to (b) (5) of (b) (5) SPD shall be fed from a (b) (5) frame circuit breaker from (b) (5) of (b) (5) (b) (5) of (b) (5) shall be replaced with a (b) (5) trip spare circuit breaker.
77	E-600B, E-800	Confirm CKT 4 on SWB-C is designated as a space and does not require a 100A Breaker	(b) (5)
78	E-600B, E-800	Drawing E-600B indicates a (b) (5) Breaker feeding Panel (b) (5) off (b) (5) Drawing E-800 (b) (5) panel schedule indicates a (b) (5) breaker. Which is correct?	
79	E-600B, E-800	Drawing E-600B indicates (b) (5) Breakers feeding (b) (5) on both (b) (5) (b) (5) Drawing E-800 (b) (5) panel schedule indicates (b) (5) breakers for both of these circuits. Which drawing is shown correctly?	
80	E-800	Drawing E-800 (b) (5) Circuit (b) (5) indicates the panel designation to be (b) (5) This should read, (b) (5) correct?	
81	E-600B, E-800	Drawing E-600B indicates a (b) (5) Breaker feeding Panel (b) (5) off (b) (5) Drawing E-800 (b) (5) panel schedule indicates a (b) (5) breaker. Which is correct?	
82	E-600B, E-800	Drawing E-800 (b) (5) indicates a Surge Protective Device circuit designation. E-600B does not indicate this circuit. Please clarify	(b) (5) shall not have a Surge Protective Device. (b) (5) shall be provided with (b) (5) frame, (b) (5) trip circuit breaker labeled as spare.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
83	E-800	Drawing E-800 does not indicate there is to be a load on circuits 26, 27 and 30. Please verify this is correct.	Switchboard "C"—Circuit 26 load: 17.4kVA, Circuit 27 load: 17.4kVA, Circuit 30 load: 28.3kVA.
84	E-800	Drawing E-800 does not indicate there is to be a load on circuit19. Please verify this is correct.	Switchboard "B"—Circuit 19 load: 22.0kVA
85	70523	Refer to section 3.3.5 of the specifications that states " Hold Excluded Building Areas at the Outdoor Pressure Level". Please confirm the extent of the test envelope and areas of the building that need to be excluded from the air barrier testing.	The test envelope is to include the entire building. No areas of the building are to be excluded from the air barrier testing. Section 3.3.5 will be deleted from 07 05 23.
86		Please confirm if the buiding needs to comply with DOD Minimum Antiterrorism Standards and what the blast mitigation criteria is as there is no information in the contract documents on the ATFP requirements for the project	See response to question #09.
87	A-411	Utility shelves (Toilet Acc. W) are shown in the smaller Janitors closets (119A, 219B, 319B, 419B) per detail 16/A-411. Should a shelf also be included in Janitors Closets 155, 369 and 469?	Yes. Please provide the shelf in Janitors Closets 155, 369, and 469 as well.
88	A-411	Detail 2/A-411. Should the box in the Womens room located opposite from the toilet accessory L in the mens room near the door also be called out as toilet accessory L?	Yes. Please provide the L accessory by the door in both toilet rooms. The L designation along the back wall (column line D.7) should read 'K'. 2/A-411 will be updated.
89		No locations were found for corner guards on the project. Please confirm desired locations.	Corner guards are as indicated in details 8/A-416, and 11 & 12/A521.
90	A-734	Please confirm the breakout space markerboard shown on detail 9/A-734 occurs only on the 2nd floor.	No. The breakout space 9/A-734, noted on A-712A, occurs in the same stacked location on floors 2, 3, and 4.
91	P-102B	Please show piping to the ES/EW-1 indicated on drawing P-102B at column D19 (or delete the note if it is incorrect)	There is no ES/EW-1 at column D19. Please disregard this text.
92	A-410/ A-411	Toilet accessory 'X; for the sufrace mounted towel bar is not shown on any toilet room elevation. Please advise if this toilet accessory is to be installed, and if so please provide location.	Toilet accessory 'X' is to be installed in each Shower Room - 129 & 131 - along CL E, adjacent to 'T'.
93	A-621	The following rooms are shown on signage schedule A-621 to receive type K signs, which are designated for stairs. This appears to be in error, please advise on the correct sign type for these rooms: 457, 461, 463, 465, 469, 471, 473, 475, 479	Rooms 457, 461, 463, 465, 469, 471, 473, 475, & 479 are to receive sign type E. Sign type K was indicated in error.
94	A-601, A-602, A-603	Door schedules on A-601, A-602, A-603 list several HM door frames, however no spec is provided. Please provide.	See Steel Doors and Frames - 08 11 13.
95	A-601	Door schedule on A-601 lists door 107C-A and 107C-B as "frameless" frame type. Detail 13.A-603 offers information. Please provide additonal information (spec, additional details, etc).	See Door Hardware - 08 71 00 Section 3.5.
96	A-601	The first row of the door schedule on A-601 is incomplete. There is no door number, room name, door type, frame type, fire rating, details, or hardware group. However, other cells are completed. Please provide.	Kindly disregard this row - it was included in error.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
97	Spec 016230, LP202	Spec 012360 lists Add Alternate 1: Parking lot. Add parking lot north of Victory Street, west of West Taylor Street and south of Langley Boulevard as shown in the construction documents. When a count was done on plants show on LP202, it appears there is a conflict. Please confirm the planting schedule on LP501 only contains plants in the base bid, and does NOT include the plants in the add alternate.	The plant schedule on sheet LP501 contain the species/quantities inclusive of the alternate for the parking. Quantities on the plans govern with the following quantity updates to the schedule for the trees: 43 – MV, 15 – PP, 7 – PT, 9 –QA(QF), 21 – QP.
98	LP501, LP202	LP202 indicates location and quanties of exterior plants in the Add Alternate 1: Parking Lot. There are a number of trees identified as QF, that do not appear on the plant schedule on sheet LP501. Please provide additional information on these plants.	QF is a typo, it is QA – the White Oak in the plant schedule on LP501.
99	E-600B, E-600C, E-600A	General note 5 on drawings E-600B and E-600C are currently located in a position that makes the note unreadable. Please reposition note 5 or confirm that the verbiage remains the same as note 5 on drawing E-600A	General note 5 shall be repositioned. For drawings E-600A, E-600B, and E-600C, General Note 5 shall read as follows: PER NEC ARTICLE 701, LEGALLY REQUIRED STAND-BY SYSTEMS AND THE LIFE SAFETY SYSTEM ANALYSIS FOR THIS PROJECT, 701.2 DEFINITIONS, AECOM HAS DEFINED THE "EMERGENCY SYSTEMS" FOR MSL AS THOSE SERVING THE FOLLOWING: [redacted] (b) (5)
100	04200, S-501/18, S-502/11	The architectural elevations and Detail 18 on S-501 call for a cast stone veneer at the base of the structure. The key on the elevations and detail 11 on S-502 call for Granite. There is no specification for Granite. Please confirm that all locations where granite is called for on site is to be cast stone	See response to #53.
101	A-521	Are the only locations for the corner guards to be at the columns as shown in details 11, 12 on A-521?	See response to #89.
102	A-521	Please clarify if the wings of the corner guards should be 2" as per the specifications or 3 1/2" per the drawings? Also the specifications appear to require corner guards to color match adjacent walls where the drawings show them to be stainless steel - please advise.	The corner guards are to be 3 1/2" stainless steel.
103		Deduct Option #2 requests for a price to delete Terrazzo stair treads/risers. What material should we assume will replace the terrazzo? Or will it be assumed to be bare/sealed concrete?	See 01 23 60 section 3.1
104	A-105A	A single leaf door at Column Line 7, south of column line H.2 does not have a door tag. Please provide additional information on this door.	Door south of CL H.2. at CL 7 is to be a swinging door/gate in the screenwall - it is to match the finish and construction of the adjacent screenwall.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
105	A-472,A-410	Detail 12/A-472 indicates a stainless steel shelf in the restrooms. Details 11/410 and 10/410 show the elevation, but no lengths are indicated. 1/A-410 does show a dashed line above the toilets and urinal, please confirm this is the stainless steel shelf.	See 2/ A-410 tag 'Z'.
106	Spec 062000	Spec 062000/2.4.4 and 062000/3.3 lists closet hanger rods. None are shown on the drawings, please provide locations, sizes, and quantities.	Closet hanger rods are not required under this contract. Delete 06 20 00 / 2.4.4.
107	Spec 062000	Spec 062000/3.1.2 lists wood base. None are shown on the drawings, please provide locations, sizes, and quantities.	Wood wall base is not required under this contract. Delete 06 20 00 / 3.1.2.
108	Spec 129300	Spec 129300 lists tables and chairs, waste receptacles but none are shown on the drawings. Please provide locations and quantities.	Movable tables and chairs and waste receptacles are not included under this contract. Delete 12 93 00 / 2.7 & 2.8.
109	07 54 23 / 07 42 13	Refer to Section 1.11.1 of Specification 07 54 23 Thermoplastic Polyolefin (TPO) Roofing and 1.9.1 of Specification 07 42 13 Metal Wall Panel Systems, Screenwall and Canopies, where it identifies the requirement of a “No Dollar Limit” Manufacturer’s Warranty for the roofing system and the metal panels. Please be advised that roofing and metal panel subcontractors will not be able to comply with this requirement as the bonding sureties, who back their project obligations and project warranties, will not provide a payment and performance bond, nor back the roofing and metal panel warranties, if the “No Dollar Limit” warranty is a contractual requirement. In addition, General Contractor's will also not be able to bond the "No Dollar Limit" warranty. Can the Government waive the requirement for "No Dollar Limit" warranties for the roofing and metal wall panel systems?	The NDL warranties are from the manufacturers, not the GC or the subs, so there should be no effect on bonding. Refer to 07 42 13.1.9.1: Metal Wall manufacturer warranty requirements Refer to 07 54 23.1.11.1: Roof Manufacturer warranty requirements Refer to 07 54 23.1.11.2: Roofing System Installer Warranty for installer warranty requirements
110		The contract documents do not appear to provide the level of BIM participation required for BAS Controls.What is the level of BIM coordination and participation required for DDC Controls Contractor? Please indicate the minimum trade size conduit, conduit rack system widths devices, panels etc., which will be required by your BIM manager / Contract for BAS controls. Typically we provide the following, “BIM participation as provided by JCI: We will attend weekly coordination meetings with all trades. Drawing of all models in BIM software will be done by others. JCI will provide input and required device dimensions/revits where appropriate.”	See response to question #73.
111	J&A Documents	Please confirm the GSA will not accept alternative manufactures for the items identified in the J&A's included in Amendment 0002.	Confirmed.
112	Amendment 0003	Confirm we to write in the actual actual quantities in the No. Units column for Bid Items 0001B and 0001C.	Confimed.
113	Amendment 0003 and S-101A and S-101B	Provide a Unit Price Bid Item for the battered piles found on the structural drawings. These will be a different cost than the compression piles.	Please see update Bid Sheet, which adds a line item for Batter Piles.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
114	Amendment 0003	Confirm the TOTAL BASE BID cost on the GC Price Proposal Form by Division breakdown should equal the TOTAL BASE BID cost on the GC Price Proposal Form by Paragraphs 0001A - 0001D.	Confirmed. The total amounts on the two tabs should equal.
115	08 44 00 and Details 2 & 3/A511	Paragraph 2.1.13 requires aluminum sunshades with fixed airfoil extrusion shapes attached ot the outriggers. The drawings require flat metal panel with a perforated hole pattern supported by the outriggers. Please clarify which sunshade assembly is desired.	The horizontal sunshades are to be flat metal panel with a perforated hole pattern supported by the outriggers. See also response to Question 60.
116	08 41 13	Please provide ATFP blast requirement, charge weight and level of protection for aluminum storefront and curtainwall.	See response to Question 09.
117	S-101A, S-101B and S-525	Please provide the depth of Combined Pile Caps (CPC) 1 through 6. Depth is not indicated on the drawings.	See below for pertinent combined pile cap thicknesses: 18/S-525 – 42" Thick 20/S-525 – 48" Thick 1/S-526 – 48" Thick 2/S-526 – 48" Thick 10/S-526 – 48" Thick 8/S-526 – 42" Thick
118	01 33 29 LEED Documentation	Paragraph 1.3 states that no substitutions or variations to the credits will be allowed without written consent from the Contracting Officer. The documents require Silver certification. In achieving Silver certification on our previous projects, we generally apply for a total of 54-58 points. Table 1 shows a total of 66 required points. This puts the project in the Gold certification range. Will the contractor be allowed to submit for Silver certification or will we be required to submit for Gold certification, thus complying with all of the indicated Contractor credits?	Specification 01 33 29, paragraph 1.3 is in error. The LEED rating in the first sentence should state "GOLD" and not "SILVER".
119	Q-403	Please confirm all O/O equipment shown on Q-403 will be delivered and installed by the GSA during the 730 construction period, before BOD.	No. It is anticipated that the O/O items will be installed after substantial completion.
120		Please provide the anticipated delivery date and the installation duration of the owner-furnished/owner installed WISE3R lab so that we may address this item in our proposal schedule.	The WISE3R delivery date is not yet known The installation duration is to be determined by the General Contractor.
121	A-101B	Does the GSA anticipated requiring access over and beyond the access provided by the exterior opening for Door 170-D for the WISE3R lab components?	ETS-Lindgren does not require additional openings beyond those available for assembling the Chambers. They do require laydown space equal to about half the area of the chambers, which we believe can be covered by the remaining space within Room 170.
122	Q-403	Will the GSA be responsible for all hoisting of O/O equipment?	Yes.
123	Q-403	Will the GSA require use of the elevator during delivery and installation of O/O equipment?	Yes, but it is anticipated that any such requirements will be after substantial completion.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
124		Please advise where Oral Discussions will be held. NASA Langley or GSA Mid-Atlantic Region Philadelphia. This has a cost impact to the project.	Oral Discussions will be held at NASA Langley.
125		Respectfully request an extension to the proposal due date to June 23. Monday bid dates are unconventional as it will require travel on Sunday in order to hand deliver the proposal.	The proposal due date remains unchanged. Any extension will be communicated via an official amendment. Please note that all submissions are to be made electronically. Hand delivery is neither permitted nor desired.
126	A-701	FGL-1 is indicated on the Finish Schedule on A-701. No specification section is provided. Confirm this is Section 06 73 01 FIBERGLASS REINFORCED PLASTIC (FRP) GRATING.	Confirmed. FGL-1 as specified in 06 73 01 FIBERGLASS REINFORCED PLASTIC (FRP) GRATING.
127	C201 and 01 30 00 and 01 35 26.00 41	Phase I submission requirements outline the Key Personnel as does Section 01 30 00. C201 states the Construction Project Manager, the Construction Superintendent, the Construction MEP Coordinator and the Quality Control Manager be on the construction site, full time and totally dedicated to the project, i.e. no other duties. It seems odd Section 01 35 26.00 41 NASA LANGLEY SAFETY REQUIREMENTS does not indicate a Site Safety and Health Officer (SSHO) requirement to be full time and on-site. Section 01 45 00.00 10 QUALITY CONTROL refers to the Safety and Health Manager (SHM) as part of the QC staff, but does not provide duties or state they are required full-time. Please advise what the GSA requirements are for the SSHO or SHM.	The requirements for the Safety and Health Manager are as stated in specification 01 45 00.00 10 (Quality Control). The General Contract has complete responsibility for jobsite safety and is given the latitude to manage safety in a manner it deems most effective.
128	01 35 26.00 41	The specifications refer to asbestos abatement. However, we do not find any on the drawings. Please advise if asbestos abatement is required.	No asbestos containing materials are anticipated to be encountered on this project.
129	31 23 19	Please provide a copy of the geotechnical report and soil borings. It is not included in the project manual.	See Question #42.
130	230923.132	SF-11 / 12 Damper interlock note M-101B Call out to 36x36 damper connected to duct serving SF-11 indicates this damper to be interlocked with SF-12. Please indicate if this damper is actually to be interlocked to SF-11 and not SF-12	The southern one of the two 36”x36” outdoor air dampers should read “interlock to SF-12”.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
131	230923.132	CT-1/2 Basin level controls Div. 236500 2.5.1.6 (page 6) States: "Cold Water Basin Equipment. Include sump with removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. Provide float valves with adjustable arms. Valve sizes larger than 1/2 inch pipe size shall be the balanced piston type. Valve seats and disks shall be replaceable. Provide electric water level control." However M-601 Sequence of Operation paragraph 4 states: "COOLING TOWER BASIN LEVEL CONTROL SHALL BE MAINTAINED THROUGH DUAL ELECTRONIC PROBE WATER LEVEL CONTROLLER LOCATED IN EACH CELL. BAS SHALL [redacted] (b) (5) [redacted] (b) (5) [redacted] 1. Please indicate the following: a. Which basin water level control type shall be required? b. Which division shall provide the level controller? c. We are unable to locate a specification for a "Dual Electronic Probe Water Level Controller in the contract documents, if this type of controller is required, please provide specifications or indicate where this system is specified.	a. The basin water level control shall be [redacted] (b) (5) [redacted] one set for the high level alarm, one set of the low level alarm, one set for high level cutoff, one set for low level cutoff, one set for make-up control. b. The Div 23, the cooling tower manufacturer, shall provide the level controller, including the high water alarm, the low water alarm, high water cutoff, low level cutoff and make-up control. The Div 23, the BAS manufacturer, shall provide [redacted] (b) (5) [redacted] (b) (5) [redacted] c. The specification for the cooling tower 23 65 00 shall include: "water level controller, including dual electronic liquid-sensing probe type, one set for the high level alarm, one set of the low level alarm, one set for high level cutoff, one set for low level cutoff, one set for make-up control".
132	230923.132	CT-1/2 Basin heater controls 1. Div. 236500 2.5.3.12 Electric Basin Heater states: "Heater shall be the electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 40 degrees F at an ambient temperature of zero degrees F. Heater shall be complete with control thermostat, transformer, contactor, and low water level heater protection." However M-601 Sequence of Operation paragraph 4 states" THE COOLING TOWER BASIN TEMPERATURE SHALL BE CONTROLLED BY TEMPERATURE SENSORS. INDIVIDUAL BASIN HEATERS SHALL ENERGIZE WHEN WATER TEMPERATURE DROPS TO 38°F AND DE-ENERGIZE THE HEATERS WHEN WATER TEMPERATURE RISES TO 40°F. THE BAS SHALL [redacted] (b) (5) [redacted] (b) (5) [redacted] 1. Please indicate the following: a. Which basin water heater type shall be required? b. Which division shall provide the heating controller? c. Will the required basin water heater be controlled by thermostats or controllers with temperature sensors?	a. The basin water heater shall be electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 40 degrees F at ambient temperature of zero degrees F. Heater shall be complete with control thermostat, transformer, contactor, and low water level heater protection. b. The Div 23, the cooling tower manufacturer shall provide the basin heater. The Div 23, the BMS manufacturer shall provide a [redacted] (b) (5) [redacted] (b) (5) c. The control shall be by a thermostat provided by the cooling tower manufacturer.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
133	230923.132	CT-1/2 Auto Bleed off valve M-601 Condenser and Chilled Water Control System Diagram indicates an automatic bleed off to drain valve, however the sequence of operations does not appear to address the operation of this valve. Please indicate the following: a. Is this valve required? b. Which division is to provide this valve? c. What is the control sequence for this valve?	a. The cooling tower automatic bleed-off valve is required. b. The cooling tower automatic bleed-off valve shall be provided by Div 23, by the cooling tower manufacturer. c. The bleed-off valve shall be controlled by [redacted] (b) (5) [redacted] (b) (5)
134	230923.132	Vib-Accelerometers Which Division Provides? Div. 23 05 48 00 40 Page 7 states: "Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers. Provide pressure switches on each set of filter banks. Provide vibration accelerometers with breakout boxes. Provide vibration accelerometers with signal conditioners. Provide quantity per table below." However SECTION 23 09 23.13 20 Page 30 Part 2 2.2.9 Vibration Equipment Monitoring States: "Provide vibration-Accelerometers, per specification section 23 05 48.00 40, on equipment. Vibration Accelerometers shall [redacted] (b) (5) [redacted] Both Sections appear to require that section to provide the same devices? Please indicate the following: a. Which division should provide these?	a. All vibration accelerometers shall be provided by Div 23, by the BMS manufacturer.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
135	230923.132	SSF-1 Controls SSF-1 Side stream Filtration system SECTION 23 65 00 Page 11/12 states: "2.6 SIDE STREAM FILTRATION Provide side stream filtration for condenser water system. Pressure rating minimum 125 psig, temperature rating minimum 100 deg F. Provide capacities as scheduled on the drawings. System shall include: a. Separator b. All interconnecting piping and valves c. UL listed NEMA 4X motor starter and controls including 115 volt transformer and with safety disconnect and H.O.A. switch. d. Inlet/outlet valve kit e. Programmable Logic Controller f. Premium Efficiency Motor g. Pump basket strainer h. Inlet flange/grooved connector i. Outlet flange/grooved connector3/4" purge outlet j. Inlet and outlet pressure gauges k. Reinforced rubber housing However M-601 Points list indicates the following points: a. Pump Status Input, b. Pump Diff. Press. Input, c. Pump Flow Switch Input, d. Pump Off-On Command Output, e. Pump Proof Alarm, f. Pump Vib-Accelerometer Alarm, g. SSF-1 Hi-Analog Alarm, h. SSF-1 Proof Alarm Please indicate the following: a. Are the points as listed on M-601 (shown above) required to be provided by the equipment vendor in section 23 65 00 as part of the controls as listed in that section or are they to be overlaid on top of the controls for that section and provided by 23 09 13 20? b. Is there a requirement to provide integration to the controls for this system?	a. The side stream manufacturer shall provide a side stream filter with pressure gauges for manual reading and a controller with a differential pressure indicator. The BMS manufacturer shall provide [redacted] (b) (5) [redacted] (b) (5) b. The BMS manufacturer shall provide, [redacted] (b) (5) [redacted] (b) (5) [redacted]
136	230923.132	ACD Air Cooled Duct Seq of Ops There appears to be no sequence of operations or Flow diagrams or description of the equipment labelled ACD "Air Cooled Duct" Resolution of Problem: Please indicate if there is any scope of work for the BAS Control System.	[redacted] (b) (5) [redacted]

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Master RFI #	Spec Reference	Bidder Question	GSA Response
137	230923.132	FCU Controls By whom? 230000 Page 30 Fan Coil Units States: Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Please indicate if this paragraph is part of these specifications, or if valves and controls should be included by Div. 23092313 20 BACnet DDC for HAVC?	a. The Div 23 FCU manufacturer shall provide the chilled water control valves with (b) (5) [redacted] (b) (5) [redacted]. The Div 23 BMS manufacturer shall provide the return air space temperature sensor. b. The FCU shall be controlled by [redacted] (b) (5) [redacted] (b) (5) [redacted]
138	230923.132	VAV Controls By Whom? Section 230000 Part 2 2.12.2 Variable Volume, Single Duct Air Terminal Units 2.12.5 States: DDC Controls Provide [redacted] (b) (5) [redacted]. Provide with room sensor that is compatible with temperature controls specified. 2.12.2.5.1 Damper Actuators See Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC. 2.12.2.5.2 Terminal Unit Controllers See Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC. 2.12.2.5.3 Room Sensor Provide a wall mounting room sensor per Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC. Please indicate Who provides these controls?	The Div 23 BMS manufacturer shall provide controls for the office VAV terminal units.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
139	230923.132	Electrical Installation Clarification Request 23 09 23.1320 Page 15 states: 2.4.3 Wiring: "Provide complete electrical wiring for the DDC System, including wiring to transformer primaries. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring shall be exposed plenum rated wiring. Wiring shall be routed parallel and perpendicular to building structural members. Where practical, low voltage cables (<100) shall be bundled together and supported from J-hooks and or cable trays. All exposed cable shall be supported as in accordance with the requirements of the National Electric Code and as a minimum be supported every 5 ft. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, above suspended ceilings, in attics, and within ductwork. Contractor shall submit electronic files of the drawings." Please identify / clarify the following: 1. Where conduit would be required for control circuit wiring? 2. Please confirm that this specification allows for all class 2 control wiring less than 100 volts to be exposed cabling where properly support by J-hooks and cable trays.	1. Wiring where 120 volt has been specified requires metallic tubing. 2. Confirmed, J-hooks and cable trays are acceptable for the less than 100 volt wiring.
140	230923.132	[redacted] (b) (5) Spec section 230923.1320 paragraph 2.1 requires the building control system to be compatible with [redacted] (b) (5) SPec section 012360 paragraph 3.1 deduct alternate no. 10 specifies connecting building control systems to [redacted] (b) (5) Please clarify what is required for this project? What [redacted] (b) (5) system is the MSL building required to interface? What are the interface and integration requirements of the MSL project DDC system specified in 230923.1320? Thank you.	[redacted] (b) (5)

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Master RFI #	Spec Reference	Bidder Question	GSA Response
141	230923.132	Vib-Accelerometers Spec Requirements / Manufacturer requested 230548.0040 Page 7/8 states: 2.2.8 Vibration Accelerometers Provide 24 volt Vibration Accelerometers, with internal DIP switch, capable of accepting signal input of acceleration, velocity, temperature and displacement, capable of dual banding for filter outputs. Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers. Provide pressure switches on each set of filter banks. Provide vibration accelerometers with breakout boxes. Provide vibration accelerometers with signal conditioners. We are unable to locate a Vibration Accelerometer which meets all of the specifications as listed above. Please provide a manufacturer / make / model which this specification is based on or which is approved as meeting all of the requirements above. In-lieu of the former request please provide a Vibration Accelerometer manufacturer / make / model which is currently in use and is deemed acceptable to NASA at this time.	Connection Technology Center, Inc. is an approved vibration accelerometer manufacturer - CTC AC102-1A and CTC LP202-1R1-1D
142	230923.132	Main Steam Meter connection M-707 Shows Main Steam Meter connection "BACnet System" Also indicates Steam Pressure and Steam Temperature but does not indicate if it is connected to the "BACnet System". Please indicate if the "BACnet System" referred to is the system defined in SECTION 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC and is therefore to be included in this project under that sections scope of work. Please indicate if the steam pressure and temperature sensors shown are also connected to the BACnet system.	(b) (5) [redacted]
143	230923.132	EF-6 Refrigerant Purge Fan / Dampers EF-6 Refrigerant Purge Fan located on 3rd level roof above Chiller plant is shown on M-601 to have a Purge Damper. The Sequence indicates there is "a" damper, which appears to be at the end of the duct line drawing. M-102B shows this Ductwork as having 4 drops in the chiller plant all terminating at 8" AFF (refer to Notes 13 & 14) but does not indicate motorized damper/s? Please indicate is there only one damper, or are there 4 (one at each drop)? If there is only one where is it located?	There is only one refrigerant purge motorized damper (not 4). The refrigerant purge motorized damper shall be located in the main duct just upstream of the EF-6.

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144	230923.132	Lab Control Equipment / Clarifications Required Clarification is needed for all fume hood scheduled airflows and valve numbers. It appears that the schedules do not match the plans. Box type, Box flows and If designate as Lab (Yes/No) are not correct. For example: It appears that 9 fume hoods are present with only 5 scheduled on the VAV BOX SCHEDULE for LABS and only 1 fume hood 2-EF-1-1 is consistent with the air balance schedule from M-102L showing 825max CFM. Other Fume hoods scheduled for example 3-EF-1-3 and 3-EF-1-4 show 0 CFM. Fume hoods 4-EF-1-1 and 4-EF-1-2 do not appear to be scheduled. Fume hoods 3-EF-1-1 and 3-EF-1-2 appear to be scheduled in the Non-Lab portion of the schedule. Additionally it is requested that Clarification be provided with regard to the Sequence of Operations for lab module types 1 (W/O fume hoods) and type 2 (W/ fume hoods). A sequence is requested for each lab room configuration as the Types shown do not match the room equipment and configurations on the plans	a. Each of the 9 fume hoods requires Lab VAVs with 825 CFM each. The EF for all of the fume hoods is on schedule M-802. The VAV schedules for the rooms with fumes hoods are on schedule M-804. The seq of operation for lab VAVs with fume hoods is in the drawings, on sheet M-609 detail 2. b. The seq of operation for office VAVs is in the drawings on sheet M-605 detail 2. The seq of operation for lab VAVs is in the drawings, on sheet M-609 detail 1, 2, and 3.
145	RFP	The Value Engineering Suggestions state “The Value amounts you provide are for comparison purposes only and will NOT be used to adjust your bid. Any VE suggestions the Government wishes to pursue will be addressed after the contract award as changes to the contract.” Please clarify if the VE provided will be factored into the selection of the Contractor. Please confirm that the VE values provided are only estimates since the VE design will need to be finalized.	The Value Engineering suggestions offered by the Contractor will not be scored and are not part of the selection criteria. It is confirmed that the VE estimates provided by the Contractor are not considered final, fixed price offers. If the Government elects to pursue a VE suggestion, the Contractor will be expected to negotiate in good faith as it would with any other change to the contract..
146	01 33 00	Amendment 2 states "The Government and its representatives reserves two (2) weeks of review time for submittals…." This conflicts with specification 01 33 00 paragraph 1.10.e which states a review period of 30 working days. Please confirm that the submittal review period will be two weeks in accordance with amendment 2.	The timeframe specified in section 01 33 00, paragraph 1.10.e for submittal review by the Contracting Officer may be reduced from thirty (30) working days to fifteen (15) working days. Please note the that the time specified is working days and not calendar days, so the review time is closer to three weeks than the two weeks stated in the question.
147	01 33 00	Please advise if the QC Manager submittal review period can be shortened from 15 to 10 working days due to the project schedule.	The timeframe specified in section 01 33 00, paragraph 1.10.e for submittal review by the QC Manager may be reduced from fifteen (15) working days to ten (10) working days for critical submittals. Please note that the duration specified is in working days.

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148	Structural Dwgs	Reference response to RFI #38. The structural plans include building section references that do not provide the building section number or the sheet on which the section is drawn. For example, on S-101A there are approximately 50 section references missing information. There are approximately 300 incomplete section references throughout the structural drawings. Please provide this missing information or reissue the drawings to remove erroneous section references.	Please see the response to #65.
149	01 91 00.00 40	Per Amendment 2 and specification 01 91 00.00 40 paragraph 1.3, the Government and its representatives will retain an independent, 3rd party Commissioning Agent/Authority. Per specification 01 9100.00 40 paragraph 1.5.1, "the Commissioning Firm shall be a subcontractor of the prime Contractor...." Please confirm that the prime contractor is required to hire a Commissioning Firm in addition to the Commissioning Agent/Authority hired by the Government. Please also confirm that the Commissioning Team Supervisor and Commissioning Specialist roles cannot be performed by the prime contractor's own personnel.	Confirmed. The Commissioning Firm, including the Commissioniong Team Supervisor and Commissioning Specialist, shall be a subcontractor of the prime as stated in 01 91 00.40 paragraph 1.5.1.
150	Site Furnishings	Are alternative items of equal quality but different manufacturer permitted for site furnishings?	The specifications are intended to be non-proprietary, as this is not a sole-source product. The "Or equal" applies to any products that can meet the performance specifications, a standard approach for federal procurements.
151	Site Furnishings	Please specify location and quanitity of exterior waste receptacles, tables, and chairs.	Please see the response to #108
152	11 53 00-6, 2.2.1.2 / Drawing Q-403	The specification indicates fume hoods to have "double wall ends, not more than 4" wide . . . ". Typically hood wall thicknesses vary from 4-3/4" to 5" to provide adequate speace for plumbing service valves and associated piping. Please review and indicate if the minimum dimension can be increased.	Yes. 5" maximum double walls width is acceptable.
153	11 53 00-4, 2.1.6	The specification indicates filters however this is not indicated on the drawings. Please review and indicate the size and quantity of filters if they are required.	11 53 00 / 4 / 2.1.6 is the definition of HEPA filters, if they occur anywhere within the project, or if they are integral part of some equipment. The scrubber filter for the vented cabinet is self contained within the scrubber.
154	11 53 00-8, 2.2.1.10	Specifications indicate fume hood ceiling enclosure. The drawings indicate an exposed exhaust duct with no ceiling enclosure. Please review and provide details if ceiling enclosures are required.	Ceiling enclosure is not required. Delete paragraph 2.2.1.10 in its entirety.
155	33 61 13	Drawing M200 note 3, detail 2 on M200 (by referencing the specification), and specification section 33 61 13 describe the steam tunnel as a pre-engineered, pre-cast concrete trench and lid structure. However, detail 8 on S504 shows the steam tunnel as cast-in-place concrete. Please confirm that the steam tunnel shall be pre-cast structure in its entirety.	Mechanical trench is to be constructed as a pre-cast trench from the Utility Tunnel to the stair side / south face of shear wall E. From the opposite face of shear wall E, the trench is to be a cast-in-place structure below the slab on grade until it opens into the steam pit – see 8/S504 and section on M201B for the cast-in-place portion. The pre-cast trench shall be as indicated by M200 and Specification Section 33 61 13.

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156	Structural Dwgs, Mechanical Dwgs	Reference drawing S101B, detail 10 on S526, and drawing M201B. The steam tunnel route conflicts with the piles and combined pilecap at shearwall 6 and 3. It does not appear that the steam tunnel can be installed at this location. Alternate routes include shifting the tunnel to the west and going around the pilecap or entering the east side of the building between column lines A.7 and B to avoid the urban bioretention filter. Please advise.	The mechanical trench runs above the pile cap at this location. Reference 2/S-302 for relative elevations of mechanical trench opening and pile cap.
157	Civil Dwgs, Mechanical Dwgs	Note 2 on drawing M200 states "demo existing trench between trees." Drawing CD105 notes that these trees are to remain and be protected. However, it may not be possible to demolish the existing trench and install the new trench without damaging the trees. In accordance with specification section 01 35 40.00 41 paragraph 3.11.2, please advise what replacement strategy is acceptable if it is necessary to remove these trees.	All of the large specimen trees are of vital importance to NASA. The building design was, in part, based upon preservation of the trees indicated. The Contractor is expected to exercise extreme care including hand work if necessary to preserve these trees.
158	Civil Dwgs, Resource Dwgs	Removal Note 1 on Drawing RC-001 indicates that Building 1168 and foundation in its entirety is to be removed. This is in conflict with Drawing CD105 which indicates the extents of an existing underground foundation. Is it correct for the contractor to assume that all features including buildings, foundations, utilities, etc. on the RC drawings are to have been already removed under separate contract by others? Likewise, is it correct for the contractor to assume that all features specifically noted on the CD drawings are to be removed including buildings, foundations, utilities, etc. under the NASA MSL contract?	a. B1168 was removed prior to MSL design beginning and no as-built drawings were provided. See also NOTE on CD105 re: survey data. B. The features noted on the CD and S drawings are items that are known to exist below grade. It is the responsibility of the GC to either remove those items in their entirety or to coordinate new construction around them. Not all items will need to be fully removed in order to construct MSL.
159	Civil Dwgs, Structural Dwgs, Resource Dwgs	Removal Note 1 on Drawing RC-003 indicates that Buildings 1192, 1192A, 1192B, 1192C, and 1192D and foundations in its entirety are to be removed. This is in conflict with Drawing CD105 and S040 which indicates the extents of an existing underground foundation. Is it correct for the contractor to assume that all features including buildings, foundations, utilities, piles, etc. shown on the RC drawings are to have been already removed under separate contract by others? Likewise, is it correct for the contractor to assume that all features specifically noted on the CD and S-040 drawings are to be removed including buildings, foundations, utilities, piles, etc. under the NASA MSL contract?	a. Confirmed. All features indicated to be removed on the RC drawings are assumed to have already been removed as a part of a separate contract by others. B. The features noted on the CD and S drawings are items that are known to exist below grade. It is the responsibility of the GC to either remove those items in their entirety or to coordinate new construction around them. Not all items will need to be fully removed in order to construct MSL.
160	31 62 13.20	Specification Section 31 62 13.20 - 1.6.4 states that an independent Geotechnical Engineer is to be hired by the contractor to observe test pile installation and job pile installation. Would it be acceptable for the Geotechnical Engineer to be hired and retained by the subcontractor installing the precast / prestressed concrete piles scope of work?	No. The Contractor shall retain an independent Geotechnical Engineer in accordance with the referenced specification. The intent is to preserve objectivity and greater independence from the sub with production responsibility.

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161	32 62 13.20	Specification Section 31 62 13.20 - 3.4.1 states that test piles are to be ordered 10 feet longer than production piles. The drawings and specifications currently do not show or indicate length of production piles other than to state in 31 62 13.20 - 1.2.1 that piles are to be driven to a minimum depth of 60 feet below existing grade. Should it be assumed that all production piles are to be a length of 60 feet or more. The length of production piles is typically determined from the results of the driving and test analysis of the test piles. The requirements of the test piles is typically derived from the Geotechnical Report. Please provide length of the production piles if available. If production length is not available please provide a copy of the Geotechnical Report so that the requirements of the test piles can be determined.	The length of production piles is to be determined by the results of the test pile program. Per the July 23, 2014 geotechnical report issued by GET, the estimated embedment depth of the piles is 60 feet below existing grades. The final order lengths and tip elevations will be adjusted based on the results of the test piles and load test programs. Reference GET geotechnical report for additional information.
162	33 62 13.20	Specification Section 31 62 13.20 - 3.4.3 states that static load tests shall be performed on a minimum of 5 test piles. 31 62 13.20 3.4.1 does not indicated how many test piles are to be driven. Please provide the quantity of test piles to be driven or provide the Geotechnical Report so that quantity and size of test piles can be determined.	Provide 8 test piles as indicated in the geotechnical report. Please see the response to #42.
163	34 62 13.20	Specification Section 31 62 13.20 - 3.4.3 states that static load tests shall be performed on a minimum of 5 test piles. 31 62 13.20 3.4.1 does not indicated how many test piles are to be driven. Please provide the quantity of test piles to be driven or provide the Geotechnical Report so that quantity and size of test piles can be determined.	Please see the response to #162.
164	35 62 13.20	The process to set up and perform a static load test is time consuming and expensive. The requirement of performing static load test on 5 test piles appears to be excessive given the foot print size of the building. Can the number of required static load tests be reduced?	Provide 8 test piles as indicated in the geotechnical report.
165	36 62 13.20	Specification 31 62 13.20 requires both dynamic pile analysis test (PDA) as well as static load test (Hydraulic Load Test). Is a PDA test to performed only on test piles similar to the static load test? Is a PDA test required to be performed on a production pile. If so how many PDA tests are to be performed?	As indicated in the geotechnical report, all test piles shall be monitored using the PDA. All test piles should also be re-struck while being monitored with the PDA.
166	37 62 13.20	Per discussions with the precast / prestressed concrete piles subcontractors it does not appear that it is typical for a precast pile project to utilize a dynamic pile analysis test (PDA) test. PDA tests are expensive and time consuming and are not applicable for precast piles. Can the requirement for a PDA test be deleted from the specification requirements given that a static load test is the more applicable test for precast piles?	Please provide PDA testing per the contract documents.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
167	Dwg A503	The response to Master RFI #25 states that detail 10 indicates design intent and it is the responsibility for the GC to coordinate field conditions. Is it acceptable for the steel tube framing and associated drywall wrap shown in the detail to be moved off of the guide rail to provide sufficient clearance for the guide rail cover plate?	An RFI submitted with a proposed solution during construction will be reviewed for compliance with design intent.
168	Detail 2/Q-402	Detail 2 on Q-402 shows the bottom knuckle of the 60"L x 3" diameter extractor arms at 96" AFF. The connection to the bracket would be 10" above that. The basis of design product is the Terfu (MT/MV 1500-75) with a recommended mountgin height of 76" to 88" AFF. The specified height appears too high for the 60" arm. Please review and indicate if the mounting height should be lowered or a longer arm should be specified or both.	96" A.F.F. is be to the underside of bracket (86" to the top knuckle). When the snorkel is fully extended the metal hood shall be 36" A.F.F.
169	Detail 2D/Q-402	Detail 2D on Q-402 shows an extractor vented through the wall of a clean room. The arm will not function as intended if it is installed in this manner. The Movex arm has a 360 degree swivel joint where the arm meets the bracket allowing free rotation of the arm. The user will not be able to position the arm above the pivot joint without holding it in place as gravity will cause the arm to rotate down. A suggestion would be to mount an extended wall bracket to the structural wall and have it extend through the clean room wall with the arm attaching vertically (similar to Detail 2A on sheet Q-402). Please review and provide direction.	Detail 2D should be similar to Detail 2A. The support bracket shall be attached to the building wall beyond the clean room plenum. Provide a ductwork extension with an elbow from the top of the snorkel to the exhaust ductwork located inside the plenum as required.
170	13 20 00	Specification section 13 20 00 – 1.3 states, "Work under this section shall include all labor, services, materials, and equipment, and performance of all work, as necessary, to design, furnish, install and commission the cleanrooms as detailed in this specification section and the contract documents". Specification section 13 20 00 specifies products and methods that conflict with each other, e.g. plenum modules vs. component t-grid ceiling, ECM FFU's vs. 3-speed FFU's, structural wall systems vs. non-load bearing wall systems, fluorescent type luminaire housings with doors vs. sealed LED luminaires, etc., etc. Please confirm that the cleanrooms are to be built to a performance criteria meeting ISO Standards versus a line-by-line conformance to Section 13 20 00?	Cleanrooms shall be built to a performance criteria meeting ISO Standards with non-load bearing wall systems and laminar flow plenum with flush LED lighting, FFUs, and cooling coils .
171	13 20 00	Specification Section 13 20 00 – 1.1 references FED-STD- 209E. This standard was canceled on November 29, 2001 by the United States General Services Administration (GSA). The document was superseded by standards written for the International Organization for Standardization (ISO). Please confirm that the ISO Standards supersede FED STD 209E for Particulate Cleanliness and is acceptable?	Yes. ISO Standard shall be used.
172	13 20 00	Specification Section 13 20 00 – 1.6 indicates pre-manufactured ceiling plenums that is integral to the cleanroom ceiling grid. Drawing Q301A indicates an on-site plenum. Recommend using suspended ceiling with perimeter walls to deck (as shown on drawing Q301A) be utilized for the plenum. Please confirm this is acceptable.	Using a suspended ceiling with perimeter walls to deck to be utilized as the plenum is not acceptable. Provide laminar flow plenum with flush LED lighting, FFUs, and cooling coils as specified

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173	01 23 60	Specification section 01 23 60 – 3.1 states, "If Add Alternate 2 is accepted it will maintain the capabilities of a Class 100 space within the MSL building while allowing for additional standard lab space. Rebalance AHU, rebalance FFUs, and rebalance the associated clean room chilled water coils if Add Alternate 2 is accepted. Please clarify how allowing for additional standard lab space is defined or to be achieved?	A separate Class 100 Cleanroom was removed from the project during design, and was replaced with a standard electronics laboratory. The following phrase will be removed from the 01 23 60 - 3.1: 'If Add Alternate 2 is accepted it will maintain the capabilities of a Class 100 space within the MSL building while allowing for additional standard lab space.'
174	13 20 00	Specification Section 13 20 00 - 1.4.2 indicates the installation of Digital Space Temperature Sensors, digital humidity sensors and localized positive pressure indicators. Recommend placing temperature and humidity sensors near return air grilles (even behind the grilles) to provide optimal control of the environment conditions. Please confirm this is acceptable to locate the sensors near or behind the grills?	Placing temperature and humidity sensors near return air grilles or behind grilles is acceptable. Local positive pressure indicators must be provided in the space.
175	13 20 00	Section 13 20 00 - 1.7 states, "Calculations; G": "Provide design Calculation for clean wall framing system". Per section 2.2, the wall system is indicated as non-load bearing. With this wall framing system being non-load bearing, please confirm that calculations will not be required?	Calculations for wall framing system is not required.
176	13 20 00	Section 13 20 00 – 1.7 states. "Samples: "Color samples of not less than ten (10) standard manufacturer's colors." There is only one standard color from cleanroom wall manufacturers – white. Custom colors are available for additional cost. Without knowing which color the Architect will choose, please confirm if pricing should include non-standard colors?	Standard white cleanroom walls are all that will be required. No custom colors.
177	13 20 00	Specification Section 13 20 00 - 2.1.1: "FFU's are indicated as 115 volt. Section 2.5.2 indicates 277 volt. Please clarify?	Per the Mechanical and Electrical Schedules, the FFUs are to be 277V/1Ph/60Hz. The voltage of the control panels associated with the FFUs is 120V
178	13 20 00	Specification Section 13 20 00 - 2.1.1: NC is listed as 45. Most FFU's individually cannot meet NC 45. Placing multiple units in the same cleanroom space will definitely exceed NC 45. Recommend NC 60 with use of 'quiet' high-end FFU's. Please confirm?	Provide NC 55 max.
179	13 20 00	Specification Section 13 20 00 - 2.1.1: Environmental setpoints are listed at 65°F +/- 1°F, 45%RH +/- 5%. Mechanical drawing M-101L lists RH as 40%. Please clarify which setpoints are required?	RH shall be 40% +/- 5, as listed on Mechanical Drawing M-101L.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
180	13 20 00	Specification Section 13 20 00 - 2.1.1: FFU's are listed "w/ sensible cooling coil". Mechanical drawings show coils mounted in return air plenum. Mechanical cooling coil schedule shows that these coils are not sensible only, but also have a latent cooling capacity. It is possible that these coils could become 'wet' due to the low entering water temperature of 41°F. Coil locations on the mechanical drawings, drain pans and drain piping are not shown and wouldn't be accessible if installed. Recommend elimination of sensible cooling coils with additional make-up air flow rate (with returns) or rising the entering chilled water temperature above the room operating dew point to prevent condensation. Please confirm intent and if suggestions are acceptable?	It is possible that these coils could become 'wet'. The condensate drain lines for these coils are shown on sheet M-201A (See Note 2). Eliminating the sensible coils and replacing with additional make-up air would not be a cost effective solution and would reduce the overall building energy savings. Suggestions are not acceptable. Clean room manufacturer shall provide drain pans and drain lines as indicated on the plans.
181	13 20 00	Specification Section 13 20 00 - 2.1.1: MAU-1 is listed as a 4,000 CFM supply fan. Mechanical schedule lists MAU-1 as 2,940 CFM. Please clarify which size is required?	MAU-1 should be a minimum 2,940 CFM.
182	13 20 00	Specification Section 13 20 00 - 2.2.2: Section indicates to provide door automatic operated swing types, however door schedule or Q drawings do not indicate which doors are to receive the auto operators. Please indicate which rooms are required to receive auto operators?	All doors into and within the cleanrooms require automatic operators. Door into the cleanrooms shall be part of the cleanroom package as specified in section 13 20 00.
183	13 20 00	Specification Section 13 20 00 - 2.1: This section does not indicate which cleanroom doors are to receive half-glass or which doors require UV blocking amber filter film? Review of the hardware schedule and Q drawings do not indicate these items. Please provide which doors are to receive glazing and UV blocking?	All doors into and within the cleanrooms shall be the solid type as shown on the Q drawings.
184	13 20 00	Specification Section 13 20 00 – 2.2.2 indicates that UV blocking is to be installed on half-glass doors. Please provide what criteria or specifications to meet for the film?	UV is not required. All doors into and within cleanrooms are solid as indicated in response #183.
185	13 20 00	Specification Section 13 20 00 - 2.5 states, "Fan filter units shall be provided with ECM motors for variable speed control." Section 2.5.2 indicates FFU's to be 3-speed. Please clarify which is required or if either option is acceptable?	FFUs shall be provided with ECM motors for balancing, control and energy efficiency. Typical operation will be 3 stages: occupied, unoccupied, and off.
186	13 20 00	Section 13 20 00 - 2.6: A plenum divider would be required to ensure that the cleanroom recirculation air diverts through the cooling coils. This is neither specified nor shown on the drawings. This plenum divider would interfere with all the ductwork, electrical, and miscellaneous utility work above the ceiling. Recommend eliminating cooling coils and increasing air flow (including return air) from MAU-1 to provide the room cooling. Please confirm if this is acceptable?	Plenum dividers are required. Clean room walls that must go to the deck are identified in the Q drawings. Eliminating cooling coils is not acceptable.
187	13 20 00	Specification Section 13 20 00 - 2.6 indicates cooling coils are sensible cooling and therefore drain piping would not be required. Please confirm no drain piping is acceptable?	Cooling coils are deigned to condition the sensible load, however they may become 'wet' and therefore require drain piping as indicated on sheet M-201A (See Note 2). Clean room manufacturer must provide these drains and drip pans.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
188	13 20 00	Specification Section 13 20 00 - 2.6.1: Locating prefilters at cooling coils would make them inaccessible. Recommend locating filters in low wall-mounted return air grilles. Please confirm if this is acceptable?	The design intent is to locate the filters in the low wall-mounted return air grilles as indicated by note 5 on sheet M-101A
189	13 20 00	Section 13 20 00 - 2.7.1: Type of luminaire housing defined is for a fluorescent type fixture while LED is specified in paragraph 2.7.2. Please confirm which is correct?	LED light fixtures shall be incorporated into the flush light ceiling system.
190	13 20 00	Specification Section 13 20 00 - 2.7.2: IES standard does not specify a lighting level. What lighting level is desired by the end users? Typical cleanroom light levels are 70-90 footcandles. Please confirm lighting levels required for the cleanrooms?	Lighting level required is 80 foot-candles.
191	13 20 00	Section 13 20 00 - 2.10: Specification calls for a [redacted] (b) (5) Recommend [redacted] (b) (5) [redacted] Please confirm if this is acceptable?	[redacted] (b) (5)
192	13 20 00	Specification Section 13 20 00 - 2.10: Please clarify the need to exhaust the make-up air from the cleanroom. Without process exhaust this is wasted energy that needs to be conditioned from outside air make-up. Please confirm if eliminating the exhaust from the make-up air is acceptable?	Eliminating the exhaust is not acceptable. The clean room requires ventilation air. Without exhaust, the space would become too pressurized.
193	13 20 00	Specification Section 13 20 00 – 2.10: Since the make-up air unit is dedicated to the cleanroom, environmental control would be more repeatable and consistent without LAB VAV TU's. We recommend deletion of the exhaust system and the terminal units along with the associated controls. Cleanroom would control better with constant volume system with zone reheats and humidifiers. Please confirm this is acceptable?	MAU-1 provides outdoor ventilation air to the clean room. The terminal units control the amount of air delivered to the space and the exhaust system regulates the pressure. Reheat is not required because the FFU will generate a substantial amount of heat. This solution is not acceptable.
194	13 20 00	Specification Section 13 20 00 – 3.6.3.4: Since most FFU's come in either a single piece construction with both HEPA filter and fan module factory assembled or two piece where the fan module is set on the HEPA filter and then both elevated into the ceiling as an assembly, the specified procedure to install the HEPA filters after all other components (including the fan modules) are in the ceiling would require an expensive option to go with 'room side replaceable' HEPA filters. Each HEPA filter would have to be smaller to accommodate an adaptor frame in the ceiling grid to mount the filter. Please confirm which method is acceptable?	The HEPA filters must be "Room Side Replaceable"
195	Amendment 6,7	Amendments 6 and 7 both include the following statement "Questions left unanswered are due to the fact that information is either unavailable, not releasable, or is already identifiable in the solicitation package." Please confirm that each RFI submitted will receive a specific answer to that RFI in lieu of this general statement.	Confirmed.

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196	Price Proposal Form	Amendment 2 provide a Base Bid GC Price Proposal Form broken down by Specification sections. Item 13b, Drawings RQ (ETS-Lindgren) and Spec 13754 (Allowance) has a note that this will be an allowance – "Note that this work will be sole sourced and the allowance will cover the for the sole source". Please confirm GSA will be providing allowance to Contractors to include in base bid?	The allowance shown on the Base Bid tab of the Bid Form should be included in the Contractor's bid.
197	Price Proposal Form	In Amendment 2, an excel pricing spreadsheet was provided including 3 tabs – (1) Base Bid with Spec Section Breakdown, (2) Options, (3) Value Engineering Suggestions. Should these 3 pricing sheets be provided along with the updated Price Proposal Form provided in Amendment 3?	Please utilize the revised Bid Forms dated 6/17/2016.
198	Price Proposal Form	In Amendment 2, an excel pricing spreadsheet was provided including 3 tabs – (1) Base Bid with Spec Section Breakdown, (2) Options, (3) Value Engineering Suggestions. Do we provide the Base Bid with Spec Section Breakdown form as well as the updated Price Proposal Form provided in Amendment 3? If so, how do we deal with the unit pricing on the Price Proposal Form provided in Amendment 3 on the Base Bid with Spec Section Breakdown? Do just include the total price of the unit prices into its appropriate specification categories?	Please utilize the revised Bid Forms dated 6/17/2016.
199	Price Proposal Form	In Amendment 2, an excel pricing spreadsheet was provided including 3 tabs – (1) Base Bid with Spec Section Breakdown, (2) Options, (3) Value Engineering Suggestions. On the Base Bid with Spec Section Breakdown form it adds the TOTAL BASE BID plus TOTAL OPTIONS (NET) = TOTAL EVALUATED PRICE. The Amendment 3 Price Proposal form does not include the Alternate Pricing. Please confirm if the net total of the options will be added to the base price (Price Proposal Form) and in fact be the TOTAL EVALUATED PRICE.	Please utilize the revised Bid Forms dated 6/17/2016. Regarding the specific question, yes, the total evaluated price is the sum of the base bid plus options as indicated on the Bid Forms.
200	10 22 43	Reference response to RFI #47. Please confirm that 1) panels shall be 4' wide, 2) panels shall be full height, and 3) drop pins, closers, pivots, floor quides, and handles are not required. Additionally, please clarify if the panel count provided in the response to RFI #47 is total panels per floor or panels per double track section. Floors 1 through 4 have two double track sections per floor.	1. Confirmed, panels are to be 4' wide. 2. Confirmed, panels are to be full height. 3. Not confirmed. Drop pins are to be provided per 10 00 43 - 2.3 #9. Confirmed - response to # 47 indicates the total number of panels per floor, not per double track section.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
201	01 23 60	Amendment 2 provided an Options spreadsheet with a column entitled "Days Option Open from Award" listing calendar days the Contracting Officer has to accept the options. Many of these "Days Option Open from Award" are not feasible and will not fit within the project schedule such as: Deduct Option 6: Delete BIM – 90 days. BIM will need to be implemented within 60 days for procurement. Recommend 60 days. Deduct Option 8: LEED USGBC Silver Rating – 180 days. Cannot wait 6 months to start submittals on a 24 month project. Need to provide submittals within 60 days of award. Recommend change to 60 days. Deduct Option 9: Delete Cleanrooms – 240 days. Cannot wait 8 months to hold off on procurement of cleanrooms due to long lead times, and subcontractors will not hold pricing that long. Need to begin procurement within 60 days. Recommend changes to 60 days. Add Option2: Cleanroom Capability – 90 days. Cannot wait 90 days for a redesign of the cleanrooms. Need to begin procurement in 60 days. Recommend change to 60 days. Add Options 1, 3, 4, 5 all show 240 days open for approval. Cannot hold open 8 months on a 24 month project due to procurement issues and subcontractors will not hold pricing that long. We recommend reducing all to 90 days.	The number of days the Contractor is required to hold its option pricing has been reduced to 60 calendar days for all except Add Alternates 1, 3, 4, and 5. It is anticipated that funding for Add Alternates 1, 3, 4, and 5 may not be available until FY 2017, and that it could take up to 240 days for such funding to become available to NASA. The Government understands the concern raised and will endeavor to exercise these options as early as practicable. An updated Bid Form is provided with the revised durations stated above.
202	01 78 25	Specification Section 01 78 25, 1.1 states that Autodesk Revit and AutoCAD Civil 3D are required software platforms for modeling. This may limit the prequalified subcontractors who can participate in coordination. Many BIM mature mechanical subcontractors are still using 3D CAD applications to fabricate from. Additionally, most steel and concrete subs use Tekla as a fabrication tool. This may require subcontractors to use a 3RD party modeler to convert their fabrication models to a record Revit model at the end of the job. Will coordination drawings in either 3D CAD or Tekla be acceptable or will conversion Autodesk Revit and AutoCAD Civil 3D be required? If Autodesk Revit and AutoCAD Civil 3D are required is conversion by a 3rd party modeler acceptable?	The Contractor is required to submit AutoCAD Civil 3D for items outside of the building. Contractor is required to submit Autodesk Revit for all other building elements at 30% and 60% fiscal completion milestones, then at Substantial Completion and Project Closeout milestones as specified in 01 78 25, the NASA BIM Execution Plan, NASA Level of Development Specification for Building Models, and the NASA LOI Level Of Information Specification. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.

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203	01 78 25	Specification Section 01 78 25, 1.3.1 requires a Revit certification of the BIM manager which is an unusual requirement. You can be qualified to use these software platforms without paying Autodesk for a certificate. The test is a written exam which does not prove a person's BIM competency. Can this requirement be removed from the specifications?	No the requirement can not be removed.
204	01 78 25	Please provide further clarification / specifics on what must be demonstrated as part of the BIM demonstration stated in Specification 01 78 25 1.3.3.	The detailed means and methods by which the required BIM uses will be accomplished as described in the Government approved BEP will be demonstrated. Live BIM models and BIM tools shall be used. Pre-recorded demos or still screenshots are not acceptable. Key personnel, hardware, and software solutions documented in the Government accepted BEP shall demonstrate their abilities to accomplish the described means and methods as described in the Government approved BEP. For instance, the Contractor must actually perform a clash detection analysis of a federated coordination model to demonstrate their ability to accomplish this BIM use. All BIM uses shall be demonstrated in the same manner. The Contractor may use non-MSL model content as long as it complies with the BIM requirements specifications of the contract.
205	01 78 25	Specification Section 01 78 25, 1.4 states that the Government will provide a 100% Design BIM, but that the contractor is not relieved of coordination requirements. Please provide information regarding what will be provided by the design team in terms of model deliverables. Specifically what will be provided by the design team?	Per response to RFI 207, please refer to the LOD Matrix that outlines each major model component category of the Design BIMs, and what LOD they have been modeled to. This LOD matrix shall be for information only, as a guideline and not as a specification and shall not be relied upon by the contractor as such. Per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the design BIMs. The Contractor is also fully at risk if they decide to rely upon the LOD Matrix provided in response to this RFI.
206	01 78 25	Will the contractor receive a Revit model for all major design disciplines (A, S, MEPF, security, communications, fire alarm, lab equipment) and any additional consultants? Specifications reference trades like security, communication, Fire Alarm, Pneumatic Tubing, and Equipment.	Yes. Architectural, Civil, Electrical, Fire Protection, Mechanical, Plumbing, Labaratory Equipment, Structural, Telecom, Audio Visual, Auxilary Systems (Security). See Design BIM Model Element Matrix attachment to RFI response for detailed description of model element types included. Note, per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the design BIMs.

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207	01 78 25	What LOD can the contractor expect the design models to be constructed? Please provide a Model Development Specification (LOD Table) which outlines each major model component category and what Level of Development they will be modeled to for each milestone phase of the project. This will help gauge which subcontractors be required to provide modeling and coordination. If A/E design model is not adequately constructed to assist with coordination, the contractor will have to supplement with a 3rd party modeler which will add cost to the BIM effort. The LOD specification attachment details what is expected from the record model, but what is required from the AE team in the production of the design model?	An LOD Matrix that outlines each major model component category of the Design BIMs, and what LOD they have been modeled to will be provided but shall be for information only, as a guideline and not as a specification and shall not be relied upon by the contractor as such. Per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the design BIMs. The Contractor is also fully at risk if they decide to rely upon the LOD Matrix provided in response to this RFI. A Model Development Specification (LOD Table) which outlines each major model component category and the as-built LOD they are required to be modeled to for construction is already provided; see the NASA Level of Development Specification for Building Models in section 01 78 25. Per section 01 78 25 the Contractor shall submit an as-built record model for all work that, up to the milestone dates specified, has been installed/constructed compliant to the NASA Level of Development Specification for Building Models, and the NASA LOI Level Of Information Specification. Per section 01 78 25 these milestone dates are 30% Fiscal Completion, 60% Fiscal Completion, Substantial Completion and Project Close Out. Nothing is required from the AE team in the production of the Design BIMs. Per section 01 78 25 1.4 the Contractor is fully at risk if they decide to utilize the Design BIMs.
208	01 78 25	How often will the contractor be transmitted design models? Confirm new models will be transmitted within 10 days of a receipt of any Bulletins/ ASIs/ Revision Packages.	Changes will not be provided in BIM format. Only 2D, non-CAD format drawings shall be provided. The Contractor is responsible for incorporating these changes into Coordination BIMs and into all BIM deliverable requirements as specified in sections 01 78 25, 01 79 00, and ammendment 0007 NASA Level Of Information.
209	01 78 25	Will the contractor be provided CAD backgrounds for every major project milestone to supply to subcontractors? Will updates be provided for all Bulletins/ ASIs/ Revision Packages? The contractor can create these backgrounds from the design models, but if there is a contractual requirement for the A/E to provide them, it would assist coordination efforts if they were transmitted to the contractor as well. Please confirm this will occur.	Changes will not be provided in CAD format. Only 2D, non-CAD format drawings shall be provided. The Contractor is responsible for incorporating these changes into Coordination BIMs and into all BIM deliverable requirements as specified in sections 01 78 25, 01 79 00, and ammendment 0007 NASA Level Of Information.

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210	01 78 25	It will be required to conduct file sharing through a secured buffalo drive or a cloud based systems like Google drive and Box acceptable? Is the use of a file sharing cloud base system acceptable? Box is the primary means for transmitting model files usually.	Any file transfer solution must be compliant to GSA policy and procedure 3490.2 Public Buildings Service document security for Sensitive But Unclassified building information and US Government computer security standard, the Federal Information Processing Standard (FIPS) publication 140-2, (FIPS PUB 140-2). Box.com is FedRAMP certified and should be acceptable, however this will need to be confirmed with the GSA Contracting Officer.
211	01 78 25	Are the trades listed in Specification Section 01 78 25, 3.1.1 required to produce fabrication models? Are there additional trades that must participate in the coordination process? It is noted that trades like communications, Equipment, FA and Security are not always as BIM mature as our traditional MEP or FP subcontractors. They may not be able to develop a Revit model deliverable in-house. This may require additional 3rd party modeling. Is the development of a Revit model by a 3rd party modeler acceptable?	All trades traditionally required to participate in the coordination process are required to participate in the BIM coordination process and to produce models sufficient enough to represent the exact geometry of elements and element clearances to prevent coordination errors in the field. The intent of the BIM record model is to show the as-built conditions. This must be in accordance with the section 01 78 25, NASA BIM Execution Plan, NASA Level Of Development and Amendment 0007 NASA Level Of Information. Any shop drawing requirement must be compatible with updating the deliverable record models. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.
212	01 78 25	Specification Section 01 78 25, 3.2 states that design changes must be pre-clashed to determine extent of impact prior to approval of a change. This implies that the contractor would be directing subcontractors to proceed with a change prior to change order approval. Per the solicitation, the contractor cannot direct subcontractors to proceed with re-modeling until Government approval. Is the contractor to follow the RFP requirement or the specification requirement?	The intent is where appropriate, the Contractors shall utilize the BIM to assist in the development of cost proposals for change orders to improve proposal accuracy.

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213	01 78 25	Specification Section 01 78 25, 3.3 states that we are "encouraged" to submit a 4D schedule before payment and defines the minimum object categories that should be reflected. Provide additional clarification on what is contractually required. Please provide a better understanding of the following: What does the Government hope to gain from 4D scheduling (i.e. site logistics and initial phasing, concrete pour sequence, steel erection sequence, exterior skin phasing, etc.)? How often does the Government want the 4D model updated? With each payment would imply bi-monthly or weekly updates. This would require dynamic connection to the project schedule and will add additional time to the BIM Manager's job description to maintain. This will add additional cost to the BIM effort requirements.	There is no 4D BIM contractual requirement. The 4D BIM specification section is recommended guidance. The intent is to utilize 4D BIM capabilities to better detect future site and construction sequencing errors that traditional GANNT chart CPM schedules could never show. If used properly, schedule delays and field rework could be minimized and the project team's understanding of the site and construction sequencing plan could be improved. It is possible to minimize crane moves and other strategic advantages to site logistics using 4D BIM tools.
214	01 78 25	What (if any) GIS data must be captured in the record BIM?	See section 01 78 25, NASA BEP, Section K, Item 6.
215	01 78 25	Specification Section 01 78 25, 3.8.3.2D states requirements for the design team in the production of construction documents. If the Contractor is required to deliver a record Revit model with all corresponding sheets from the contract documents, that would require the Contractor to take ownership and liability for their errors and omissions in the original creation of the model. The Contractor is not responsible or liable for the design. Can this section of the specifications be omitted? If not please clarify requirement regarding the production of construction documents.	No, this section cannot be omitted. The Contractor's requirement is not to deliver design 2D sheets, but to deliver as-built, record 2D sheets compliant to the BIM requirements specifications of section 01 78 25. The only 2D sheets that the Contractor would be responsible for or liable for are those which the Contractor designed themselves, per Section 01 78 25, 3.8.3. 2D, 2nd paragraph "If the contract requires the Contractor to design portions of the project and if, for the portion designed by the Contractor will be reviewed by inspection or permitting agencies, the Contractor must produce printed drawings from the model, signed and sealed by licensed professional architects and engineers, as required by the reviewing or permitting agency."
216	01 78 25	Does the Government want all subcontractor shop drawings created in Revit? This goes back to the software specific requirement in Specification Section 01 78 25, 1.1. Requiring subcontractors to comply with one software package, it may limit the amount of potential qualified bidders and significantly increase costs of the BIM effort.	The intent of the BIM record model is to show the as-built conditions. This must be in accordance with the BEP, LOD and LOI. Any shop drawing requirement must be compatible with updating the deliverable record models. How the GC coordinates this responsibility with their subs is up to them to decide then to describe to us post award.

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217	01 78 25	The Contractor will need to walk through the model exchange that will need to take place with the A/E in order to meet the Revit deliverable that is required including as-built model with O&M and asset data link. Does the Government want all asset data kept internally within Revit, COBie, both, or an external O&M Database as described in 01 78 23? The contractor needs to know exactly what asset data will be tracked in each system in order to acquire BIM accurately from our subcontractors. The LOI requirement defines some attributes, but is the extent of the attributes that need to be tracked indicated in its entirety?	There will be no model exchange with the A/E beyond the single issuance of Design BIMs immediately following contract award. The data specified in Ammendment 0007, NASA LOI must be data located internally within the Revit Models except for documents which must be linked to the revit models. The links to the documents must be located internally within the revit model as specified in the LOI. The exact, entire asset data requirements are specified in ammendment 0007 the NASA LOI and is the responsibility of the contractor to deliver. However, per page 2 of the NASA LOI specification instructions "..the contractor is ultimately responsible for including any product asset types not currently highlighted in green, or components of this product asset types which become added to the project scope as the design and construction of the project progresses or as a result of a modification or amendment to the construction contract." The contractor would then be required to contact the Government who will specify the exact asset data requirements of the asset types or components added to the project scope.
218	01 78 23	Specification 01 78 23, 1.2.5 refers to an O&M database as a project requirement. Is this a separate deliverable from the COBie Database or can it be used in place of COBie as an alternate? Can the contractor choose between an eOMSI (Section 01 78 24.00 20) or COBie (Section 01 79 00)?	Specification 01 78 23 1.2.5 is a separate deliverable from the COBie database and cannot be used in place of COBie as an alternate. The Contractor cannot choose between Section 01 78 24.00 20 eOMSI or Section 01 79 00 COBie. These two sections are separate requirements. The Contractor may leverage or utilize the COBie database to more efficiently deliver the section 01 78 32, 1.2.5 requirement or the section 01 78 24.00 20 requirement.
219	01 78 23	Would eOMSI an “or equal” to COBie? What CMMS/CAFM system does the Government use? With either COBie, or eOMSI, would it be expected to interface directly with your CMMS system prior to turnover?	eOMSI is not an equal to COBie. The COBie requirement specified in 01 79 00 and ammendment 007 the NASA LOI must be met regardles of the CMMS/CAFM system the Government uses. Currently the NASA CMMS system is IBM Maximo. COBie data is expected to be imported periodically throughout construction into the NASA CMMS prior to turnover. eOMSI would not interface directly with CMMS.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
220	Civil Dwgs, Landscape Dwgs	The Civil drawings indicate several mature trees on the South side of the site that are to be protected and preserved throughout the duration of construction. The Civil drawings also indicate several major pieces of work that need to take place within the indicated tree protection zone including demolition and relocation of storm sewer structures and piping, demolition of existing sidewalks, placement of new sidewalk and landscape features, as well as demolition of an existing utility tunnel and install of a new pre-cast utility tunnel. The work associated with the utility tunnel is of most concern as the existing tunnel is within feet of a tree that is called to be protected and preserved. Due to the amount and extent of work that is required in and around the tress called to be protected there is a strong likely hood that the trees will not survive throughout the duration of construction. These trees are mature trees with unknown root structures. It is unreasonable to assume that the contractor can protected these trees with the amount of construction activity and excavation that needs to take place around these trees. The contractor will do everything possible to protect these tress; however, what will be required by the contractor to replace these trees if they can not be saved in order to install work as indicated on the Drawings? How critical are these trees and is there any ability of the Government to relax the extent of the tree protection requirements in order to install the work as indicated on the Drawings?	All of the large specimen trees are of vital importance to NASA. The building design was, in part, based upon preservation of the trees indicated. The Contractor is expected to exercise extreme care including hand work if necessary to preserve these trees.
221	Drawing Q-001	Drawing Q-001 indicates Tables T01 and T02 to have ESD Bench Top. The Laboratory Casework General Information indicates modified epoxy resin for tops. Epoxy resin in not available in ESD. There are some laminates that are available in ESD. Please review and clarify the top material of T01 and T02.	Per Q-403, ESD tables are not to be provided as a part of this contract.

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222	01 23 60	Deduct Alternate #8 Achieve LEED Silver. This deduct allows the Contractor to reduce LEED points shown on the LEED Scorecard, but please specify which ones are not to be deducted such as Enhanced Commissioning. We are sure the Government does not want to delete enhanced commissioning. Please clarify the credits that must remain. Also many of these credits require NASA input such as Green Power and ID: Greenguard Furn/ Green Housekeeping/ Education. Need to know if the NASA will be participating in these.	For the purposes of Deduct Alternate #8, the contractor shall limit the eliminated credits to those for which the contractor would have been responsible had the option not been awarded. The contractor is required to comply with all system performance requirements as detailed in the project drawings and specifications. Savings may be associated with reducing the administrative burden of LEED documentation for points not required to be submitted to achieve only LEED Silver certification. For example, activities associated with MRc2 Construction Waste Management may be eliminated entirely, or may be performed by the GC but not documented for LEED purposes. The contractor shall assume that NASA will provide Green Power and Greenguard Housekeeping
223	Architectural Dwgs	Window types W1 and W2 are shown on drawing A604, however, no information could be located regarding the frame type. Please provide. Additionally, Finish types GL-6 and GL-10 on A701 reference the window schedule. The window schedule could not be located. Please provide.	Window types W1 and W2 are to be hollow metal frames. The window types are as indicated on sheet A604.
224	07 42 13	Specification 07 42 13 paragraph 2.3 calls for MPL-1 to be white with a clear coat. A clear coat on white is unusual. Please confirm that the clear coat is required.	Confirmed. The clear coat is required.
225	07 42 13	Specification 07 42 13 paragraph 2.3 calls for MPL-2 to receive Reynobond EcoClean at horizontal surfaces. IF this coating is used the hoizontal surfaces will not match the vertical surfaces. It is suggested that this coating be used on all surfaces or none. Please advise.	Coatings are to be provided as specified in 07 42 13.
226	01 23 60, 27 51 19	Specification 27 51 19 - Sound Masking Systems is not referenced in the description for Add Alternate No. 4. Plese confirm that complete sound masking systems shall be installed in accordance with specification 27 51 19 as part of the base bid.	Confirmed. A Sound Masking System is to be installed in accordance with 27 51 19 as a part of the base bid.
227	10 14 02	Many of the sign types do not appear to be ADA compliant due to the location of the braille text. Per ADA requirements, braille shall be placed below the text. If the text is multiline, braille shall be placed below the entire text. Please advise.	Documents indicate design intent. Signage to meet all ADA requirements. Submittal will be reviewed for compliance with design intent and ADA requirements.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
228	General	Standard Form SF 1442, line 11 states that the contractor shall begin within 1 calendar days and complete within 730 calendar days after receiving award / notice to proceed. Neither check box adjacent to "award" or "notice to proceed" is checked. Confirm that performance of the contract shall be within 730 calendar days after receiving notice to proceed.	Confirmed.
229	27 41 16	Specification section 27 41 16, Integrated Audiovisual Systems and Equipment, indicates “for the Control system and software, a single manufacturer shall be provided” (2.2 B.) The section for the control system interface (2.2 H, I, J) indicates only AMX as an acceptable manufacturer. The section for Matrix Switchers (2.3 D), System Switchers (2.3 E), Video Scalers (2.3 F), and Twisted Pair Receivers and Transmitters (2.3H) indicate AMX, Extron, and Crestron. The control system interface and these other components must be by the same manufacturer so are Extron and Crestron also acceptable manufacturers for the control system interface?	No, AMX is the Government's standard for the Control System and Software.
230		1. The spec 074213 para 2.3 calls for Composite “Reynobond Panels for MPL-1 &MPL-2 and also 0.125 alum Plate or Metalwerks Arcwall 2510 in the next paragraph for the same panels. Please clarify that the Aluminum plate is an option in lieu of ACM at the contractor’s choosing or if the Plate system is intended for a specific panel type.	Per 2.3 COMPOSITE METAL AND ALUMINUM PLATE PANEL SYSTEMS "At Contractor's option provide aluminum-faced composite panels or aluminum plate wall panels with mounting system."
231		2. Also ref 074213- clarify what type of Fabricator “system method” is intended for the Reynobond material since Reynobond only makes the sheet material. Ref sht A301 for MPL-1,2,4 which appears to detail a Rainscreen system. The Arcwall 2510 system is a Flat plate design with extruded perimeter frame and is a Barrier wall to prevent ,moisture intrusion and not a rainscreen.	As indicated on A-301, MPL-1 through 4 are all intended to be Rainscreen systems. Per the manufacturer, Arcwall 2510 is also available as a rainscreen system.

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232		3. Ref spec 074213 para 1.3.3- 1.3.5 – Please clarify what test results are expected to be met? There are no published values for each test explaining how much air or water intrusion and what test pressure needs to be met. The Arcwall 2510 system meets the following for example: "Air and Water Infiltration Tests: If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards: Air Infiltration - When tested in accordance with ASTM E 283, air infiltration at 6.24 lb/ft² (75 Pa) must not exceed 0.02 ft3/min. per ft² of wall area (305 cm3/s per m2 of wall area). Water Infiltration - Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. No uncontrolled leakage shall occur in any system under a differential static pressure of 4 lb/ft² (300 Pa) after 15 minutes of exposure in accordance with ASTM E 331."	07 42 13 METAL WALL PANEL SYSTEMS, SCREEN WALL, AND CANOPIES includes the metal panels that are part of the metal panel exterior wall systems. Per A-301, the wall system are to be rainscreen type. Air/water infiltration of the system are as indicated in 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS and 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM.
233		Other equipment manufacturers can provide [redacted] (b) (5) [redacted] meters in their equipment to meet project GSA requirements; however, spec section 260913 Power Monitoring System is extensive and will be a large portion of the project value. Is this section required to be provided by [redacted] (b) (5) [redacted] or can independent vendors provide? Will the Power Monitoring System upgrade be part of the same bid /contract? If this section is a separate bid, it enables other manufactures beside [redacted] (b) (5) [redacted] to provide a competitive package. Paragraph 2.4 says: "Contractor shall provide the latest upgrade to the existing campus power monitoring system software." Unless 260913 is separated from the rest of the bid package – provided under a separate contract, this is essentially a sole-source project.	Vendors: Independent vendors can provide all of the "Basic Intelligent Electronic Devices (IEDs)". The three Enhanced IED devices must be [redacted] (b) (5) [redacted] as specified on drawing E-603 Power Monitoring System: The only upgrades to the existing campus power system is to upgrade the software per paragraph 2.4 to the latest version. There is no intent to do a general upgrade of the Campus power system monitoring as part of this project. Manufactures beside [redacted] (b) (5) [redacted]: It is the discretion of the general contractor as to whether this is a separate bid package or part of the electrical sub-contractors bid package. Sole source: The existing campus monitoring system is a [redacted] (b) (5) [redacted] system. Any software upgrades will be required to be [redacted] (b) (5) [redacted] to maintain functionality of the balance of the system. It is not the intent to limit the integration of the MSL systems into the existing package by [redacted] (b) (5) [redacted]

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234		1) Drawing T-002 note 3 states "PROVIDE A NEW (b) (5) AND A (b) (5) CABLE, BOTH TO BE (b) (5) THAT IS CURRENTLY ROUTED IN UTILITY TUNNEL (b) (5) FROM BLDG (b) (5)" Each end of these cables originates at the splice and extends to the lightning protection field in room (b) (5) of the MSL. An (b) (5) is not a standard pair count for a telecommunications cable. You can get to (b) (5) in a few possible ways but we suggest that a new (b) (5) be installed from the (b) (5) (b) (5) at the lightning protection field. Is this acceptable?	On sheet T-002, replace New Telecom Site Note 3 with the following: (b) (5) (b) (5) (b) (5) NASA requests use of labeling specified by their cable plant, available after contract award.
235		2) Approximately how much (b) (5) cable will be needed within the existing Utility Tunnel (b) (5) to get from the new duct bank to the existing (b) (5) location?	See Demolition Telecom Site Note #1 on T002.
236		3) Drawing T-111A note 2 states "OUTLETS IN CLEAN ROOMS TO BE INSTALLED BY CLEAN ROOM PREFAC INSTALLATION CONTRACTOR IN SURFACE MOUNTED BOXES." Please define "OUTLETS" for the purpose of this note. Is it just the raceways and surface mount boxes or would the clean room contractor also install the cabling, jacks, etc?	Installation of electric power, and conduit and wiring to points of connection in junction box, and installation of cabling, jacks, etc. shall be provided by the respective Division 26 and 27 Contractors. Coordinate with electrical and AV drawings.
237	01 23 60 OPTIONS	Para. 3.1 Schedule of Alternates, Deductive Alternate 2 makes reference to Specification Section 03 35 43 Polished Concrete Floors. It also mentions low sheen 400 grit polish level and a "stain" in the last sentence of the 3rd paragraph. a. Section 03 35 43 (listed as 03 37 00 in the spec title) Polished Concrete Floors calls for 800 grit in 3.4.G.2. Please clarify if 400 grit or 800 grit is required. b. Section 03 35 43 (listed as 03 37 00 in the spec title) Polished Concrete Floors does not make mention of using a stain. Please advise as to the desired stain.	A. Provide 400 grit polish level. B. Stain is not required.

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238	03 35 43 POLISHED CONCRETE FLOORS	Para. 1.7.10 prohibits the use of lifts or rolling equipment on concrete. The deductive alternate of deleting terrazzo and using polished concrete instead captures a substantial area of the building. Please consider allowing the use of lifts or rolling equipment with adequate floor protection.	Lifts or rolling equipment will be allowed on the floors as long as loading requirements stipulated in the structural contract documents are not exceeded, and the floor is protected with a minimum of 1/8 inch smooth Masonite or plywood covering with taped joints.
239	RAC RFI #12	Our RFI #12 was not responded to in Amendment 0006 or Amendment 0007. We are not sure if it is because it is similar to GSA RFI #38. However, we did provide Structural Sheet number where Section designations are missing. Please review and respond.	See response 004 which was issued with Amendment 0008.
240		Other equipment manufacturers can provide [redacted] (b) (5) [redacted] meters in their equipment to meet project GSA requirements; however, spec section 260913 Power Monitoring System is extensive and will be a large portion of the project value. Is this section required to be provided by [redacted] (b) (5) [redacted] or can independent vendors provide? Will the Power Monitoring System upgrade be part of the same bid /contract? If this section is a separate bid, it enables other manufactures beside [redacted] (b) (5) [redacted] to provide a competitive package. Paragraph 2.4 says: "Contractor shall provide the latest upgrade to the existing campus power monitoring system software." Unless 260913 is separated from the rest of the bid package – provided under a separate contract, this is essentially a sole-source project.	See response to #233
241	01 91 00.00 40	Paragraph 1.3 (Page 3) – The Government is going to retain a third party CxA for QA purposes. At this time, is GSA able to disclose who they are using, or intend to use?	The GSA intends to use ONIX II, Inc. to provide commissioning oversight.
242	01 91 00.00 40	The electrical commissioning requirements are very general. Can the government confirm if commissioning is required for the following electrical systems and components: 1) automatic transfer switches, 2) manual transfer switches and portable gensets, 3) switchboards, 4) secondary unit substations, 5) existing 750 kW generator at IESB, and 6) utility substation commissioning.	Commissioning is required for the followings systems: ATS, manual transfer switches, switchgears, switchboards, transformers, secondary electrical service systems, circuit breakers, conductors, grounding, panelboars, power monitoring /metering system, emergency power system, UPS modules and systems, batteries, lighting and lighting control systems, emergency and egress lighting operation, interior and exterior lighting controls lightning protection systems, and existing 750-kW Emergency Generator. The integral Loss Power Test is also required to verify the emergency power operation.

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243	23 09 23.13 20	Paragraph 2.10 (Pages 37 to 42) – The [redacted] (b) (5) is explained at length in this section, and it is noted that "System startup shall be provided by factory certified and trained employees of the [redacted] (b) (5) manufacturer". However, the LCS is not explicitly mentioned in the commissioning specification, nor [redacted] (b) (5) yet it is understood [redacted] (b) (5) . What responsibility, if any, do we have pertaining to this system? Please note that the Clean Room system specified in Par. 2.14 is mentioned in the Cx specification (Fan Filter Units), under Par. 1.5.3.3 a.(1).	The GC shall commission the entire BAS system including the [redacted] (b) (5) portion.
244	23 09 23.13 20	Paragraph 3.4.1 through 3.4.11 (Page 50 to 55) – There are numerous requirements in this section that duplicate items that will be tested during our functional performance testing. However, there are no requirements for the CxA to be involved in the Performance Verification Testing (PVT). Please confirm that this Government-witnessed testing is distinct and separate from any CxA functional performance or integrated systems testing and the CS is not responsible for generating any PVT documents nor attending.	See RFI 496.
245	01 91 00.00 40	Paragraph 1.4 (Page 3,4) – One of the required submittals is "Start-up Plans". Is this re referring to the manufacturer / vendor equipment startup forms typically provided and completed by the respective trade contractors or a separate distinct start up plan?	The manufacturers' start-up forms and proposed start-up schedules are sufficient. The contractor may also develop a separate start-up plan in lieu of manufacturer /vender forms.
246	01 91 00.00 40	Paragraph 1.5.3.3 a.(3) (Page 6) – Requires the [redacted] (b) (5) [redacted] (b) (5) Will the new facility be connected to the main system prior to the commencement of the functional testing?	The MSL BAS will be [redacted] (b) (5) [redacted] after commissioning of BAS and functional testing of connected [redacted] (b) (5) [redacted]
247	01 91 00.00 40	Paragraph 2.6 – Are the Functional Performance Test Plans referred to a separate document for each discipline (i.e.: mechanical / electrical / plumbing), or is the required information to be incorporated into each individual functional performance test for each discipline?	The information should be incorporated into each individual functional test based on equipment /system approach. For example, the test of AHU should include mechanical, electrical, Tab and control contractors.
248	01 91 00.00 40	Paragraph 3.2.4 (Page 11) – A sampling strategy is noted for testing multiple identical pieces of "non-life safety or non-critical" equipment. What equipment is defined as "non-life safety or non-critical"?	VAV Boxes, FCUs or similar identical (type and function) units that serve non-critical or non-life safety spaces. For example, offices or conference rooms are not-critical and non-life safety spaces.

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249	01 91 00.00 40	Specification Section 01 91 00 part 1.5.3.3 a(6) includes Reliability Centered Acceptance for Facility Shells (01 83 00.07 40), Mechanical Systems (01 86 12.07 40) and Electrical Systems (01 86 26.07 40) under systems to be commissioned, in addition to the specific Mechanical and electrical systems listed under parts (1) and (2) respectively. Please confirm that responsibility for compliance and execution of Reliability Centered Acceptance for Facility Shells (01 83 00.07 40), Mechanical Systems (01 86 12.07 40) and Electrical Systems (01 86 26.07 40) is the responsibility of the General Contractor and their associated specialty trade contractors and certified testing firms and not the responsibility of the Commissioning Specialist.	Compliance and execution of Reliability Centered Acceptance for Facility Shells (01 83 00.07 40), Mechanical Systems (01 86 12.07 40) and Electrical Systems (01 86 26.07 40) is the responsibility of the General Contractor and their associated specialty trade contractors. The responsibility of the Commissioning Specialist is the verification and documentation of compliance.
250	Architectural Dwgs	RFI No. 61 provides a response that is still not clear. Are door assembles that are not called out as STC door assembles on the Door Schedule to match the STC wall assemble rating? Is it the intent to provide STC 45 door assembles in all walls that are not specifically called out for a STC rating on the Door Schedule?	Per response #61 - All doors in STC rated partitions, even those not specifically called-out in the Door Schedule, are to have a minimum STC 45 rating per Door Schedule General Note #8.
251	Architectural Dwgs	Please note that some of the door hardware provided in the specifications are to be installed with door assembles in STC rated walls are missing hardware to achieve a STC rating. For example Office 227-A&B call for walls to meet a STC 49. The door hardware (Set 510) does not include any sound seals, thresholds, door sweeps, etc. How can we achieve a STC rating if the hardware schedule is missing the hardware to achieve this STC rating.	The doors mentioned in the example are not located in STC rated walls, but rather in glass storefront. That storefront is not an STC rated wall, therefore, the door is not required to meet the STC 49 noted in the question.
252	08 34 73	In SECTION 08 34 73, 3.5 FIELD TESTING (Page 11) - Provide third party testing in accordance with ASTM E336. Verify in writing that installed product performs no less than five (5) FSTC or NIC rating points below the specified laboratory STC rating. Examine, adjust, and retest any installation not meeting that criteria until compliance is obtained. How can this test be achieved if the Door Schedule does not have the STC ratings for all the door assembles that are required in STC rated walls assembles. The Door Schedule, Note No. 8 calls for a minimum STC 45 door assembly to be provided. If this requirement is to be achieved, we request that a revised Door Schedule be provided with the correct door assemblies STC ratings and hardware.	See responses #61 and 250.

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253	01 23 60	Add Alternate 2 changes the cleanroom classifications and has significant design increases to base bid utilities and HVAC serving the cleanrooms. Since this is a design-bid-build, not enough information is provided to price this Alternate. Please provide the design documents to allow for proper pricing?	Provide a price for this Add Alternate using the information available in the documents and input as required from vendors and suppliers.
254	01 33 29	The LEED scorecard is showing construction credit Sustainable Site 4.3 Alt Transp – LEV & HEV Preferred Parking to achieve 3 points. Please confirm that the design has allowed for preferred parking or that the end user intends to institute a vehicle sharing system in order to achieve the points in this credits. Please also confirm that furnishing, installing, or providing infrastructure for alternative fueling stations is not included in this design.	Confirmed - the design has allowed for preferred parking. Confirmed - furnishing, installing, or providing infrastructure for alternative fueling stations is not included in this design.
255	01 33 29	The LEED scorecard is showing construction credit Sustainable Site 7.1 Heat Island Effect – Non-roof to achieve 1 point. Please confirm that the design has incorporated the required high SRI hardscape, open-grid paving, and/or shading to achieve the point in this credit.	Within the LEED boundary concrete paving accounts for more than 50% of the site paving, and standard gray concrete when maintained (washed every other year) will have no issue meeting the required SRI value of 29 and therefore does not need to have additional instruction on how to make the product “high SRI.”
256	01 33 29	The LEED scorecard is showing construction credit Energy & Atmosphere 3 Enhanced Commissioning to achieve 2 points. Please confirm that a commissioning agent has been involved throughout the design process to the extent needed to achieve the points in this credit.	Confirmed. A commissioning agent has been under contract and involved throughout the design process.
257	01 33 29	The LEED scorecard is showing construction credit Energy & Atmosphere 5 Measurement and Verification to achieve 3 points. Please confirm that the required meters, submeters, circuits, and communications infrastructure have been incorporated into the base design to achieve the points in this credit.	The mechanical documents include meters, including chilled water, steam, and domestic water. The electric drawings include electrical sub meters.
258	01 33 29	The LEED scorecard is showing construction credit Energy & Atmosphere 6 Green Power to achieve 2 points. Please confirm that the end user intends to purchase offsite renewable energy or renewable energy credits for the required duration to achieve the points in this credit.	Confirmed.
259	01 33 29	The LEED scorecard is showing construction credit Innovation and Design Process 1.5 Green Housekeeping to achieve 1 point. Please confirm that the end user will enter into a Green Cleaning agreement and provide the necessary maintenance training to achieve the point in this credit.	Confirmed.

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260	SF1442	Standard Form 1442 states that an offer guarantee is required, however, requirements for the bid bond are not provided. Please advise if bid bonds are required to utilize Standard Form 24. Please also provide the required amount of the bid bond.	28.101-2 -- Solicitation Provision or Contract Clause.(b) The contracting officer shall determine the amount of the bid guarantee for insertion in the provision at 52.228-1 (see 28.102-2(a)). The amount shall be adequate to protect the Government from loss should the successful bidder fail to execute further contractual documents and bonds as required. The bid guarantee amount shall be at least 20 percent of the bid price but shall not exceed $3 million. When the penal sum is expressed as a percentage, a maximum dollar limitation may be stated.
261	Amendment 2, Preproposal presentation	Amendment 2 states "Please provide five (5) copies of the technical proposal and one (1) copy of the pricing proposal in an electronic format." The preproposal conference presentation states that all copies shall be submitted on CDs. Please clarify the required format/procedure for submitting proposals:	Please provide one copy of the techical proposal and one copy of the pricing proposal in an electronic format.
262	Amendment 2, Preproposal presentation	Please confirm that no hard copies are required.	No hard copies of the pricing and technical proposal is required.
263	Amendment 2, Preproposal presentation	Please advise if the price proposal can be submitted via email.	The price proposal can be submitted via email to the attention of Raymond J Porter: raymondj.porter@gsa.gov
264	Amendment 2, Preproposal presentation	Please confirm that proposals shall be delivered to The Dow Building. Please confirm that bids will be received in the building lobby.	No hard copies of the pricing and technical proposal is required.
265	Amendment 2, Preproposal presentation	Please confirm the deadline for submitting proposals. The SF1442 states 6/20/16 at 2:00PM but the preproposal conference presentation states 1:00PM.	The proposals are due by 1 PM EST.

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266	230923.132	230923.132 3.3.1 Storage Cabinets states the following: "In each project mechanical room, provide a wall-mounted metal storage cabinet with hinged doors. In addition to the number of manuals specified above, provide an additional copy of the manuals in each of these mechanical room storage cabinets. Provide cabinets large enough to hold the entire set of Controls System Operators Manuals, and the HVAC operation and maintenance manuals provided under Division 15 MECHANICAL. Locate cabinets adjacent to DDC control panels where applicable. Have each cabinet's proposed installation site approved in advance by the Contracting Officer and the BAS Owner. Prominently label each cabinet with the wording "OPERATION AND MAINTENANCE MANUALS." Prominently label each binder with the wording "MECHANICAL ROOM COPY - DO NOT REMOVE."" Please confirm this section is to remain part of the project / contract requirements.	These cabinets and additional manuals are not required. Please disregard specification 23 09 23.13 20 paragraph 3.3.1.
267	230923.132	Please confirm that Johnson Controls is an acceptable manufacturer and bidder for the specification section 230923.1320.	Confirmed unless Add Alternate 6 is accepted; Provide [redacted] (b) (5) BAS System for specification section 23 09 23.13 20 [redacted] (b) (5)
268	23054800.4	Specification 23054800.40 states "Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers" However the point lists on the M-600 series control diagrams indicates that some equipment (Chillers, EF-16 various pumps and some fans) do not have vibration accelleromters. Please clarify, do the chillers and other listed fans and pumps require these devices or not?	All Fans are as indicated on the drawings and each one over 7HP is required to have a vibration accelerometer. All pumps are as indicated on the drawings and each one over 7 HP is required to have a vibration accelerometer. Chillers are not required to have vibration accelerometers. Cooling Towers are required to have accelerometers. All AHUs are required to have vibration accelerometers if the fans are over 7 HP. Heat exchangers are not required to have vibration accelerometers.
269	Structural Dwgs	Structural Drawing S102A shows the overhead unistrut structural framing grid running through the cleanrooms. Drawings Q201A and Q301A do not show the unistrut framing system but a powder coated structural system in isolated areas. Please confirm the overhead unistrut framing grid is not required in the clean rooms. Please re-issue structural drawings clarifying.	S102A indicates the concrete insert system for the slab, not the grid. The insert system is required in the slab for the owner's future use. Any grids in the cleanrooms are to be coordinated and installed by the cleanroom manufacturer per 13 20 00/1.6. The cleanroom plenum grid system shall be capable of supporting 2,000 lb loads on the suspended grids per 13 20 00/2.4.1.1 and are as indicated in the Q drawings.
270	Amendment 8, Preproposal Delivery	Amendment 8, item 2 states the Government wants five (5) CDs delivered to GSA. Response to RFI No. 125 states " all submissions are to be made electronically. Hand delivery is neither permitted or desired." Please confirm the proposal delivery method is to be electronic, and five (5) CDs can be overnighted for delivery the following day. Also confirm that the proposal is to be in an uneditable PDF format.	Please provide 1 copy of the price proposal and one copy of the technical proposal via electronic format. The proposal must be provided in an uneditable PDF format.

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271	Amendment 8, Geotechnical Report	The response to RFI No. 29 states "Government accepts no responsibility or liability for the information contained in this document." As this is a design-bid-build project and the design resonsibitly is by the Government please confirm that the Government is responsible and liable for the information provided in the Geotechnical Report.	The response to RFI 042 does not deny responsibility for all of the information in the GET Solutions, Inc. report dated July 23, 2014, only the analysis or conclusions listed in Sections 4 and 5.
272	Form 1442	Form 1442 from the RFP does not indicate the start of work days from Award or NTP, please consider from NTP and confirm.	The contractor shall begin performance within 1 calendar day and must be at Susbtantial Completion within 730 calendar days after the receipt of the Notice to Proceed.
273	Section 01 33 29 – Para - 1.3.1 Credit Validation and LEED Scorecard	LEED Checklist as registered by the government notes under Innovation and Design Process a LEED point for Exemplary Performance of EAc5 M&V. This point requires NASA commitment to Sharing Whole-Building Energy and Water Usage Data for 5 years after physical occupancy. Specifically states "This option aims to incentivize whole building data collection for LEED projects. Projects that choose to comply with EAc5 through this option are encouraged to enroll in USGBC's Building Performance Partnership (BPP) at certification or typical physical occupancy.	NASA will provide data for the GC to complete this LEED credit.
274	Section 01 33 29 – Para - 1.3.1 Credit Validation and LEED Scorecard	Please advise if MSL will have green power available for EAc6 or if the purchase of RECs will be required.	NASA will purchase green power to fulfill credit EAc6.
275	01 78 25 BIM Execution Plan – Section M	Please make available the Level of Information (LOI) documents as referenced in the specifications but not included in the bid package to identify the effort required to achieve BIM and COBie deliverables as specified. Please also identify if parameters have been created in the existing BIM design for all LOI assets	The LOI specification has already been issued as part of amendment 0007. No, the design BIMs do not contain all necessary LOI parameters or parameter values.

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276	Amendment 0008	Much of the subcontractor market is pacing themselves relative to understanding the project with the final pricing date. Three key concrete subcontractors have not looked at the documents so the Prime contractor cannot understand how best set the crane strategy, production of concrete along with access around the building. Another example is the pile contractors have not look closely at the project to understand their production and staging plan. Will GSA move the Proposal date to the same date as the Pricing date of 7/7. There is minimal information in the proposal for review by the SSEB and by extending the proposal delivery date, the offeror will be able to clearly understand production of key subcontractors and equipment delivery along with site/construction phasing. This extension will allow a more defined schedule and phasing plan that have been vetted in the subcontractor market for greater efficiency in time and cost of work.	The technical proposal due date has been extended to 6-30-16 per amendment 0009. The price proposal due date remains at 7-7-16. Please refer to any subsequent amendments for the most current response dates and not this RFI response.
277	Air Barrier	There are different parapet details shown but in most cases it has the air barrier running down the entire backside of a parapet. Typically air barrier can terminate once it ties into the roofing system either three inches on top of the parapet or three inches down on the backside of the parapet. Would either of these work rather than having transition membrane and air barrier extend down the the entirety of the parapet?	The air barrier is shown extending down the back face of the parapet where there is a wall assembly / finished material on the inside face, it then transitions to roof construction where the stud-framed portion of the parapet meets the concrete. There, the barrier that is a part of the roofing system is tied into the barrier from the wall system. For example see 1/A513. Per 07 54 23 / 2.5 - 'General: Preformed roof insulation boards, vapor retarder, and accessories manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation. See Section 07 22 00, ROOF AND DECK INSULATION.'
278	Air Barrier	A-501/6 is an example of redundancy where there are two layers of air barrier being applied. ABAA states that when there is a change of plane or a change of substrate, transition membrane should be used but only needs to be applied to 3” on either plane or new substrate, respectively. Can redundancies such as this be eliminated?	6/A501 - Only a single layer of air barrier with appropriate transition membranes is to be installed per MPL1F. The second continuous layer is to be removed.

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279	Response to RFI 09	The response to RFI 09 states that this project is subject to ISC Standard, Physical Security Criteria for Federal Facilities dated 4/12/2010 and that the project has been designated [redacted] Per GSA's guidelines for shatter resistant window protection for [redacted] the assumed air blast load is [redacted] (b) (5) [redacted] While the window wall needs to be designed to resist the blast load, is it correct to also assume that the structural studs supporting the window wall system will also need to be designed (1) TO RETAIN THE WINDOWS WITHIN THE OPENING, IN THE EVENT OF A BLAST, AND (2) THAT THESE STRUCTURAL STUDS MUST BE DESIGNED TO INCORPORATE THE BLAST REACTIONS OCCURRING AT EACH WINDOW ANCHOR?	[redacted] (b) (5) [redacted]
280	Detail 7/A-514	Please refer to detail 7/A-514 and confirm that there is metal decking underneath the canopy TPO roof assembly, above the beam and underneath the 1/2" sheathing. The detail does not show the metal decking.	Provide cold form metal infill framing between the steel outriggers at 24" o.c. to support the 1/2" sheathing.
281		Amendment 0008 states " Price Proposals Are Due – July 7, 2016 at 1:00 pm • 1 CD Copy of Price Proposal • DO NOT SEND FAX OR PDFs. Are we no longer able to email the price proposal or do we email price proposal and send price on CD next day. Please advise.	The price proposal can be submitted via email to the attention of Raymond J Porter: raymondj.porter@gsa.gov
282	Section 054000	Section 054000 para. 2.1.a.1 calls for Sheet Steel Grade to be NLT [redacted] (b) (5) [redacted] steel is standard for all stud manufacturers for [redacted] and heavier gauge. [redacted] presents a problem with cold formed stud in the rolling process.	The design team takes no exception to the use of [redacted] steel for [redacted] framing on the project.
283	Section 092200	Section 092200 para. 1.2 calls for Shop Drawings signed and sealed by engineer. This not a normal requirement for this Section	The requirement for Shop Drawings signed and sealed by an engineer will be removed from 09 22 00.
284	Section 092200	Section 092200 para. 1.5.I prohibits using powder actuated fasteners. Can I assume that gas actuated fasteners are acceptable?	Powder actuated fastener tools are acceptable to use here at LaRC. With the following stipulations 1. Users must be trained on how to properly use the tool. 2. The company that each user is employed by, must either issue users cards stating they have been trained or that company can submit, on company letter head, a brief statement of employee training with a list of user names and signed by company management. 3. Tools can not be altered in any way and all safeties must be functional

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285	Section 092200	Section 092200 para. 2.1.2.2 states ASTM certified third testing statement for equivalent thickness shall not apply. Also Dimpled Metal Studs will not be a lowed. This is the process that all manufacturers use for interior metal studs. It uses heavier grade metal and thinner metal to accomplish the older method. Sheet A-610 general note 3 addresses this.	Studs shall be provided as specified in 09 222 00.
286	Section 092200	Section 092200 para. 2.1.2.4 states to use double runner system for top track at interior walls. This is an outdated system and most manufacturers do not make anymore. Suggest use track with 2" legs for deflection or slotted track.	The use of a deeper track or slotted track is acceptable.
287	Drawing A-611	Drawing A-611 partition type 2X914 & 2X914S calls to use 811 shaftwall CH stud. 811 CH studs are not made. 611 wide CH stud is the largest	Provide 611 CH studs in lieu of 811 CH studs.
288	Drawing A-611	Drawing A-611 partitions lX & 2X states CH stud at 16" oc. Shaftwall framing is 24" oc to allow for the 1" shaftwall liner which only is made 24" wide. UL U415 calls for 24" spacing.	Shaft wall framing shall be spaced per the UL Assembly.
289	Drawing A-611	Drawing A-611 states all walls with sound attenuation blankets to use a clip to fasten to stud. All SAB are friction fitted and no clip is required.	Provide clips as indicated/specified.
290	Drawing LP501	The quantities in the plant schedule (LP 501) are not matching the show on LP 201, LP 202 and LP 203. Specifically Plant (QP) has a quantity of 3 in the schedule but has 22 shown on drawing LP 201 and LP 202. Please advise what takes precedence?	Plans take precedent when showing quantities.
291	Drawing LP 201, LP202	Drawing LP 201, LP202 calls for Plant type (QF) and (MC). These are not included in the plant schedule on LP501. Please provide info.	QF = QA on the plant schedule. The MC should be MP.
292		Clarify existing concrete removal? (see Picture Attached) .This existing structure does not appear to be identified on the contact drawings. Please clearify what it is and if we are resonsable to remove or if it is remain in place.	This is the remaining portion of an existing grade beam from recently demolished Building 1192-E (see sheet CD101). This grade beam bridges an electrical controls duct bank. It remained in place only to prevent damage to the duct bank while still active. Duct bank and grade beam are scheduled to be demolished by the GC after relocation of controls cabling (see sheets CD105 and E-400).
293	Drawings M200 Drawing S101B	Drawing M 200 call for precast concrete trench (note #) for the utility tunnel . Additional the detail refers to specification - Specification Section 33 61 13 identifies a Precast construction. However drawing S101B provides section 8/S504 which is a cast-in-place trench . Please advise what is required?	Please see response to #155.

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294	Sheet Q-201A	Sheet Q-201A - The note "powder coated overhead structural frame with stainless steel fittings, clamps and fasteners" – does this apply to the "clean room ceiling grid" components? These are located in the same room (with different type of dashed line) and throughout the project but the finish requirements are not clearly stated. Please advise.	Please see response to #269
295	Sheet Q-201D	Sheet Q-201D – "overhead structural frame" is located in the replication Shop – does this follow the same requirements as the clean room ceiling grid materials?	There are 2 grid systems in the cleanrooms - the ceiling grid system and the suspended grid system. The ceiling grid system is integral to the cleanroom package. See spec 13 20 00. The suspended grid system is part of Division 5, and is suspended from the ceiling grid system in the cleanrooms. In a typical (non-cleanroom lab) the suspended grid system is to be suspended from the structural slab above.
296	Sheet P-600	Sheet P-600, plumbing fixture connection schedule: ES/EW-2 - who's responsible for this item, Plumbing contractor or Casework contractor?	ES/EW2 has since been deleted from this project.
297	Sheet P-600	Sheet P-600 – Plumbing Fixture connection schedule – SK-3, SK-4 and SK-5 are listed as "specified in section 123610. Section 123610, 2.2.4 lists stainless steel sinks as specified in section 220000. Please confirm who is responsible for the lab sinks and the type of materials needed. Is this from the plumber or the casework contractor? What is the material we are to provide? Sheet Q-401, detail B lists epoxy resin as the worksurface and sink material. Please advise.	Epoxy sinks are integral part of the epoxy countertops and are to be provided by the Casework Contractor. Stainless steel sinks are freestanding and are to be provided by the plumbing contractor. Refer to lab drawings for quantity and location of the different sink types. SK-3, SK-4, and SK-5 are specified in 22 00 00 - 2.4.11 Laboratory Sinks. The plumbing fixture schedule on P-600 will be revised.
298	Section 123610	Section 123610 , 2.2.6 – Please confirm the quick connect/quick disconnect fittings are also required per this section. Will standard chrome finish be acceptable?	Yes. Standard chrome finish is acceptable.
299	Section 226070	Section 226070, 2.3, G: requires all gas pipe and fittings to be supplied cleaned and sealed for oxygen service, does this apply to all Gas/CA/NIT fixtures specified in section 123090? Please advise is this is required.	Yes.
300		General Question – please confirm this project is to be drawn in Revit, thank you.	Yes.
301	Section 123610	Section 123610 - 2.2.7 – Kewaunee Scientific standard drawer slide is 100 lb static load, full extension, self-close, soft-close and meets SEFA 8 2012 requirements, will this standard slide be acceptable for this project?	No. Provide as specified. 150 lbs is required.
302	Section 123610	Section 123610, 2.2.7.2 – Kewaunee Scientific does not manufacture steel cabinets with a roller catch but use a positive catch as standard product instead. This is a superior closing mechanism, will this be acceptable? This closure meets SEFA 8 guidelines. Please advise	Provide metal cabinets with roller catch as specified.
303	Section 123610	Section 123610 – 2,2,7.2 – calls for the lab casework supplier to furnish and install vinyl cover base. This is typically found in the flooring contractors section, please review and advise if this can be changed, The project will get a better cost/install from a flooring contractor versus a casework contractor.	Provide as specified in this section.

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304	Sheet Q-402	Sheet Q-402, detail 7 – clean room pass-thru: Please expand on this item. Are we to use this detail for all clean-room pass-thru requirements? Please see sheet Q-304F, elevation 1 as an example shows a "utility pass-thru – see Arch" in multiple locations. What is the dimension for these items? Additionally, these are not shown at the same height AFF as shown on detail 7. Please advise if this is the correct detail. Please provide the correct specification for this item if it differs from the clean room pass-thru detail # 7.	There is a difference between a "cleanroom pass-thru" and "an utility pass-thru". The clean room pass-thrus, detailed on drawing Q-402, are to be provided and installed by the cleanroom provider. They are specified in section 13 20 00. The cleanroom is a turnkey item and all components associated with the cleanroom shall be provided by the cleanroom manufacturer. Laboratory Utility Pass-Throughs (non-cleanroom) are to be 8"x8" as located on the Q drawings. Provide one panel for each side of the partition. Basis of Design: WB RP 110 Series Removable Panel Access Door w/ primed grey baked enamel finish - to be included in 09 29 00 - GYPSUM BOARD / 2.1.14 LABORATORY UTILITY PASS-THROUGHS
305		Clean Room pass—thru cabinet: - detail # 7 on sheet Q-402, please provide the specification for this item.	Refer to specification 13 20 00 as indicated above. This item is an integral component of the cleanroom package.
306	Section 132000	Section 132000 – 2.4: Clean room grid system. Please confirm this material is integral to the clean room supplier/manufacturer/vendor and not part of Division 5 – miscellaneous metals section 055013 – 2.19 and 2.20 respectively.	See response to #295.
307	Section 13200	Section 13200 – 2.4.1: Grid system shall be manufactured of 2" extruded aluminum alloy 6063, temper T5 with a painted finish. This doesn't match section 055013, 2.19 or 2.20. Please advise which spec section is correct for the clean room grid system and if this is to come directly from the clean room vendor.	See response to #307 above.
308	Section 122210	Section 122210, 2.2 – details the "fabric" composition for this project. In section 132000, 2.14.1 – details an "all-metal" cleanroom laser curtain. Please update the 122210 spec to include the metal laser curtain if applicable to this section. Otherwise this item will be excluded and left with the clean room vendor's scope. Please advise, thank you.	The metal laser curtain in the cleanroom item is integral to the cleanroom package. See spec 13 20 00.
309	Section 122210	Section 122210 – interlock system – this is also noted in spec section 284002. Is section 284002 be responsible for the furnishing wiring/devices/installation for materials located within the building and section 12210 is responsible for the track, curtains and interlock wiring within the curtains only? Please confirm this accurate. We also see this applicable within section 132000, please confirm all areas of responsibility, thank you	The laser curtains shall be complete with curtains, tracks, and wiring within the curtains. Refer to specification section 12 22 10 for scope of work. Metal laser curtain for the cleanroom shall be provided as part of the cleanroom package.
310	Section 102243	Section 102243, 2.3, 2, a – lists clear anodized aluminum for the top and bottom rails but in paragraph 2.3,2 the requirement is white powder coat, please clarify if two (2) finishes are required or if it's only one (1), which one to furnish?	Two finishes are required. Per 10 22 43 / 2.3 (2) clear anodized aluminum is for the top and bottom panel rails - (6) white powder coat is for the ceiling track system.
311	Sheet A-101B	Sheet A-101B – Floor plan key notes – Item # 1 states "double" track ceiling supported frosted glass marker board sliding panels. The graphic doesn't match the other sheets with the same note – see sheet A-101A for example. This keynote shows two (2) dashed lines. Is sheet A-101B correct or should it be a single track assembly - see keynote # 9? Please advise.	A-101B is correctly noted as keynote #1.

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312	Section 115300	Section 115300, 2.2.2.1 – specification dimensions do not match sheet Q-403 dimensions listed for the same item. Please provide the correct size needed for this project.	Fume hood exterior depth shall be 32" nominal. Minimum clear interior worksurface depth shall be 24".
313	Sheet E-221B	Sheet E-221B – note 14 states paint booth fan furnished with booth local start/stop switch control mounted on the exterior of the paint booth. Who is responsible for supplying the control switch and mounting this unit?	Paint booth shall be provided complete with fan and light fixtures as specified in section 11 53 00, paragraph 2.2.2. Local switch and control shall be provided by the booth manufacturer. Coordinate with electrical. Coordinate with mechanical, including schedule on sheet M-802 for exhaust stack schedule.
314	Section 115300	Section 115300, 2.2.5.1 – Stainless steel canopy hood – requirements call for an on/off switch. Please confirm that we will only need to provide the cut-out for the switch and the electrical contractor will provide the wiring and the switch.	Fan and on/off switches shall be provided by the canopy hood manufacturer as specified in section 2.2.5.1. Coordinate with electrical and mechanical drawings.
315	Section 115300	Section 115300 – 2.2.5.1 – Flourine Exhaust – please confirm Division 23 will furnish and install the Flourine exhaust fan. This division (11) has the cylinder cabinets.	There is a stainless steel exhaust canopy for fluorine exhaust. The fan shall be provide by Division 23, coordinate with the canopy manufacturer specification Division 11. In addition to the exhaust canopies, provided by Division 11, there are vented cylinder cabinets specified in section 11 53 00, paragraph 2.2.6, with a very detailed scope of work. Coordinate with mechanical design documents, schedule on sheet M-802 for exhaust fan EF-13.
316	Section 115300	Section 115300 – 1.4.5 – testing “as manufactured” … are mock-ups required for the chemical fume hoods? If so, please advise which item(s) would be required and if they can be incorporated into the final project.	Testing "As Manufactured": Manufacturer shall construct an operating prototype of the type of hood to be supplied for the project and a test report ANSI/ASHRAE Test 110-1995 shall be provided. The prototype hood could be incorporated into the final project. Refer to specification 11 53 00 for additional requirements.
317	Section 115300	Section 115300 – 1.4.5 – fume hoods are required to be CSA certified and UL 1805 classified. Will hoods also be required to meet UL61010 requirements since they are pre-wired at the factory? Please advise.	Yes.
318	Section 115300	Section 115300 – 2.1.6 – HEPA Filter – where does this apply? Please advise, thank you.	Refer to response #153.
319	Section 2.2.1.8	Section 2.2.1.8 – requires duct collar to be 4” high – type 316 SS. Kewaunee standard is type 304 with 1” high, will this be acceptable?	Provide 316 SS duct collar, 2" high min.
320	Sheet Q-401	Sheet Q-401 – Detail 3: Notes indicate the Overhead structural frame is to painted to match the lab casework. Does this paint need to meet SEFA 8 performance requirements?	Paint on overhead structural frame does not need to meet SEFA 8 performance criteria.
321	Sheet Q-401	Sheet Q-401 – Detail 3: Structural frame and support on 36” centers ….. see structural drawings. On sheet Q-401, detail # 2 – “provide multi-directional bracing as required - see Arch and Struct drawings. Please provide the correct detail for this bracing. We couldn’t identity the specific detail showing this type of bracing for this item. Are we to use detail # 2 on sheet S-555?	Bracing is to be designed and provided as needed by the structural frame manufacturer.
322	Sheet Q-402	Sheet Q-402- detail 2C, typical vacuum pump exhaust outlet, please confirm this material is specified and furnished by the Mechanical Contractor and not the Casework Contractor.	Vacuum pump exhaust outlets to be provided by mechanical Division 23 contractor as indicated on lab drawing Q-402. Coordinate with mechanical design documents, ductwork to be same material as the exposed ductwork in labs. Exhaust duct shall extend to a minimum of 7' -6" above finish floor.

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323	Sheet Q-401	Sheet Q-401 detail # 2 – the graphics are a little misleading, does the cable tray connect to the deck above or connect to the overhead structural frame assembly?	Cable tray is located above the grid. See 6/A-731 for Lab Zoning Elevation/Section.
324	Sheet Q-401	Sheet Q-401, metal casework – detail B – sink information: Size listed is available but where is this applicable? The sink schedule on P-600 doesn't list the type of sink but refers to section 123610. Please confirm we are to use sink schedule on Sheet Q-001 for all sinks locations within this section.	Refer to response to #297
325	Sheet Q-001	Sheet Q-001, Casework types: R09 is often shown on the plans as a single unit in a lab room. Does this cabinet require an epoxy resin worksurface or is the painted steel cabinet top sufficient for this project?	Painted metal top is sufficient. Epoxy top is not required
326	Sheet Q-001	Sheet Q-001, Casework types: "T" – indicates ESD bench top. Please provide a specification for this worksurface. Does it need to include a wrist strap and grounding plug?	All instances of T-01 and T-02 in the Q drawings are to be provided with the following, with the exception of Flight Software D207 - Room #356 (Tables in #356 are NIC): The following information will be included in 12 36 10 / 2.1.14: Electro Static Dissipative Laminate Worksurfaces: 1. Basis of Design: Bally (Nevamar Static Dissipative Laminate) 2. Product Description: a. Static Dissipative Laminate, suited for a variety of electronically sensitive applications. b. Laminate performance properties shall meet or exceed NEMA LD 3-2000 standards for grade HGP. c. Laminate sheets, shall be available in post formable grade within ½" to ¾" radius, shall be designed for permanent lamination to workstation furniture surfaces and shall be individually certified and labeled to meet the specific electrical property requirements. d. Color: White. e. Surface Finish: Textured finish. f. Properties: >105 to < 109 for surface resistance g. Chemical Resistance: Resistant to common solvents such as Acetone; III Trichloroethylene; Solder flux; Isopropyl; Alcohol; Naphtha. h. Use standard contact or white glue adhesives and standard (NEMA) application procedures for High Pressure Decorative Laminates. i. Provide an upper shelf for equipment (where indicated), surge protected outlets integral to the work bench, drawers, and continuous wrist strap monitoring.

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327	Section 123610	Section 123610 – specs indicate the type and size of the caster required for the table but doesn't detail the material used to manufacture the table. What is the load capacity required? What is the minimum thickness of the steel legs and cross members?	Table frame shall consist of a 12 gauge welded tubular frame and leg assembly. The following pertain: a. Provide a self-supporting moveable workstation table design. b. Top of countertops shall be adjustable to 30 IN and 36 IN high, above finished floor. c. Each unit shall be complete so that units can be relocated at any subsequent time without requiring field application of finished ends or other such parts. d. Provide integral, adjustable leveling device in steel leg with non-marring foot cap. e. Adjustable module shelving shall attach to the structural module upright with height adjustability on 1 inch increments.
328		General Question – are stamped engineering drawings required as part of our submittal process for the lab casework, lab equipment, overhead service carriers and curtains?	Stamped engineering drawings are not required for the lab casework, lab equipment, lab overhead service carriers, or lab curtains.
329	Section 102243	Section 102243 – 2.3,: 3/8" thick laminated safety glass in 12' sections is not manufactured any longer. The weight limit of 330 lbs per panel is not physically possible, do you have any flexibility in these specifications?	Several manufacturers have been contacted. Laminated safety glass as specified in 10 22 43 / 2.3 can be manufactured and will not exceed the maximum weight limit indicated.
330	Section 102243	Section 102243 – 1.4.1: Glass manufacturers typically do not provide LEED certification, this will be excluded from our proposal. All other submittal items are acceptable.	It is understood that products do not themselves have LEED certifications. However, glass and associated metal frame work could potentially contribute to Recycled Content (MRc4) or Regional Materials (MRc5). Also any adhesive used in the field associated with this product would be subject to adhere to Low-Emitting Materials for Adhesives and Sealants (IEQc4.1). Refer to sections 1.4.2, 1.4.3 and 1.4.4 of this same section. Any product that contributes or is subject to LEED credits would have associated documentation for the purpose of documenting the building. Furthermore these noted credits are the responsibility of the general contractor to achieve.
331	Section 115300	Section 115300 – 2.2.2.2: and sheet E-502 - paint booth – the specifications do not mention wiring the unit to meet Class I, Division 1 yet this is noted on sheet E-502. Will standard wiring/electrical devices at time of manufacture be acceptable for this project? Please advise.	The paint booth internal wiring will be required to meet the classifications as shown on E-502.
332	Section 122210	Section 122210 - Provide laser safety requirements for each lab as calculated by the lead staff member from each lab and verified by the responsible Laser Safety Officer. In particular, for each laser curtain, window block and laser barrier, provide according to ANSI Z136 the required Damage Threshold. Alternatively, please provide location of each laser in each room plus detailed specifications of the output characteristics of each laser to facilitate the calculations required to specify appropriate barrier materials.	Laser curtains are to be provided as specified in 12 22 10.

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333	Section 122210	Section 122210 – 2.4 - It is our experience that double-track and by-pass curtain breaks or entryways create difficulties in establishing a reliable and error-free interlock system. Will the customer consider a single-track system with engineered curtain breaks which can be interlocked?	Provide double-track as indicated on drawings and as specified in section 12 22 10.
334	Section 122210	Section 122210 – 2.4 Confirm that we have identified all of the room locations (non-cleanroom) for which laser curtains, window blocks, and barriers are required. We identified these rooms: [redacted] (b) (5) Provide more information on each laser curtain, window block, and barrier: ▯ Configuration: Straight runs? Curves? L-Shapes? Vestibule blocks? ▯ Configuration: breaks and entry points? ▯ Height: Estimate finished ceiling height. Confirm floor positioning of each curtain (1" drag, 2" drag" or ¼" elevation from finished floor) ▯ Length? ▯ Will all room doors require magnetic locks? Describe whether each is secure or non-secure. Describe whether each is a single or double door.	It is the contractor's responsibility to review all drawings and equipment lists for scope of work. Contractor to verify quantity, dimension and configuration of laser curtains. There is no room 319. Refer to lab interior elevations (drawings Q-300 series) for ceiling height and top of curtain dimensions. Curtains shall be designed with a 2" floor overlap as specified. Refer to specification 28 40 02 for Laser Interlock System requirements.
335		Provide more detail on how the curtain interlocks (for each room, each curtain, each curtain section) and any window block interlocks will be used: ▯ Location of hardware including keypads, access controls, interlock by-pass switch (interlock override), and other switches or devices connected to the interlock system ▯ Describe wire chase locations? (how will wiring in laser curtains and window blocks be connected to the interlock system? Where are the exit points?) ▯ Are any of the laser rooms or laser working areas linked or interdependent? For example, will laser safety in any room depend on laser safety in any other room? It appears that the working spaces on the 3d floor will require laser curtains and interlocks that are carefully coordinated with work processes. ▯ Is there a specification for the wiring in the curtains to handle the interlocks and any supplementary devices? (wire gauge, color coding, shielding, etc.) ▯ It appears that the interlock system will require dual-channel interlock switches. Provide the counts and locations for interlocks in each laser curtain section and each window block.	Interlocks will be as indicated in the TY drawings and as described in: 28 40 02 - LASER INTERLOCK SYSTEM. Warning lights, etc. are to be located as indicated on 1/A-731.
336		Section 122210 – 2.4: Customer specified dual track of aluminum construction. Will customer accept steel track with black low-reflectance coating, such track to be supported by superstructure using UniStrut or similar? ▯ Are there laser curtain configurations in which our standard 26" radius curve will not be acceptable?	Provide curtain as specified. Refer to lab drawings for radius and laser curtain plans.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
337	Section 12210	Section 12210 – 2.3: Will customer consider alternate laser barrier materials? The specification indicates a vinyl-laminated construction. The specification does not indicate the desired (required) ANSI Z136 damage threshold. We will provide single-layer, non-laminated, laser barrier fabrics suitable for the intended applications and certified to appropriate power levels. Please see our questions also in the "Laser Safety" section of this document. Please clarify: ANSI Z136 requires (b) (5) until "burn through" for a laser barrier. The specification for this project refers to ANSI Z136 yet mentions (b) (5) as a target. The laser barrier fabrics we employ do not require reinforcing strips at any seam or grommet placement. Please confirm this is acceptable. We place grommets every 12" (nominally) on center to improve "stacking depth" of the curtains when pushed to their fully open position. This grommet spacing does not impact system performance. Please confirm this is acceptable. It is our experience that weighted hems can actually interfere with the overall light blocking when an extended floor drag is specified. Confirm that customer will accept appropriate light-blocking design for those spaces requiring this attribute. Confirm that 2" drag without a weighted hem using our fabric will be acceptable. Specification calls for vertical strips of Velcro where laser curtains attach to hard surfaces. We believe that other attachment methods are more consistent with the laser interlock requirement. Velcro is easy to defeat. Will customer consider quick-disconnect mechanical fasteners? Clarify the flame retardancy specification required. The reference to NFPA 701-1999 is not consistent with the reference to NFPA 701-2010.	Provide as specified and as indicated on drawings.
338	230923.132	M-609 Notes indicate that only one LCP Lab Panel should be installed for every two lab rooms? Please confirm this is the case as the Labs without these panels will not have a means to display the status of the room conditions inside that room?	One LCP Panel shall be installed for every two labs and it must have the capability to display the status of each of the two room conditions individually.
339	230923.132	Page 40 of this specification requires Dip Switch selectable Fail Safe positioning for the Lab Valves. Please confirm this is a requirement.	The Lab valves shall maintain their current position upon power failure.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
340	230923.132	The sequence of Operation for the AHUs sates the following [redacted] (b) (5) Is it requires to provide damper end switches and interlock wiring to Fire-Smoke and or Smoke dampers a part from the AHU (D-1 and D-5) Isolation dampers?	[redacted] (b) (5)
341	Amendment 8, RFI No. 72 Response, 31 62 13.20 - Precast/ Prestsressed Concrete Piles	The response to RFI No. 72 issued in Amendment 08 provides two different responses which conflict each other. The response dated June 3, 2016 states "The requirements are as stated in the contract documents." The response dated June 6, 2016 states "The design team takes no exception to the elimination of the pile driving points provided the contractor's geotechnical engineer and the pile subcontractor have no concerns that the piles will be damaged during driging operations." Please confirm which response to RFI No. 72 should be followed.	Please disregard the response to RFI 072 on 6/3/2016 and follow the revised response issued on 6/6/16.
342	01 10 00	The response to RFI No. 43 states "Please amend specification 01 10 00 paragraph 1.14 B with the addition of the following: "Examples of work considered to be disruptive include but are not limited to noises that prevent normal conversation within adjacent buildings, vibration that might interfere with ongoing NASA experiments or testing odors that cause discomfort or disruption to Center employees; and any other activities that would adversely impact the efficient operation of the Center or Impair the Center from fulfilled its mission." Can the Government please confirm whether it views the driving of Precast/ Prestsressed Concrete Piles as disruptive? Does the Government believe the driving of piles should be performed off hours?	Pile driving operations will be permitted during normal working hours.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
343	31 62 13.20 - Precast/ Prestsressed Concrete Piles	Can the Government please confirm whether pile driving points are required? If pile driving points are required, neither the specification or the Geotechnical Report provides a description or detail of what is required. There are many kinds of pile driving points, which also impact the cost. Please provide a description or detail of what is required.	Please see response #341 above.
344	General	Can the Government please confirm that if a Tower Crane was utilized for this project the foundation pad, as well as piles and pile caps if required, for the Tower Crane could remain in place after the completion of work?	A tower crane foundation located within the MSL building footprint, not interfering with any existing or proposed utilities/building elements, and below an elevator shaft or mechanical shaft can remain in place after project completion. A tower crane foundation in a location not meeting the criteria above would need to be removed upon completion. Location to be approved by NASA prior to installation.
345	GSA Pricing	Will this project qualify for a GSA standard pricing schedule? If so, please provide.	Please clairfy the question.
346	13 20 00	Please confirm the Government owns and is responsible for all the base building design that serves and surrounds the clean rooms, including but not limited to MEP equipment located in the penthouse and second floor mechanical room; the Government also owns the user related design, including but not limited to user related electrical & telecomm., IDS, and process piping for tools & equipment provided by the Government. Please confirm that the clean room contractor owns the clean room environment design including all components of the envelope, including the filter fan units with HEPA filters, and lighting, not the epoxy flooring.	The Government does own and is responsible for all of the base building design. We believe that the question refers to the division of scope between the General Contractor and Sub-Contractors/Suppliers. The intent is for a turn-key single-source responsibility for the cleanrooms through the General Contractor. .
347	12 24 13	Section 2.1.1.b calls for front fascia, RCP general note #13 indicates to provide recessed roller shade and pocket at all perimeter glazing. Which is correct? Are the shades to be mounted below the ceiling with a front fascia or above the ceiling in a recessed shade pocket?	Shades are to be mounted above the ceiling in a recessed shade pocket.
348	12 24 13	Please advise if a standard color housing is acceptable or if, per section 2.1.1.e, we will need to include price for custom painting the fascia/pocket throughout the project.	Per 12 24 13 / 2.1.1.e, provide paint to match the ceiling color.
349	12 24 13	The ceiling legend shows a graphical representation of WT-1 and WT-2 on the RCP drawings; however, the graphical representation appears to be inconsistent and is extremely illegible. Can an architectural annotation be provided on the RCP drawings that shows the designation of WT-1 and WT-2 for each shade required?	See Finish Schedule A-701 for WT-1 / WT-2 locations.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
350	12 24 13	General note #13 on the RCP drawings indicates to provide recessed roller shade and pockets at all perimeter glazing. There are numerous rooms that do not appear to require shades (see H1A, H1D, H1F, H2A, H2C, H2F, etc.). Please clarify if ALL perimeter glazing is to be covered by this scope.	Confirmed. All perimeter glazing along the office areas are to receive recessed roller shades and pockets - see drawing-referenced wall sections and details for shade scope in shared spaces and corridors.
351	10 10 00	The specifications for the marker board calls for both a recessed tray and a magnetic tray. Does the owner want a combination of both, or will each MB1 receive just a magnetic tray?	Please see the design drawings - interior elevations and sections - for recessed marker board tray locations. All other marker boards not identified with a recessed tray are to receive a magnetic tray.
352	10 10 00	Under the basis of design there is no mention of the functional reveal rail nor the chartrail insert and hook for the boards. However, in the specifications, the reveal rail and chartrail insert are mentioned. Is the chartrail insert and functional reveal rail required?	Yes. The chartrail insert and functional reveal rail are required.
353	07 27 10.00 10, 07 21 13	Spec Secton 07 27 10.00 10, Paragraph 1.7 eludes to the air leakage rate as specified in Section 07 21 13. There is no air leakage rate data available in this section. Typically, NASA follows the USACE air leakage testing protocol of .25cfm/75Pa for Architectural Testing and anywhere from .30cfm/75Pa to .40cfm/75Pa for Architectural Plus HVAC Testing. Please advise.	The air barrier shall have an air permeance of 0.004 CFM/sq.ft. @ 75 Pa or less and shall be tested according to the USACE air leakage testing protocol.
354	S525	Reference detail 4/S525. This detail shows a typical pile cap including dowels in the top of the piles. Specific information regarding the dowel size, quantity per pile, embedment, grout, etc. could not be located. Please provide.	Provide (4) #7 dowels in corrugated metal sleeves cast into the top of the precast piles (at corner locations). Dowels shall have a 90 degree hook in the pile cap with a minimum embedment depth of 24” above the top of the pile into the pile cap. Dowels shall be cast into the sleeves with non-shrink, non-metallic grout with a minimum compressive strength of 7,000 psi. Dowels shall extend a minimum 6’-9” into the pile.
355	08 11 16	Reference response to RFI #9. Please confirm that the use of laminated glass will be an acceptable method for achieving the required level of blast protection. Please also confirm that a window security film is not required if laminated glass is used.	The laminated glass, as specified in the contract drawings, is acceptable for meeting the FSL II requirements for blast resistance of windows per the ISC Physical Security Criteria. Additional fragment retention film is not required.
356	Base Bid GC Price Proposal Form	Division 13b requires an allowance for the WIS3R Lab that is to be provided by amendment. Please provide.	Please see the Bid Forms issued with Response 011.
357	GSA RFIU #08	Is the Small Business Subcontracting Plan to be submitted in the Technical Proposal or in the Price Proposal?	Technical Proposal.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
358	Solicitation C201	Please provide a list of ALL items required to be submitted in the Phase II Price Proposal.	Items include: SF1442; Project Bid Sheet; Project Labor Agreement; Proof of Bonding; Reps and Certs;
359	Amendment 0002, Item 2	Item 2 only referes to one (1) copy of the Price Proposal in electronic format. Please confirm no hard copies are required.	Confirmed. No hard copies are required.
360	Amendment 0002, SF 1442, Item 13.b.	Item 13.b. states a bid guarantee is required. Please provide form and amount of bid guarantee.	28.101-2 -- Solicitation Provision or Contract Clause.(b) The contracting officer shall determine the amount of the bid guarantee for insertion in the provision at 52.228-1 (see 28.102-2(a)). The amount shall be adequate to protect the Government from loss should the successful bidder fail to execute further contractual documents and bonds as required. The bid guarantee amount shall be at least 20 percent of the bid price but shall not exceed $3 million. When the penal sum is expressed as a percentage, a maximum dollar limitation may be stated.
361	Amendment 0002, SF 1442, Item 13.b.	Is the bid guarantee to be submitted only on the electronic format or is a hard copy required?	The bid guarantee shall be provided electronically. No hard copy is required.
362		Please provide the construction cost budget or limitation.	The construction cost budget is not being shared at this time.
363	01 23 60	Based on the interpretation of the bid options and understanding of the specification the utilization of onsite cut for fill material is acceptable. Specification 31 23 00.00 41, 2.4 states "The Contractor shall obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property." Required undercutting below proposed subgrade is not part of the Base Bid and will be accounted for on a Unit Price basis (Bid Item 0001D Removal and Replacement of Unsuitable Soil with Backfill and Fill Materials). Can the Government please confirm that this interpretation is correct.	Confirmed.
364	S525	Reference detail 4/S525. Please confirm that it would be acceptable to install sleeves in the top of the precast piles for future installation of the pile cap dowels. Dowels would be installed in the sleeves and grouted as indicated in the detail on S525. Please confirm.	See response to RFI #354.
365	Landscaping	Detail 1 on Drawing L202 has incorrect references. Detail 2 /L403 refers to the west Taylor courtyard bio retention planter #5 elevation, but is shown on the north side of the building. Detail 6/L403 refers to 1268 knee wall that does not seem to belong to the bioretention planter. Please confirm that these details are incorrect. Are there 1268 knee walls on the north side of the building? If so specify quantities and location.	Detail call-outs are incorrect. 2/L403 is the elevation for Planter #5. The single knee wall associated with the 1268 entry is documented with details 1/L403 and 6/L403. Refer to the plans for the details regarding the planter walls along the north side of the building.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
366	Civil	On drawing CS101, key note 10 and 23 refer to a concrete walk. Note 10 refers to the landscape drawings which show a pedestrian grade concrete paving detail (detail 1 on L503). Note 23 refers to D5/CG503. This detail does not exist. Please provide detail or confirm that note 10 and 23 both refer to detail 1 on L503.	Notes 10 and 23 on CS101 should refer to 1/L501. Note 24 on sheet CS101 should refer to CG503 - D3 REINFORCED CONCRETE PANEL.
367	Landscaping	Pa (Polystichum Acrostichoides) may be mislabeled on detail 5 of sheet LP203. Should they be Pd (Phlox divaricate 'Blue Moon')? On center spacing of Pa does not match the quantity when the area is taken off, however if the Pd spacing is used in the Pa call out area, the quantities do match. Please clarify.	Quantity of Pa should be reduced to match the designated spacing of 12" o.c.
368	Landscaping	Ps (Phlox Subulata) quantities appear to be incorrect. Should they be 18" oc instead of 6" because the quantities are off significantly?	If gallon size are to be used then the spacing can be at 18" o.c., otherwise the number shown on the plant schedule shall be distributed amongst the planting areas at approximately 6" o.c. spacing.
369	Landscaping	QF (tree) shown on sheet LP202 is not listed in the plant schedule. Please provide information on what this tree is.	See response to #291.
370	Landscaping	QA (Quercus Alba) is listed in the plant schedule but not shown in the plans. Please advise.	See response to #291.
371	Landscaping	22 QP (Quercus Phellos) are taken off from the LP drawings but only 3 are listed in the plant schedule. Please advise.	Plans take precedent when showing quantities for trees and shrubs shown by individual symbols.
372	Landscaping	Drawing L202, Detail 1 refers to 1268 Courtyard Enlargement. Drawing L403, Detail 2 refers to the West Taylor Courtyard Bioretention Planter #5 elevation, but is shown on the North side of the building. Detail 6/L403 refers to 1268 knee wall that does not seem to belong to the bioretention planter. Please confirm that these detail references are correct. Are there knee walls on the North side of the building similar to the one in 268 Courtyard? If so specify quantities and location.	See response to # 365.
373	28 20 01.11 10	Specification section 28 20 01.00 10, 1.3.1 provides information on the Central Station. 3.2.4 states "system components shall be compatible with existing Central Station equipment in the [redacted] (b) (5) [redacted]". a. Is the existing Central Station to be replaced? Or is this a redundant second Central Station or is this a local workstaiton in the base wide system? b. If the Central Station is to remain, What make, type and version is the existing equipment and software?	[redacted] (b) (5) [redacted]. Per paragraph 3.2.4, perform a field survey, including testing and inspection of all existing system equipment and DTS intended to be incorporated into the system. System components shall be [redacted] (b) (5) [redacted]. Paragraphs 2.3 and 2.6 identify the existing software as [redacted] (b) (5) [redacted]. Also, see Sheets TY-601 and TY-602 for additional information on connectivity. The contactor shall verify the software and relevant hardware versions from the government during the survey.
374	28 23 23.00 10	Specification section 28 23 23.00 10m 2.8.3 indicates "software shall be compatible with existing". What make, type and version is the existing software?	Per specification 28 20 01.00 10, paragraphs 2.3 and 2.6 the existing software is [redacted] (b) (5) [redacted]
375	27 41 16, 2.4	Specification section 27 41 16, 2.4 references Lifesize Icon as the approved manufacturer for the VTC Codecs in Room 107A, 107B, 217, 317, 417. Is is acceptable to provide an "or equal" to the Lifesize? Would Cisco VTC or Polycom be viable options?	No, Lifesize Icon is the Government standard VTC system.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
376	27 41 16, 1.2	Specification section 27 41 16, 1.2 indicates "custom programmable handheld remote controller" for Team Rooms (System A), Huddle Rooms (System D), Think Tank (System E), Corridor Display (System F). These types of remotes require additional external control processors and infrastructure to function that are not identified in the documents. a. Can the custom programmable handheld remotes be eliminated in these rooms and control be handled by the included display remotes? b. If the custom programmable handheld remotes are required, please provide additional information for a complete system.	Handheld remotes supplied with the displays for Systems A, D, E, F can be used provided they can control all intended functionality and will be user friendly.
377	27 41 16	Please confirm that any furniture / tables being supplied by the governement will have connection / boxes for telecom and/or audiovisual inputs integral to the furniture. The Contractor will not have to modify or cut boxes into furniture / tables.	Confirmed.
378	27 41 16	What will be the contractor's responsibility or government process for any codec settings/configurations that will need to be done to the codec after a classification switch?	The subcontractor/vendor will be responsible to provide professionally trained and experienced installers to setup and configure the codec system according to government specifications. Once the codec is integrated with the audio and video systems and is ready to connect to the data network, the contractor will contact Ed Scaife or Nancy Shevlin, as alternate, to obtain data network configuration settings and to arrange testing with NASA video conferencing services for operational validation.
379	Section 12 24 13	Paragraph 2.1.1.b. calls for Front Fascia. RCP General Note 13 indicates: Provide recessed roller shade and pocket at all perimeter glazing. Which is correct? Are the shades mounted below ceiling with a front fascia or above ceiling in recessed shade pocket?	See response to # 347.
380	Section 12 24 13	Paragraph 2.1.1.e. Housing: Match ceiling color. Please advise if a standard color housing is acceptable or if we will need to account for custom painting the fascia/pocket throughout the project.	See response to #348.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
381	Reflected Ceiling Plans A-111A through A-115B	General Note 13 indicates: Provide recessed roller shade and pocket at all perimeter glazing. Ceiling Legend shows a graphical representation of WT-1 and WT-2 on the RCP drawings, however, this graphical representation appears to be inconsistent and extremely illegible. 1. Can an architectural annotation be provided on the RCP drawings showing the designation (WT1, WT2) of the shade required? 2. Can the Finish Schedule be updated to provide a column/remark for each room indicating what perimeter window treatment type (WT1, WT2) is required for that space? 3. The Electrical Equipment Drawings show motorized shade locations and groups. This is the most thorough representation of this scope I have seen on the drawings. Can a similar representation of scope be provided on the Architectural Drawings? 4. Regarding ALL perimeter glazing. There are numerous rooms that do not appear to require shades. Examples: H1A, H1D, H1F, H2A, H2C, H2F, etc. Please clarify if literally "ALL" perimeter glazing is to be covered by this scope, or if there is a better way of describing this requirement on the drawings.	See responses to #349 & 350.
382	Section 31 23 00.00	Status of classified/unclassified materials onsite: Paragraph 2.4 BORROW states, "The Contractor shall obtain borrow materials required in excess of those furnished from excavations…" Bid Item 0001D indicates "Removal and replacement of unsuitable soil with backfill and fill materials" as a Unit Price distinct from the Base Bid. We interpret from our reading of the specifications and the bid form that utilization of onsite cut for fill material is acceptable as a basis for the Base Bid and undercutting below proposed subgrade is not included in the Base Bid and will be accounted for on a Unit Price adjustment if added to the contract. Please confirm if this is not the case.	See response to RFI 363.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
383	230923.132	230923.132 3.3.1 Storage Cabinets states the following: "In each project mechanical room, provide a wall-mounted metal storage cabinet with hinged doors. In addition to the number of manuals specified above, provide an additional copy of the manuals in each of these mechanical room storage cabinets. Provide cabinets large enough to hold the entire set of Controls System Operators Manuals, and the HVAC operation and maintenance manuals provided under Division 15 MECHANICAL. Locate cabinets adjacent to DDC control panels where applicable. Have each cabinet's proposed installation site approved in advance by the Contracting Officer and the BAS Owner. Prominently label each cabinet with the wording "OPERATION AND MAINTENANCE MANUALS." Prominently label each binder with the wording "MECHANICAL ROOM COPY - DO NOT REMOVE."" Please confirm this section is to remain part of the project / contract requirements.	See response to #266.
384	Amendment 0009 - RFI 223	Please provide glazing types for W1 and W2 shown on A604	W1 and W2 shall be GL-6 per SECTION 08 81 00 / 2.1.7
385	Amendment 0009 - RFI 196	There is no allowance value shown on the Base Bid tab of the Bid Form provided to us. Please provide value.	See revised bid form issued by Amendment 011.
386	Amendment 0008 - RFI 120	RFI 120 states the installation duration is to be determined by GC. Is the WISE3R lab to be installed before substantial completion?	Yes, the WISE3R is to be included in the General Contractor's overall project schedule and shall be completed by Substantial Completion.
387		Buy American Compliance: The project specifications provided does not mention if "Buy American" is a requirement. If applicable, what is the Buy American Act FAR number and please confirm it is a project requirement.	52-22511 Buy American —Construction Materials under Trade Agreements (MAY 2014). Please see C101 The Agreement.
388	236400	Absorption Chiller: There are no domestic manufactreres of absorption chillers. If Buy American is applicable to this project, please confirm the packaged absorption chiller is exempt from compliance.	To the extent that certain equipment is not available domestically, please comply with the procedures outlined in 52-22511 Buy American —Construction Materials under Trade Agreements (MAY 2014). See C101 The Agreement.
389	236410.2.6.3	Air Cooled Chiller: The basis of design air-cooled chiller is a scroll compressor model. Would an air-cooled variable screw compressor model chiller be acceptable if it meets or exceeds the efficiency scheduled?	Yes.
390	236410.2.6.7	Air Cooled Chiller: The specifications call for [redacted] (b) (5) protection of the air-cooled chiller, and glycol is not mentioned in either the mechanical schedules nor the mechanical specifications. Please confirm if glycol is being utilizied in the system or if the system will be protected with heat trace, electric heat, and insulation. If glycol is in the system, please confirm which type and what percentage.	[redacted] (b) (5)

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Master RFI #	Spec Reference	Bidder Question	GSA Response
391	230923.132	Given the response to RFI 340 as transmitted in amendment 10 that all smoke dampers and end switches associated with AHUs [redacted] (b) (5) and given that the Div. 26 electrical contractor is to [redacted] (b) (5) [redacted] (b) (5) [redacted] (b) (5) [redacted] (b) (5) [redacted] . Is it acceptable [redacted] (b) (5) [redacted] (b) (5) [redacted]	[redacted] (b) (5) [redacted]
392	Drawing A-731, Detail 1	1. Drawing A-731, Detail 1 – One note references stainless steel reveal molding for drywall applications. All other notes in this detail and others for vertical & horizontal reveal molding refer to aluminum trim, including the note to meet or exceed trim as manufactured by Fry Reglet, who fabricates this trim in aluminum. Can all drywall trim be furnished as aluminum?	All drywall reveal trim can be furnished as aluminum.
393	Drawing A-404, Detail 5	2. Drawing A-404, Detail 5 – Four windows, approximately 2'x26', are located at each level in an exterior lt. ga. metal framed wall. The 26' horizontal break in the wall structure does not provide the necessary support without adding structural steel framing. Will additional design information be provided for these walls?	Provide an HSS8x4x3/8 frame around the ribbon window in the toilet rooms at each level. Horizontal HSS8 girts will be located within the 8" light-gage wall which will frame to HSS8 columns at each end of the ribbon window.
394		In regards to the clean room... I'm pretty sure the walls and ceilings will be by a single sourced clean room contractor, however in doing some research on that system, they have the option to provide all related items within the clean rooms, which also includes fan filter units (there are several) and return grilles that would normally be provided by us. I'm wondering...should I exclude all clean room fan filter units (FFU) and/or Return Registers with Pre-filters (RR), as they will be provided by the clean room manufacturer? (They are scheduled on the mechanicals.)	Fan filter units shall be provided by the clean room manufacturer. All other mechanical items shall be provided by the mechanical contractor including return registers with pre-filters.
395		Booster pump detail and schedule call for horizontal pumps which look to be end suction closed coupled but spec calls for vertical multistage. Additionally, schedule calls for 475 gpm capacity…is this for each pump or the system? The schedule shows 20HP…I ask this because if they want 475 gpm split across pumps then I can provide 2 ea 10 HP. If they want each pump to be 475 gpm, I need to use the 20HP pump. Also I need a different header system (your piping connections) based on 475 gpm total or 950 gpm total.	Assuming the referenced "booster pump" is the process water pump, the schedule calls for a total of 360 GPM split between 2 pumps of equal size. The 220 feet of head is based on end user equipment usage needs. The scheduled 20 HP is the maximum acceptable.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
396		Drawings M-609: Note 3. States "Provide LCP Room Controller (1 Per every 2 labs). Currently, no LCP Room Controller locations were found on the floor plans. Typically there is one LCP Room Controller per lab. Please provide locations of ALL LCP Room Controllers.	See response to # 338.
397		Drawings M-603 through M-607: Please verify the intent of the smoke control sequence on pages M-603 through M-607. Is the FACP to open/close all fire/smoke dampers? Is the BAS system to be [redacted] (b) (5) [redacted] Typically the BAS system will be interlocked only to the fire/smoke dampers directly isolating the air handling unit. Please indicate [redacted] (b) (5) [redacted]	[redacted] (b) (5) [redacted]
398		236410.2.5.1: R-134a is on the 2016 EPA SNAP fact sheet for proposed change of listing status (Phase-out). Will the 2016 EPA SNAP approved lower GWP refrigerants, such as R514A, also be acceptable for this application?	Yes.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
399		236410.2.3.f: For the centrifugal water cooled chiller, the variable frequency drive references specification 262923. This specification does not match up to the variable frequency drive, integral to centrifugal chillers. Should this section be removed or a different specification provided for such? Sample Chiller Variable Frequency Specification: NEMA 1 ventilated enclosure with a hinged, locking door is tested to a short circuit rating of 65,000 amps. It includes a padlockable door-mounted circuit breaker/shunt trip with AIC rating of 65,000 amps. The circuit breaker is interlocked with the enclosure door. The entire package is UL/CUL listed. The drive is rated for maximum 480/60/3 input power, +/-10%. Displacement power factor of .98 at full load, minimum of .96 at all other part loads. Minimum efficiency of 97% at rated load and 60 hertz. Full motor voltage is applied regardless of the input voltage. Soft-start; linear acceleration; coast to stop. Adjustable output frequency from 38 to 60 hertz. All control circuit voltages are physically and electrically isolated from power circuit voltage. 150% instantaneous torque available for improved surge control. Output line-to-line and line-to-ground short circuit protection. Harmonic attenuation- integrated active rectification control of the building AC power assures low line-generated harmonics back to the users power grid. The VFD has less than or equal to 5% current total demand distortion (TDD) as measured at the VFD. This is based on an electrical system with voltage distortion less than 1.5 %. The chiller unit control panel capabilities provide for the control/configuration interface to, and the retrieval/display of, VFD related data including current limited to 100% motor overload protection, motor overtemperature protection phase loss, reversal, imbalance protection overvoltage/undervoltage protection, digitally displayed: output speed in hertz, input frequency, output speed in rpm, input line voltage, output voltage, input line kw, output kw, input line amps per phase, average input line amps, output/motor amps average current in % RLA, load power factor, fault, VFD transistor temperature. Environmental Ratings:* 32F to 104 (0C to 40) operating ambient temperature, humidity, 95% non-condensing.	The chiller manufacturer shall provide a VFD that is compatible with the chiller. The chiller VFD shall include [redacted] (b) (5) (b) (5)
400	Amendment 0012 - RFI 274	Please confirm contractor is to carry the cost of the Green Power in our pricing.	The Contractor is not required to carry the cost of green power in its bid. NASA will provide green power.
401	Amendment 0010 - RFI 356	Is the allowance for the WISE3R Lab for material only or material, taxes, freight, insurance, and labor to install?	The allowance breakdown is as follows: Base Bid is [redacted] (b) (4) [redacted] Options include Estimated Freight at [redacted] (b) (4) [redacted] Access Control Readers [redacted] (b) (4) [redacted] 3 sliding doors) [redacted] (b) (4) [redacted] Signal Filter (For FA in Control Room) [redacted] (b) (4) [redacted] 1 signal filter) is [redacted] (b) (4) [redacted] Refer to ETS proposal included in the WISE3R design package.
402		Elevations 3/L402 & 4/L402 for the Bioretention Planters 3 & 4 conflict with Section 1/L502. Please Clarify. It appears on the elevations that you have a Cast Stone Coping and Cast Stone Panels similar to what is shown on Section 3/L502 are shown. However, Section 1/L502 shows only a monolithic block with no precast panels. Please clarify.	The elevations 3/L402 and 4/L402 should show the monolithic condition similar to the detail 1/L502.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
403		Please provide enlarged section and veneer/cap requirements for retaining walls shown on 3 and 4/L401 at 1268 Courtyard.	Walls shown in section on details #3 and #4/L401 are cast in place concrete, short retaining walls with 3/4" chamfered tops, refer to grading plan and structural detail #13/S-504.
404	Amendment 0006 - RFI 31	As was stated in RFI#31, Room 128 is not a clean room. The Reflected Ceiling Plan does not designate which type of ceiling this is. On the Electrical Lighting Sheet E-201A the lighting is designated to be B4 which according to the Electrical Lighting Fixture Schedule on Sheet E-700 is a clean room lighting fixture compatible with the clean room ceiling system. Is Room 128 to receive a flush grid type ceiling? Is the CRM responsible for providing this lighting fixture?	Room 128 is not a cleanroom - it is to be an exposed ceiling to structure above with type B3 light fixtures. There will be a total of (18) B3 type fixtures in Room 128 in lieu of the (15) Type B 4 fixtures currently indicated on drawing E-201.
405		Please specify the wall type 1S714S as noted in room 156 (Conditioned Storage Common) on the north and west walls. It is not specified on the partition schedule on A-611.	1S714S is to follow the same construction as 1S714, but will add a minimum of 3" of SAFB to achieve STC 56 (min).
406		Please specify the wall type 0S778S as noted in room [redacted] (Secure Work Area) on the west and south walls. It is not specified on the partition schedule on A-611.	This wall type is indicated on A-611 (0S, Non-Rated Steel with foil backed gyp bd), but will be adjusted to match the following: This partition is to be constructed with 6" studs with 2 layers of 5/8" foil backed gyp board on both sides of stud, 3 1/2 SAFB to achieve STC rating of 50 min (test # RAL-TL11-080). The requirement for 3/4" mesh is to be eliminated from this wall type. - This wall is to be installed at following locations: o West and south wall @ Secure Team Room [redacted] o West and south wall @ Secure Work Area [redacted] o South wall @ Secure Work Area [redacted]
407		Please specify the wall type 1S778S as noted in room [redacted] (Secure Work Area) on the north wall. It is not specified on the partition schedule on A-611	Wall type 1S778S is to be constructed similar to 0S778S partition type (see Response to #406.), but with [redacted] foiled backed gyp board. This wall is to meet STC rating of 50 min (test # RAL-TL11-080) UL Listing U-407 - This wall is to be installed at following locations: o North walls @ Secure Work Area [redacted] o North and East wall @ Secure Team Room [redacted]
408		Booster pump detail and schedule call for horizontal pumps which look to be end suction closed coupled but spec calls for vertical multistage. Additionally, schedule calls for 475 gpm capacity…is this for each pump or the system? The schedule shows 20HP…I ask this because if they want 475 gpm split across pumps then I can provide 2 ea 10 HP. If they want each pump to be 475 gpm, I need to use the 20HP pump. Also I need a different header system (your piping connections) based on 475 gpm total or 950 gpm total.	The elevations 3/L402 and 4/L402 should show the monolithic condition similar to the detail 1/L502.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
409	Drawing M-609	Note 3. States "Provide LCP Room Controller (1 Per every 2 labs). Currently, no LCP Room Controller locations were found on the floor plans. Typically there is one LCP Room Controller per lab. Please provide locations of ALL LCP Room Controllers.	See response to # 338.
410	Drawings M-603 through M-607	Please verify the intent of the smoke control sequence on pages M-603 through M-607. Is the FACP to open/close all fire/smoke dampers? Is the BAS system to be [redacted] (b) (5) [redacted] Typically the BAS system will be interlocked only to the fire/smoke dampers directly isolating the air handling unit. Please indicate [redacted] (b) (5) [redacted]	See response to #397
411	Section 23 64 10	Paragraph 2.5.1: R-134a is on the 2016 EPA SNAP fact sheet for proposed change of listing status (Phase-out). Will the 2016 EPA SNAP approved lower GWP refrigerants, such as R514A, also be acceptable for this application?	See response to #398.
412	Section 23 64 10	Paragraph 2.3.f: For the centrifugal water cooled chiller, the variable frequency drive references specification 26 29 23. This specification does not match up to the variable frequency drive, integral to centrifugal chillers. Should this section be removed or a different specification provided for such?	See response to #399.
413	Section 13 20 00 - Paragraph 2.1.1.	Will the clean room subcontractor be responsible for the provision and installation of components related to the mechanical system that serve the clean rooms (MAU-1, S/A & R/A ductwork, clean room coils, condensate/drip pans, BAS control wiring and/or components, HWR/CWR piping and components, condensate piping, etc.) ? Or is this work to be performed by the appropriate mechanical subcontractors and coordinated with the clean room subcontractor?	The mechanical contractor is responsible for providing and installing all mechanical system components that serve the clean rooms except for the fan filter units which should be provided by the clean room contractor. The clean room contractor is responsible for approving the installation of work completed by the mechanical contractor and coordinating points of connection. The clean room contractor is responsible for all controls integration and all space requirements per the specifications, including, but not limited to filtration, temperature, and humidity.
414	Section 13 20 00 - Paragraph 2.1.1.	If the provision and installation of the aforementioned mechanical components and ancillary items are the clean room subcontractor's responsibility, where are the start/stop points of connection for components entering and exiting the clean room envelope (i.e. cw/hw piping, control related wiring, etc) that are sourced from or serving other spaces and/or components outside of the clean room envelope?	See RFI 413.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
415	23054800.4	Specification 23054800.40 states "Provide vibration accelerometers on an all fans, pumps, chillers, cooling towers, AHUs, heat exchangers" However the point lists on the M-600 series control diagrams indicates that some equipment (Chillers, EF-16 various pumps and some fans) do not have vibration accelerometers. Please clarify, do the chillers and other listed fans and pumps require these devices or not?	See response to #268.
416		Buy American Compliance: The project specifications provided does not mention if "Buy American" is a requirement. If applicable, what is the Buy American Act FAR number and please confirm it is a project requirement.	See RFI 387.
417	236400	Absorption Chiller: There are no domestic manufactreres of absorption chillers. If Buy American is applicable to this project, please confirm the packaged absorption chiller is exempt from compliance.	See RFI 388.
418	236410.2.6.3	Air Cooled Chiller: The basis of design air-cooled chiller is a scroll compressor model. Would an air-cooled variable screw compressor model chiller be acceptable if it meets or exceeds the efficiency scheduled?	See RFI 389.
419	236410.2.6.7	Air Cooled Chiller: The specifications call for [redacted] (b) (5) protection of the air-cooled chiller, and glycol is not mentioned in either the mechanical schedules nor the mechanical specifications. Please confirm if glycol is being utilizied in the system or if the system will be protected with heat trace, electric heat, and insulation. If glycol is in the system, please confirm which type and what percentage.	See RFI 390.
420		Please confirm whether Technical Proposal can be e-mailed or must be delivered on CD.	The techical proposal shall be provided on a CD and delivered to GSA as stated in solicitation. The price proposal may be submitted via email per the response to RFI 261 and 263.
421	LS-001	A note under the Chemical Storage Room notes states to provide a 4" berm for spill containment. Please provide description/section of berm.	The berm is to be provided via a 4" slab depression to be 'filled' with a grating material - see A-101B for general slab depression dimensions and A-701 for grating material designation.
422	L503	Please provide more information on Detail 6 Artifact Display. The only thing defined is the 3" SS post and clips. What is the depth of the footing? What reinforcing is required? Who provides the panels/lettering/logo? What is the basis of design?	The panels are an artifact to be provided by NASA and the detail shows the intent for the display. The final design of the footings will be the Contractor's responsibility through sealed shop drawings.
423	Section 05 52 00	This section offers a short description of the stainless steel and glass railings. Is there a basis of design the GSA wants to meet?	See the A-400 series for stainless steel and glass railing configuration. Synergi Minima Square was used as the general basis of design with some custom modifications.
424	Amendment 0002	The floor plan revisions for the WISE3R lab in Amendment 0002 are impossible to read. Please provide a replacement sheet A-101B.	Please see Amendment 0013.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
425	Sheet A-519	Is there a basis of design for the removeable insulated metal panel closure w/handles and the manually operated steel interlocked sliding port door at the laser port shown in Detail 9/A-519?	The removable panels are to be custom made for the particular location. The interlocked sliding port doors are to be custom per the Laser Interlock Manufacturer as noted in 28 40 02 / 2.2.9
426	Sheet A-519	Please confirm the aperture plates at the laser port are O/O.	Contractor to supply (1) solid blank aperture plate per opening, along with all manufacturer information for future procurement of aperture plates that are compatible with and fit into the installed units. All future aperture plates to be Owner supplied.
427	Sheet A404	Rigid insulation is only shown at the first floor level at the edge of slab (thickness transitions) in Wall Sections 3 and 5. Please confirm rigid insulation is not required at levels 2, 3 and 4.	Rigid insulation is required as indicated on detail drawings - see the A-500 series.
428	Sheets A-401 through A-404 and A-511 through A-513	Wall Sections and Enlarged Sections show rigid insulation under the slab and, in some cases in the enlarged details, show it turned down at the foundation wall. The insulation is not mentioned in the structural drawings. Please advise how far from the edge of slab to carry the rigid insulation and how far down the foundation wall. 7/A-511 is the only callout for the type of rigid insulation, calling out INS4. Section 07 21 13, paragraph 2.1.3.h. defines INS4 as Curtainwall Insulation. Is this what is to be provided under the slab? What thickness?	Insulation types are as indicated on A-301. Insulation is to be carried a minimum of 3'-0" under the slab from the inside face of the foundation or turn-down. Vertically, it is to be carried to the bottom of concrete at a turn-down condition or a minimum of 3'-0" from finished grade at all other locations.
429	Section 01 23 60	Please clarify what is to be the finish floor at the stairs if the Deduction Alternate 2 is taken.	The finish is to be as indicated.
430	RFI 15	Please provide brick specification for the required brick to match Building 1268 at the knee walls.	Brick to match existing - samples are to be provided by the GC during construction.
431	A-740	Provide enlarged head/sill/jamb details for Interior Sections 1 and 2 to indicate what the dichronic glass panels are set into. Section 1 indicates (2) 5/8" Gyp Bd. Is gypsum board the finish material at the opening?	As indicated on 1/A-740, the dichroic panels are to be top/bottom channel set.
432	RFI 43	Please advise if pile driving will be allowed during normal working hours or if will be required to be performed after hours and on weekends.	Pile driving operations will be permitted during normal working hours.
433	Sheet S-105A and S-105B	Stud rails are shown on Sheet S-105B along column line D. Are the required to continue along the same column line in Segment A of the Penthouse Framing Plan? None are shown here.	Stud rails are only required at locations indicated in plan.
434	Response to RFI 09	Please refer to page 44 of GSA's PBS Leasing Desk Guide, Attachment 4, Security Requirements for [redacted] The contract documents indicate all exterior glass to have an inboard laminated glass with 0.60 interlayer. When reviewing page 44 of the above mentioned GSA document it appears that shatter resistant glass make up can be: 1. As shown on the drawings 2. [redacted] without any laminated glass 3. Laminated glass plus [redacted]. Please provide clarification. Otherwise all bidders will inlcude only the glass make up as shown on the contract documents.	The laminated glass, as specified in the contract drawings, is the selected glazing system to meet the ISC Physical Security Criteria requirements.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
435	A-101B and 2/A-403	Please provide a detail for how the chain-link fence is connected to the CMU at the equipment rooms shown on A-101B	Upper most cells of the cmu walls are to be fully grouted. Provide a 1/2" magnitude crown at the centerline of the block to facilitate drainage. Chain link posts are to be embedded into the top of the CMU cells and fully grouted. Minimum embedment = 8".
436	10 22 43	The sliding glass partitions are shown on 101A, 102A, 103A, and 104A. RFI 47 indicates there should be 8 panels on the first floor and 9 panels on the second-fourth floors. Please clarify the size of each panel (width, and height or height above the finish floor)	See response to #200.
437	08 91 00 and 07 42 13	Spec sections 08 91 00 and 07 42 13 reference L2-L9. Drawing A-604 and the elevations have L1-L11 Please confirm L1, L10, and L11 match the specs L2-L9. Please also confirm that these are to be metal wall screens and not a louver in the typical sense.	Confirmed. L1-L11 shall all match the specs for L2-L9 as indicated in 07 42 13 / 2.6.5.
438	75423	Please refer to section 3.4.2 Manufacturer's Inspection of the specification 075423. 6/16/2016 [redacted] 75423 "Please refer to section 3.4.2 Manufacturer's Inspection of the specification 075423. It is unclear from the above if the manufacturer's representative is required to be present full time or is to make a site visit once a week. Please clarify as the manufacturer's fees will vary depending on what is required.	07 54 23 / 3.4.2 will be modified to read as follows: 3.4.2 Manufacturer's Inspections Manufacturer's technical representative shall visit the site a minimum of three site visits. The visits shall occur during initial commencement, at a midpoint of the installation, and at substantial completion, at a minimum, with the exception that follow-up inspection(s) of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the Roofing Contractor to the Contracting Officer within three (3) working days. The report shall note overall quality of work, deficiencies and any other concerns, recommended corrective work.
439	Air Barrier Testing	Paragraph 1.7 of specification 072710.0010 eludes to the air leakage rate as specified in Section 07 21 13. Section 2.2.1.b. of specification 072113 calls for the air barrier membrane to have an air permeance of < 0.00001 L/Pams2s per ASTM E2178. Typically, NASA follows the USACE air leakage testing protocol of .25cfm/75Pa for Architectural Testing and anywhere from .30cfm/75Pa to .40cfm/75Pa for Architectural Plus HVAC Testing. Please confirm the air leakeage rate as this information is critical in order to prepare a correct bid.	See response to #353.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
440	Response to RFI 09	Please refer to page 44 of GSA's PBS Leasing Desk Guide, Attachment 4, Security Requirements for (b) (5) There appear to be two options. Option 1 is to [redacted] (b) (5) [redacted] (b) (5) [redacted] This does not affect the curtainwall framing. Option 2 is to [redacted] (b) (5) [redacted] (b) (5) [redacted]. Please clarify if either option can be used or if both options need to be used as this will greatly affect pricing from suppliers.	See response to #434.
441	A-301	Under exterior wall types on sheet A-301 all the details show INS2 insulation except for deatil L1 which shows INS3. Please confirm this is an error and that insulation behind all the metal panels and terracotta is to be type INS2.	Confirmed. All insulation behind the metal panels and terracotta is to be type INS2.
442	Air Barrier Testing	It is unclear if the entire building/ test envelope will be subject to Architectural Only Pressurization, Depressurization Test and Architectural Plus HVAC System Pressurization, Depressurization Test. Please clarify which areas of the building get the Architectural Only Test and which ones would get the Architectural Plus HVAC System Test.	The air barrier shall have an air permeance of 0.004 CFM/sq.ft. @ 75 Pa or less and shall be tested according to the USACE air leakage testing protocol. Architectural only testing shall be conducted on floors 1 through 4 and shall have an air leakage rate less than 0.25 CFM/sq. ft. @ 75 Pa. Architectural plus HVAC system test shall be conducted on the 5th floor and shall have an air leakage rate less than 0.30 CFM/sq.ft. @75 Pa.
443	RFI 23 Amendment 6 - Dichroic Mobile	Please confirm that per detail 3/A-433, the mobile will have 11, 6" wide clear acrylic panels with dichroic film. Also please confirm the lengths of these panels. Otherwise for pricing purposes, bidders will assume all 11 panels to be 40 feet long per the information on detail 3/A-433.	Per 3/A-433, the mobile will consist of 11 ceiling hung cables with acrylic panels of varying length. Contractors to assume 220 total acrylic panels with a mixture of dichroic film colors 1&2. Panels will be a combination of 1', 2', 3', and 4' tall panels for a total of 480LF of 6" wide acrylic with dichroic film.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
444	-	On sheet A-701, FWP note says "for performance requirements, refer to spec section…" but no spec section is given. Please provide performance requirements and specifications for FWP-1 fabric wall panels.	The following information will be added to the Specifications: 09 84 33 SOUND-ABSORBING WALL UNITS Tackable Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core. 1. Panel Shape: Flat.; 2. Mounting: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.; 3. Core: Glass-fiber board.; 4. Edge Construction: Manufacturer's standard chemically hardened core with no frame.; 5. Edge Profile: Eased (small radius).; 6. Corner Detail in Elevation: Square with continuous edge profile indicated.; 7. Facing Material: Seamless Tackable, as scheduled on Finish Legend.; 8. Nominal Overall Panel Thickness: As indicated on Drawings.; 9. Panel Width: As indicated on Drawings.; 10. Panel Height: As indicated on Drawings. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction: (b) (5) [redacted]
445		Please Confirm the Key Personnel who will attend the Oral Presentation. The RFP required the Offeror to provide the resumes of these team members. • Offeror's Principal In Charge/Project Executive • Construction Project Manager • Construction Superintendent • Construction MEP Coordinator • Quality Control Manager • Safety Coordinator • BIM Coordinator and Document Manager • LEED Accredited Professional	The following Key Personnel at a minimum shall attend the Oral Presentation: Offereor's Principal in Charge/Project Executive; Construction Project Manager; Construction Superintendent; Construction MEP Coordinator; Quality Control Manager; BIM Coordinator and Document Manager.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
446		A-610 has a detail ' "P" Modifier- Partial Height Wall'. However, no _P modifier walls could be located on architectural drawings. Please confirm no partial height walls occur in this project	Walls are as indicated on the Floor Plans
447	RFI-240 RFI-233	The response to RFI-240 references the answer supplied in RFI-233. RFI-233 has not been included in the amendment packages (1 through 12). Please provide the question and response for RFI-233.	See response to #233
448	Drawings: E-301 E-401 E-405 E-406	Drawing E-405 indicates [redacted] (b) (5) [redacted] (b) (5) Are we to assume that the transformer feeders should be sized as indicated on E-405? Are we to provide ([redacted] (b) (5) [redacted] (b) (5) [redacted]	[redacted] (b) (5) [redacted]
449	13 20 00	Will the backside of the return air chase walls (labeled as '1S812S' and '1S714S'), shown on the architectural drawings, outside of the cleanroom wall panels require to be lined with cleanroom liner wall panel system (i.e. 1/4" aluminum skins)? Or will the metal stud/drywall partitions be coated with an epoxy paint?	Backside of architectural air chase walls, shall be coated with epoxy paint.
450	84 40 00	There are no requirements for hurricane impact in the psecifications, however the building appears to be right on the caost. Please confirm that there is no hurricane requirement. Without a response, all bidders intend to bid based on the low level blast and exclude any hurricane requirements.	The project is not in a hurricane zone so there are no specific hurricane design requirements applicable to the building. It is, however, subject to wind design requirements which are slightly higher for projects in this area.
451	A-701	Refer to sheet A-701 for the MWP-1 metal panel. The schedule calls this panel to be aluminum plate with 1/4" diameter perforations, however does not specify the percentage of perforations. Please confirm percentage as this will impact pricing. Without a response, bidders intend to bid assuming 25% perforations.	MWP-1 shall be 20% Open Area - perforations shall be in straight rows at 1/2" centers.
452	11/ A-514	Refer to detail 11/A-514 where it calls for 6" of insulation behind the metal panels in lieu of the standard 3". Please confirm what the insulation thickness needs to be at this location? Otherwise bidders will assume 3" as that is shown as the standard insulation thickness for metal panel wall and soffit assemblies on sheet A-301.	11/A-514 is a section detail - provide insulation as indicated in the detail.
453		Should the clean room fan filter units (FFU) and Return Registers with Pre-filters (RR) be provided by the mechanical contractor and not the clean room manufacturer? Some of the clean room manufacturers can also furnish them. Can this be done either way?	See response to #413.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
454		Plumbing Booster pump detail and schedule call for horizontal pumps which look to be end suction closed coupled but spec calls for vertical multistage. Additionally, schedule calls for 475 gpm capacity…is this for each pump or the system? The schedule shows 20HP…I ask this because if they want 475 gpm split across pumps then I can provide 2 ea 10 HP. If they want each pump to be 475 gpm, I need to use the 20HP pump. Also I need a different header system (your piping connections) based on 475 gpm total or 950 gpm total.	Vertical multistage pump or end suction pump may be provided as required by the application to meet the pump duty point and specified horsepower. Pump to be provided shall fit within the room and space allotted. Each pump shall meet the scheduled capacity for a 100%/100% duplex system.
455	M-609:	Drawing M-609 Note 3. States "Provide LCP Room Controller (1 Per every 2 labs). Currently, no LCP Room Controller locations were found on the floor plans. Typically there is one LCP Room Controller per lab. Please provide locations of ALL LCP Room Controllers.	See response to # 338.
456	M-603 - M-607	Drawings M-603 through M-607: Please verify the intent of the smoke control sequence on pages M-603 through M-607. Is the FACP to open/close all fire/smoke dampers? Is the BAS system to be [redacted] (b) (5) [redacted] (b) (5) [redacted] Typically the BAS system will be interlocked only to the fire/smoke dampers directly isolating the air handling unit. Please indicate [redacted] (b) (5) [redacted] (b) (5) [redacted]	See response to #397
457	236410	236410.2.5.1: R-134a is on the 2016 EPA SNAP fact sheet for proposed change of listing status (Phase-out). Will the 2016 EPA SNAP approved lower GWP refrigerants, such as R514A, also be acceptable for this application?	See response to RFI 398.
458	Door Schedule	The door schedule states "minimum STC 45". Since this is a competitive bid, please confirm this is meant to be STC 45 and nothing higher.	Confirmed.
459	Sound Attenuation Blanket	The drawings reference Sound Attenuation Blanket however the specifications do not reference any requirements for this material. Please provide specification requirements for the Sound Attenuation Blanket materials that are referenced in the documents.	The following information will be added to 09 29 00 GYPSUM BOARD - PART 2 PRODUCTS: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. 1. Fire-Resistance-Rated Assemblies: [redacted] (b) (5) [redacted] (b) (5) [redacted]

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Master RFI #	Spec Reference	Bidder Question	GSA Response
460	05 50 13, 26 56 00, L503, E-401	Specification Section 05 50 13, 2.9 states: [redacted] (b) (5) [redacted] (b) (5) [redacted] Specification Section 05 50 13, 3.10 states: "Set bollards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of [redacted] (b) (5) Specification Section 26 56 00, 2.2 LED Luminaires and 2.2.1, sub paragraph d General Requirements indicates "Bollards" a Luminaire Efficacy in Lumens per Watt of "35" and sub paragraph f states: "Housing finish shall be baked-on enamel, anodized, or baked-on powder coat paint. Finish shall be capable of surviving ASTM B117 salt fog environment testing for 2500 hours minimum without blistering or peeling." Drawing L503, Detail 3 refers to a "decorative bollard" which is depicted as a straight pipe bollard with a scaled diameter measuring approx. 5.75". Drawing E-401 does not indicate wiring extending to bollard locations. Please confirm which specification section should be followed as well as confirm bollard type, bollard finish, and luminaire requirements.	Only bollards utilized on project are at [redacted] (b) (5) [redacted] (b) (5) See response to #54.
461	Structural, Laboratory Drawings	Drawing Q-301D shows an overhead structural frame in room 169. Structural drawing S-102B does not show unistrut P3200 series concrete inserts in this area. Please advise if an overhead structural frame is required in this area. If the frame is required, please advise if the P3200 insert system shall be installed in this area for attachment or provide alternate attachment details.	The overhead structural frame is required in Room 169. Inserts will be included in the structural slab, similar to the other labs, for this area.
462	Structural, Laboratory Drawings	Drawing Q-503 shows an overhead structural frame in room 564. At other locations, the frame is supported from embedded unistrut P3200 series concrete inserts. However, the roof structure in this area is concrete on metal deck. Can details for this work be provided as they are not shown on the referenced drawings?	Provide a 1-5/8" unistrut channel spanning on top of the bottom chord of the bar joists at 6'-0" on center maximum. Provide a grid of 1-5/8" unistrut hung from 1/4" threaded rods to provide required frame capacities per laboratory equipment drawings. Refer to manufacturer documentation concerning recommended attachment methodologies of unistrut system with threaded rods hung from bar joists systems.
463	Architectural, Laboratory Drawings	Detail 6 on A-731 shows a 5" zone for unistrut between column lines B and C. The structural and laboratory drawings do not show unistrut P3200 series concrete inserts or overhead structural frames between column lines B and C. Please confirm that unistrut inserts and overhead structural frames do not occur between column lines B and C.	Regularly spaced Unistrut inserts in the slabs (similar to the laboratories) are not required between column lines B and C, however, systems running in the Utility Corridors are to be Unistrut supported from the slab above as required.
464	Q-401	Please advise if the section shown in detail 3B on Q-401 is a typical section for all overhead structural frames throughout the building.	Yes. Refer to each discipline as indicated in the detail for scope of work for additional details and dimensions.
465	Structural, Laboratory Drawings	Drawings Q-202A and Q-205A show hoist points and reference the architectural drawings. However, hoist points are not shown on the architectural drawings. Can details for this work be provided as they are not shown on the referenced drawings.	See S-106B for Rooftop Lab Hoist Point. Second floor Hoist Points are to be removed from Q-202A. Owner to use Owner-supplied mobile A-frame hoist.

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Master RFI #	Spec Reference	Bidder Question	GSA Response
466	Section 13200	Section 01 23 60; Amendment 10, Reference RFI 253 response - Please confirm that any required changes to the MEP supporting systems beyond the scope of the cleanroom envelope will be handled as a change order since the full scope has not been provided or determined.	Changes to the general building systems to support Add Alternate #2 per 01 23 60 are not currently anticipated. Any changes beyond the single-source turn-key cleanroom assembly and the directives in 01 23 60 would be considered a Change Order.
467	Section 13200	Spec 13 20 00: Will the backside of the return air chase walls (labeled as '1S812S' and '1S714S'), shown on the architectural drawings, outside of the cleanroom wall panels require to be lined with cleanroom liner wall panel system (i.e. 1/4" aluminum skins)? Or will the metal stud/drywall partitions be coated with an epoxy paint?	See response to #449.
468	P-111A	Drawing P-111A at domestic water riser symbol DW/3 there is a note #15 and this note states there is 3”CW/1-1/2”HW/3/4” HWR at this riser location. Enlarged plan drawing P-301 detail #4 has a note #8 at riser DW/3. This note states 2-1/2”CW/1-1/4’HW/3/4” HWR. On drawing P-402 at domestic water riser labeled DW/3 at this location the pipe sizes on level #1 piping sizes are 1-1/4” CW/1-1/4’HW/3/4”HWR. What drawing is correct for sizing this domestic water riser piping. Please clarify.	Note 15 on P-111A states the correct sizes of the piping that serves the entire riser, up & down. Drawing 4 on P-301 note 8 is correct. P-402 has an incorrect pipe size for the cold water, it should read 2-1/2" feeding up to level 2.
469	P-111B	Drawing P-111B at mechanical pump room 159, lower right corner shows a line exiting this room and is labeled 4” on detail #1/P-300 then 3” tees off this line and a 1-1/2’ tap. Drawing P-300 detail #3 and drawing P-402 shows a 2-1/2’ line. Is it safe to assume this 1-1/2’ line shown on drawing P-111b is to be 2-1/2”? Please clarify.	The pipe size shown on P-402 is correct. The CW branch that serves riser DW/1 is incorrectly labeled as 1-1/2" on P-111B and should read 2-1/2".
470	P-100A & P-100B	On drawings P-100A, P-100B there is a piping system tagged SSD which on drawing P-001 states this system to be sub soil drain or footing drain. Specification 22 00 00-3.14 table I does not list this system. What material is required for this?	Subsoil drainage piping materials shall be the same as underdrain piping materials. Refer to specification 33 40 00 paragraph 2.3.1.2 for underdrain piping materials.
471	236410.2.6.10	Please confirm capacity (gallons) of tank for air-cooled chiller tank module.	See the schedule for the expansion tank size of the chilled water system.
472	Section 096723.13	Section 096723.13 specifies a 3/16” trowelled mortar topping using walnut shell aggregate for the EP-1 finish but the Finish Schedule references Sikafloor 200 ESD product by name which is only a 15-18 mil thick coating. Do they want a 3/16” topping or the 18 mils thick coating?	The Sikafloor 200 ESD 4-part system is the Basis of Design. The total thickness will be made-up of all parts of the system, not just the top-coat.
473		There are several notes in the Resinous Terrazzo Spec section #096623 referencing “Cove” terrazzo base (parg 2.12), but all details on the plans show “Straight – stack on” (detail #9/A-610) terrazzo base, which is correct?	Terrazzo base is to be straight.
474		1. Per RFI response #61 all doors in STC rated partitions are to have a minimum STC45 rating but wall types1X914, 2X714, and 2X914 only have STC43 ratings. Do doors in these walls still need STC45 ratings?	1X914, 2X714, and 2X914 are all shaft wall assemblies. No doors should be located in these wall-types.
475		2. There are walls with doors that do not have a wall type designation. Please advise the wall type that should be used so we can determine if a STC door will be required for that location.	Please provide the door numbers or room numbers where these instances occur.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
476	230923.132	Is the cost for the integration to the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1? The paragraph 2.1.1 states to provide a [redacted] (b) (5) [redacted] (b) (5) [redacted]. RFI#140 answer did not address what are the integration requirements of the paragraph 2.1.1. RFI#246 answer states [redacted] (b) (5) [redacted] this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Amendment 11 bid form option 23c states price for [redacted] (b) (5) [redacted] (b) (5) [redacted] - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Deduct Alternate #10 states to Remove [redacted] (b) (5) [redacted] - - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. Is the cost for the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1?	[redacted] (b) (5) [redacted]
477	01 50 00.34, E Pest Control	Specification Section 01 50 00,.34 E states "Obtain extended warranty for Contracting Officer." Please provide explanation meaning of this requirement for Pest Control. It is not typical for the contractor to provide warranty of general condition item such as Pest Control.	The General Contractor will be required to address any pest control issues for one year beyond substantial completion.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
478	31 62 13.00 Test Pile Quantity	The response to RFI 164 states "Provide 8 test piles as indicated in the geotech report." This does not coincide with the Geotech Report Section 4.6.3 which states "The test program should involve at least five (5) test piles to provide an indication of various driving and/or installation conditions." Additionally, Specification Section 31 62 13.00 3.4.3 "Perform compressive load test on 5 test piles in accordance with ASTM D1143/D1143M (standard loading procedure) as modified herein." Specification Section 3.4.4 also states "Perform tensile load tests on 1 test piles in accordance with ASTM D3689, as modified and in paragraph LOAD TESTS. Per the Geotech Report and specifications there is a total of five (5) test piles are required for the Dynamic Load Test. Also noted in the specifications there is a total of six (6) test piles required for the static load test (i.e. 5 compressive and 1 tensile). Please confirm the total quantity of test piles required for dynamic load test (PDA). Please confirm the quantity and type of static load tests (i.e. compressive or tensile) that are to be performed on test piles. Please confirm that the static load test can be performed on the same test piles installed for the dynamic loads test (this scenario would require 1 additional test pile for the static (tensile) load test). In lieu of the scenario noted above confirm that 6 additional test piles are not required for static load test.	Provide 5 test piles per Section 4.6.3 of the geotechnical report dated July 23, 2014 and Specification Section 31 62 13.20 3.4.3 for compression load testing. Provide 1 test pile per Section Specification Section 31 62 13.20 3.4.4 for tensile load testing. Dynamic load testing shall be applied on all test piles receiving static load tests.
479	31 62 13.00 Test Pile Quantity	Please confirm that if Bid Item 0001C Pile Load Test (i.e. Static Load Test) is requested to be performed by the Contracting Officer that this test will be performed on one of the Test Pilings provided under Bid Item 0001B. Please confirm that a separate test pile will not be needed to be driven for Bid Item 0001C. Please confirm the number of test piles required.	See response to #478.
480	32 62 13.00 Test Pile Requirements	The original question submitted in RFI 166 inadvertently switched the terms Dynamic Load Test (PDA) and Static Load Test. The question should have read: "Per discussions with the precast / prestressed concrete piles subcontractors it does not appear that it is typical for a precast pile project to utilize a static load test. Static load tests are expensive and time consuming and are not applicable for precast piles. Can the requirement for a static load test be deleted from the specification requirements given that a static load test is the more applicable test for precast piles? This would appear to be in line with the recommendation of the Geotechnical Engineer per Geotech Report 4.6.4 Dynamic Testing. If the Static Load Test requirement is removed from the specifications confirm that this would delete Bid Item 0001C.	Provide static load tests per specification 31 62 13.20 Section 3.4 requirements.
481	01 22 00 Test Pile Unit Price	Bid Item 0001B requests a unit price for Test Piling and Bid Item 0001C requests a unit price for Pile Load Test. Please confirm that the unit cost for Bid Item 0001B Test Piling shall include the cost for the test pile, driving the test pile, and performance of the dynamic load test (PDA) only. Please confirm that Bid Item 0001C shall include the cost to perform a Static Load Test only.	Bid items 0001B and 0001C shall include all costs necessary to provide foundation piling and pile load testing in accordance with the drawings and specifications per 00 22 13 paragraph 1.1.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
482	01 22 00 Test Pile Unit Price	Please confirm that the cost for a geotechnical consultant is not to be included in the unit cost for Bid Items 0001B and 0001C. Please confirm that all cost for the geotechnical consultant requirements in Specification 31 62 13.00 1.6.4 is to be including in Bid Item 0001A.	Bid item 0001B shall include the cost of an independent geotechnical engineer per 31 62 13.20 paragraph 1.6.4. Bid item 0001C shall include the cost of an independent geotechnical engineer per 31 62 13.20 paragraph 3.4.3. In specification 31 62 13.20 paragraph 3.4.1, fourth sentence, delete the word "Government" so that the sentence reads: "The Contractor's Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation or necessary driving resistance."
483		Please provide detail information on the layout spacing for all "Future Owner Use" Unistrut Inserts, called for on the structural drawings, Note No. 14. This information is required to determine the quantity of inserts.	Concrete Framing Plan Note #14 reads "Provide unistrut P3200 series concrete insert system at 6'-0" o.c. in the concrete slab soffit above the laboratories. Reference lab zoning layout plans and layouts on architectural and laboratory drawings for additional information."
484		Please provide additional information on the Unistrut Series P3200 inserts. Numerous part numbers for inserts are under the Series P3200 insert.	Unistrut system shall be ordered to provide required load capacity requirements per laboratory drawing requirements.
485	Amendment 11	Amendment 11 was provided with a revised Base Bid GC Price Proposal Form that included a $1,600,455.00 allowance (Spec Division: 13b Drawings RQ & Spec 132754). As part of Amendment 13, ETS-Lindgren proposal002-15-0086144-1664-4 dated June 14, 2016 was included with the following clarifications: 1) Proposal excludes as-built drawings (can be provided for an additional cost), 2) Pricing is based on ETS-Lindgren non-union labor (open shop) onsite / no prevailing wage, and 3) Price excludes sales tax, freight, performance bonds, permits or fees relating to permits, plan checks, customs or other fees unless stated otherwise. Additional clarifications are included in the ETS-Lindgren proposal. Please confirm that the Base Bid allowance is inclusive of all contract requirements.	The General Contractor will be required to incorporate all as -built drawings from ETS-Lindgren into the final BIM. The allowance and ETS-Lindgren's proposal outlines their work, all to be incorporated under the Genenral Contractor's contract. All other contract terms and conditions shall apply.
486	Amendment 11	Amendment 11 was provided with a revised Base Bid GC Price Proposal Form that included a $ 1,600,455.00 allowance (Spec Division: 13b Drawings RQ & Spec 132754). As part of Amendment 13, ETS-Lindgren proposal 002-15-0086144-1664-4 dated June 14, 2016 was included. Please confirm that the Amendment 13 drawings and specification changes take precedence over the ETS-Lindgren proposal?	ETS-Lindgren proposal dated June 14, 2016 is included in Amendment 13.
487	01 83 00.07 40	Specification 01 83 00.08 40 paragraph 3.3.1.b references specification section 01 35 40.00 20. This specification could not be located. Please provide.	The correct citation should be to specification 01 35 40.00 41.
488		Due to the amount of RFIs (over 430), please confirm that the drawings and specifications will be updated and provided upon notice to proceed.	Confirmed. A conformed set of documents will be issued to the successful bidder after contract award.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
489	230923.1320 237313.0040	The Sequence of Operation located on M-601 for LABs AHUs states the following: (b) (5) [redacted] Please clarify if dampers D-1 through D-5 are to be UL listed as Smoke Damper Assemblies.	The isolation dampers are to be [redacted]
490	230923.132	M-608 Sequence of Operation indicates that SF-14 and EF-15 are to operate in a CFM matching fashion. No Air Flow measuring stations appear to be in the plans or schedules. Please clarify how this is to be accomlished and that No Ari Flow Stations are required.	SF-14 and EF-15 setpoints shall be established durring HVAC balancing according to the control sequence on M-608. Air Flow Stations are not required.
491		Is it the intent for the EP-1 finish to extend under the modular Clean Rooms of the 1st Floor prior to installation of the Clean Rooms; Rooms 100, 104, 104A, 108A, 108B, 112, 118 and 118A?	The epoxy flooring shall be completed prior to installation of the clean room walls.
492	All Bid documents	Please indicate if there is any expecatation to provide Anti-Terrorist / Force Protection control equipment of sequences of operation for this project?	The GC is responsible for providing all the systems, equipment, controls and interface requirements per the contract documents.
493	230923.132	M-603 Note indicates Smoke Damper controls by Div. 26 FA, Sequence of operations on M603 plans are unclear as to who is cotnroling these dampers.. Please confrim Div. 26 Fire Alarm Contractor is responsible for the comand and control fo these dampers.	[redacted]
494	Wage Determination	The wage determination provided does not include a glazier classification. Please advise which wage classification applies to this trade.	The project wage determination does not contain a classification for a glazier. Contractors must follow FAR Part 22.406-3 -- Additional Classifications. (a) If any laborer or mechanic is to be employed in a classification that is not listed in the wage determination applicable to the contract, the contracting officer, pursuant to the clause at 52.222-6, Construction Wage Rate Requirements, shall require that the contractor submit to the contracting officer, Standard Form (SF) 1444, Request for Authorization of Additional Classification and Rate, which, along with other pertinent data, contains the proposed additional classification and minimum wage rate including any fringe benefits payments.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
495	Amendment 13	Note 2 on drawing RQ-004 (ETS-Lindgren drawing RF1) states "1 1/4' fiberglass grating supported by angles around perimeter of chambers. Cut around filters as needed (by GC)" Please clarify the extent of the grating, i.e. does it occur around and between all shielded chambers. Also, please support details and section cuts.	Grating to extend full-length along the south side of Chamber A. GC to provide 2"x2"x1/8" steel angles to the south face of the shielded chamber as well as along the face of concrete to support the fiberglass grating. Grating to be 1" in lieu of 1 1/4" deep. See 06 73 01 for grating product information.
496	01 91 00.00 40	What are the requirements of the Commissioning Specialist in regard to the following specifications? 01 83 00.07 40 Reliability Centered Acceptance for Facility Shells 01 86 12.07 40 Reliability Centered Acceptance for Mechanical Systems 01 86 26.07 40 Reliability Centered Acceptance for Electrical Systems In paragraph 1.5.3.2 Responsibilities (of the Commissioning Specialist) in 01 91 00.00 40 Commissioning there is a requirement to perform all commissioning work specified herein and in related sections under the direct guidance of the Commissioning Team Supervisor. In paragraph 1.5.3.3 Building Systems indicates the equipment and the sections. Item (6) lists the Reliability Centered Acceptance sections listed above. In those sections there is no requirement for the Commissioning Specialist to witness any of those tests. In researching of the RCBEA Guide, no specific requirements for the Commissioning Specialist in regard to the testing was found. Does the Commissioning Specialist have to witness all the tests listed in the Reliability Centered Acceptance specifications, or does he just need to verify that the testing was completed? If witnessing is required can sampling method be used (i.e. witness a percentage of tests). If so, what would the percentages be?	Please refer to specification section 01 91 00.00 40 (Commissioning) for commissioning requirements. In the case of conflicts between the specification section 01 91 00.00 40 and the Reliability Centered Acceptance specifications, section 23 09 23.13 20, or others, the Commissioning specifications shall govern, as the RCM sections, section 23 09 23.13 20 and others are referenced within that specification. Regarding the specific question about the Commissioning Specialist, the Commissioning Specialist shall verify that the testing was completed, but does not need to witness every test.
497	01 35 40.41	Given the amount of work that is required through the tree protection zone designated on the bid documents, is it required for the Contractor have a certified arborist onsite to evaluate and inspect the tree protection and tree preservation measures.	Tree maintenance, including that of the existing trees to remain and the corresponding review and maintenance of the tree protection measures, is highly recommended to be supervised if not performed by a certified member of the International Society of Arboriculture (ISA). Any tree pruning is required to be supervised by a certified member of ISA.
498	09 67 23.13	Please address the discrepancy between the system shown on the finish legend which is “Sikafloor 200 ESD” (a high build electostatic dissipative epoxy coating) and the system detailed in spec 096723.13 which is a standard 3/16” thick trowel-applied epoxy system that has no ESD properties. Which system is required?	See response to #472.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
499	E-001, E-303, E-304	The three line busway located in the center of the rooms shows a disconnecting means; however, the wall mounted duct shows no disconnecting means. Furthermore the power distribution legend on E-001 shows the disconnect as being a combination motor starter / disconnect switch. Please clarify what disconnecting means are required for the buss duct system.	There are no "Wall Mounted" busways. All of the wall mounted systems are a surface mounted raceway housing multiple circuits and outlets. It is the intent that each Busway mounted overhead in the center of the various labs have a local disconnecting means at the point it receives its supply. The symbol on Drawing E-001 (open square box) will be updated to reflect this intent.
500	Plumbing and Q Drawings - Vented Cylinder Cabinet	The Plumbing and Q drawings do not show the process pipe runs which would transition from the connection point on each vented cylinder cabinet to the usage point in the lab. Please confirm that this work will be performed by the Owner and is not included in this pricing.	The pipe runs are to be provided by the Owner on an as-needed basis.
501	10 14 01	Reference details 11 and 12 on drawing A-623. Please provide additional information about the laminated glass, clear outer panel, and core shown for the body of the sign i.e. what material, thickness, color, etc.	Note on detail 12/A623 referring to glass panel should read "Two (2) sheets of 1/2" thick clear acrylic with 1st surface graphics. Slides into internal track, is clipped and bolted into place, and is edge lit with LEDs set in sliding track."
502		Amendment # 9, RFI answer # 221 – does not clear up the confusion. Please review Sheets Q001 and Q203D for tables T01 and Tables T02. These are not listed on Sheet Q401 per RFI answer # 221. Tables T01 and T02 are shown on Q001 to have ESD worksurfaces, please provide the specifications for this material or advise if this is to be black epoxy resin.	See response to RFI 326.
503	Sheet S-555	Detail 5 show embeds in the CIP Concrete for the Glass Marker Board System. Alternate 3 deletes the Glass Marker Board System and related structure. In this alternate do we also delete the embeds in the structural slab or leave in for future use?	Yes, the embeds in the slab supporting the sliding glass markerboard structural support would also be deleted as a part of Deduct Alternate 3.
504	230923.132	Given the response to RFI 340 as transmitted in amendment 10 that all smoke dampers and end switches associated with AHUs [redacted] (b) (5) and given that the Div. 26 electrical contractor is to [redacted] (b) (5) [redacted] (b) (5) Is it acceptable to [redacted] (b) (5) [redacted] (b) (5) [redacted]	See response to #391.
505	236410.2.6.10	Please confirm capacity (gallons) of tank for air-cooled chiller tank module.	See response to #471.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
506	230923.132	Is the cost for the integration to the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1? The paragraph 2.1.1 states to provide a [redacted] (b) (5) [redacted] (b) (5) [redacted] RFI#140 answer did not address what are the integration requirements of the paragraph 2.1.1. RFI#246 answer states [redacted] (b) (5) [redacted] this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Amendment 11 bid form option 23c states price for [redacted] (b) (5) [redacted] (b) (5) [redacted] - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Deduct Alternate #10 states to Remove [redacted] (b) (5) [redacted] - - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. Is the cost for the [redacted] (b) (5) [redacted] required by spec section 230923.1320 paragraph 2.1.1? The paragraph 2.1.1 states to provide a [redacted] (b) (5) [redacted] (b) (5) [redacted] RFI#140 answer did not address what are the integration requirements of the paragraph 2.1.1. RFI#246 answer states [redacted] (b) (5) [redacted] this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Amendment 11 bid form option 23c states price for [redacted] (b) (5) [redacted] (b) (5) [redacted] - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1. The Deduct Alternate #10 states to Remove [redacted] (b) (5) [redacted] - - this contradicts the [redacted] (b) (5) [redacted] 230923.1320 paragraph 2.1.1.	See response to #476.
507	Section 01 33 29	We respectfully request the price proposal due date be changed to July 14 at 4:00 p.m. ET. Should contracting not grant this request, we ask that the time of price proposal receipt be extended to 4:00 pm ET on July 7 in lieu of 1:00 pm.	Please see amendment 0018.
508	Section 13 20 00 - Paragraph 2.1	Para 2.1 (last para) states that the contractor is responsible for connecting [redacted] (b) (5) [redacted] (b) (5) [redacted]. Should this read that the cleanroom contractor is responsible for connecting these items to the [redacted] (b) (5) [redacted] (b) (5) [redacted] Please confirm.	Cleanroom manufacturer is responsible for [redacted] (b) (5) [redacted] (b) (5) [redacted]
509	Section 13 20 00 - Paragraph 2.5.1	What manufacturer is the basis of design for these filters? Can find no manufacturer that uses no organic materials.	Filters in the fan filter units shall be provided by the cleanroom manufacturer.
510	Section 13 20 00 - Paragraph 2.6	Section 13 20 00, para 2.6 is confusing. This paragraph indicates "contractor" is to provide cooling coils and "manufacturer" is to provide condensate piping to nearest storm riser. Please clarify – is "contractor" referring to the cleanroom contractor and "manufacturer" to the mechanical contractor?	The cleanroom manufacturer shall provide the FFUs. The mechanical contractor shall provide the cooling coils. The cleanroom manufacturer shall approve the installation of the cooling coils. See RFI-413 response.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
511	Section 13 20 00 - Paragraph 2.11	Please clarify – is "manufacturer" the cleanroom contractor? The work being performed appears to be mechanical contractor scope.	See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.
512	Section 13 20 00 - Paragraph 2.11	Also, unclear as to cleanroom contractor ductwork scope. I see no indication on the ductwork drawings of where cleanroom contractor scope ends and mechanical contractor scope begins.	See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.
513		Sheet Q-203D indicates whiteboards are required at Flight Software 356 and refers to Architectural Drawings. There are no whiteboards shown on the Architectural Drawings in this area. If required, please provide elevation and/or size.	The VAV for the supply and exhaust in the cleanrooms are controlled as constant volume boxes. See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.
514	13 27 54	RF Shielded Room 466 is noted as NIC on the Q-403 Equipment Schedule. Meta Materials (Elec EM Shielded) Room [redacted] and Meta Materials (Elec Acoustic Shielded) Room [redacted] are not listed on the Q-403 Equipment Schedule. Please confirm whether we are to include the cost of these enclosures per Section 132754—Electromagnetic & Radio-Frequency (EM/RF) Shielding in our bid.	RF Shielded Room [redacted] within Room [redacted] s existing equipment EQ-274. Relocation of this room is NOT part of this contract. It is listed in the equipment list as NIC for coordination purposes. The only EM/RF shielded room that is part of the Contract is Room #224. Scope of work for this room is described in spec section 132754. Shielded Chamber Facility in Room [redacted] is handled separately per the RQ series and other documentation.
515		Drawing M606, Cleanroom Sequence of Operation o Item C-1 – please confirm that changing the exhaust airflow consists of adjusting flow speed of the VV unit.	The VAV for the supply and exhaust in the cleanrooms are controlled as constant volume boxes. See RFI-413 response for clarification between cleanroom manufacturer and mechanical contractor.
516		I have reviewed the bid documents including 14 amendments for the flooring and ceramic tile. The finish plans on drawings A-711A through A-715B show that the toilet rooms are to receive terrazzo floor and base with paint for the wall finishes. On drawing A-410 and A-411, the elevations show ceramic wall tile. Is the wall tile to be included in the base bid? Is the wall tile to be included as part of Deduct Alternate #2? Please advise.	See response to RFI #052.
517		Revision 13 Drawings have reissued Drawings E-221B and E-225B that contain missing information. It is like the amendment is transposed on to an incomplete design development drawing. Some of the new information in the changes is also incomplete with the symbols nomenclature. Attached drawings showing the missing information.	See Amendment 15.

RFI Log

Master RFI #	Spec Reference	Bidder Question	GSA Response
518		RFI response 475 they asked for a list of door numbers where the wall type was not clearly identified. Here is the list I came up with. 119A, 127A, 127B, 157C, 159B, 163B, 169B, 170C, 170E, 190, 200-A, 200-C, 227C, 267-C, 267-E, 327C, 357, 363, 427C, 457, 463, 504-B, H1D, H1F, H20-B, H3D-B, H4D-B, H5A, H5B, H5C-A, H5C-B, S1B-B, S1B-CS1C-A, S1C-B, S1C-C, S20-B, S5B-A, S5B-B	119A, 200-C, 357, 363, 457, 463, 504-B: (0S714) 127A, 127B, 227C, 327C, 427C: (0S400) 200A: (1S812S) H2D-B, H3D-B, H4D-B: (1S714S) S1B-C, S1C-C: (0F658) S1C-A: (concrete shear wall & 0F112) S20-B: (door does not exist) S5B-A: (2S812) 157C, 159B, 163B, 169B, 170C, 170E, 190, 267-C, 267-E, H1D, H1F, H5A, H5B, H5C-A, H5C-B, S1B-B, S1C-B, S5B-B: (exterior wall – see elevations and A-301 for assemblies)

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0023	08/02/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE | FACILITY CODE

(X)	
	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED (SEE ITEM 11)
	10A. MODIFICATION OF CONTRACT/ORDER NO.
☐	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0023

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 2 August 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0023.

2. Please be advised that the attached list of questions shall form the basis of proposal clarifications scheduled with your firm via teleconference the week of 1 August 2016. The General Services Administration/NASA project team is also requesting that your firm provide a written response to each question no later than 2 PM EST 10 August 2016 via email to the General Services Administration's Contracting Officer, Raymond J. Porter

3. All other terms and conditions remain unchanged.

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

[redacted]

1. 01 - General Requirements/General Conditions. 01 - Describe how the 24 month project schedule has impacted your pricing? What would an ideal schedule (Notice to Proceed to Substantial Completion) be for this project and how would an ideal schedule affect prices.
2. Which areas of the contract documents did not have adequate detail to provide an accurate cost estimate? List only the most significant items where you had to include an allowance to account for the risk, and describe what detail you need to see in that section in order to reduce your risk.
3. 01 - Are there any processes or equipment in the procurement that appear to be over redundant and/or unnecessary?
4. 01 - Was the bidding period sufficient enough time to properly assemble your proposal and would more time allow you to lower your proposal?
5. 01 - Are there any large cost savings ideas that we can take advantage of that we are unaware of?
6. Did you receive three competitive bids on each of the packages? If not, which packages had limited competition?
7. Was there anything in the specifications that resulted in a higher than usual bid for a project of this nature?
   a. Grounding system built into concrete frame?
   b. Piles?
   c. Selection of building rainscreen – terracotta?
   d. Light fixtures?
8. 03 - Concrete. Your Concrete [redacted]
9. 03 - Concrete. Since concrete is a large cost on this project, would changing the pile type provide savings?
10. 05 -Metals. You price is [redacted]
11. 06 - Wood Plastics and Composites. You price in this area [redacted]
12. 07-Thermal Moisture and Protection. Your bid is [redacted]

13. 09 - Finishes. Your bid is [redacted] (b) (3) (A), (b) (4) [redacted] (b) (3) (A), (b) (4)
14. 13a - Special Construction. Describe what you have included in this section.
15. 14 - Conveying Systems. Your bid is [redacted] (b) (3) (A), (b) (4) [redacted] (b) (3) (A), (b) (4)
16. 22, 23a, b and c- Total Plumbing is [redacted] (b) (3) (A), (b) (4)
    a. Describe your understanding of the Building Controls specifications.
    b. Have you selected a vendor as part of this division?
    c. Have you included building controls as part of 23a as well?
17. 26 and 27 - Electrical and Communications respectively. Your price is [redacted] (b) (3) (A), [redacted] (b) (3) (A), (b) (4) [redacted]
18. Add Alternate 6 - Provide Trane BAS System.
    a. Describe your understanding of the Building Controls specifications.
    b. Have you selected a vendor as part of this division?
    c. Have you included building controls as part of 23a as well?
    d. Is the value in this Add Alternate

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0023	08/02/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*			
		(X)	9A. AMENDMENT OF SOLICITATION NO
		☐	9B. DATED *(SEE ITEM 11)*
		☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
			10B. DATED *(SEE ITEM 13)*
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0023

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 2 August 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0023.

2. Please be advised that the attached list of questions shall form the basis of proposal clarifications scheduled with your firm via teleconference the week of 1 August 2016. The General Services Administration/NASA project team is also requesting that your firm provide a written response to each question no later than 2 PM EST 10 August 2016 via email to the General Services Administration's Contracting Officer, Raymond J. Porter

3. All other terms and conditions remain unchanged.

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

[redacted] (b) (3) (A)

1. 01 - Describe how the 24 month project schedule has impacted your pricing? What would an ideal schedule (Notice to Proceed to Substantial Completion) be for this project and how would an ideal schedule affect prices.
2. Which areas of the contract documents did not have adequate detail to provide an accurate cost estimate? List only the most significant items where you had to include an allowance to account for the risk, and describe what detail you need to see in that section in order to reduce your risk.
3. 01 - General Requirements/General Conditions. Your General Conditions are [redacted] (b) (3) (A), (b) (4)
4. 01 - Are there any processes or equipment in the procurement that appear to be over redundant and/or unnecessary?
5. 01 - Was the bidding period sufficient enough time to properly assemble your proposal and would more time allow you to lower your proposal?
6. 01 - Are there any large cost savings ideas that we can take advantage of that we are unaware of?
7. Did you receive three competitive bids on each of the packages? If not, which packages had limited competition?
8. Was there anything in the specifications that resulted in a higher than usual bid for a project of this nature?
   a. Grounding system built into concrete frame?
   b. Piles?
   c. Selection of building rainscreen – terracotta?
   d. Light fixtures?
9. 03 - Concrete. Your Concrete price is [redacted] (b) (3) (A), (b) (4) [redacted] (b) (3) (A), (b) (4)
10. 03 - Concrete. Since concrete is a large cost on this project, would changing the pile type provide savings?
11. 06 - Wood Plastics and Composites. You price in this area is [redacted] (b) (3) (A), (b) (4) [redacted] (b) (3) (A), (b) (4)
12. 07-Thermal Moisture and Protection. Your bid is [redacted] (b) (3) (A), (b) (4) [redacted] (b) (3) (A), (b) (4)

13. 09 - Finishes. Your bid is [redacted] (b) (3) (A), (b) (4)
14. 13a - Special Construction. Describe what you have included in this section.
15. 14 - Conveying Systems. Your bid is [redacted] (b) (3) (A), (b) (4)
16. 22, 23a, b and c- Total Plumbing is [redacted] (b) (3) (A), (b) (4)
    a. Describe your understanding of the Building Controls specifications.
    b. Have you selected a vendor as part of this division?
    c. Have you included building controls as part of 23a as well?
17. 26 and 27 - Electrical and Communications respectively. Your price is approximately [redacted] (b) (3) (A), (b) (4)
18. Add Alternate 6 - Provide Trane BAS System.
    a. Describe your understanding of the Building Controls specifications.
    b. Have you selected a vendor as part of this division?
    c. Have you included building controls as part of 23a as well?
    a. Is the value in this Add Alternate

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	/

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0024	08/05/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	
	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
	10A. MODIFICATION OF CONTRACT/ORDER NO.
☐	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0024

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 5 August 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0024.

2. In accordance with the "Liquidated Damages" clause in Section III (Terms and Conditions), liquidated damages shall be revised from a calculated rate of $13,227.70 per calendar day to $5,700.00 per calendar day.

3. The GSA Contracting Officer shall provide a limited project Notice to Proceed of 60 days after acceptance of the required Performance and Payment Bonds along with the required Insurance. The project construction schedule is hereby revised to twenty eight months from the full project Notice to Proceed to Substantial Completion. Please provide any Rough Order of Magnitude estimates with the revised project construction schedule of twenty eight months from the full project Notice to Proceed to Substantial Completion. The General Services Administration/NASA project team is requesting that your firm provide a written response no later than 2 PM EST 10 August 2016 via email to the General Services Administration's Contracting Officer, Raymond J. Porter.

4. Please provide any Rough Order of Magnitude estimates for any proposed cost savings submitted under question 6 "01 - Are there any large cost savings ideas that we can take advantage of that we are unaware of?" provided in Amendment 0023 dated 2 August 2016. The General Services Administration/NASA project team is requesting that your firm provide a written response no later than 2 PM EST 10 August 2016 via email to the General Services Administration's Contracting Officer, Raymond J. Porter.

5. All other terms and conditions remain unchanged.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0025	08/25/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0025

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 25 August 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0025.

2. The General Services Administration is requesting that your firm submit a revised technical proposal to address the summary of those areas of your proposal that were determined to be deficient, weak or in need of additional information or clarification which are incorporated with this amendment. Only the changed portions of the proposal need be submitted, with changes clearly highlighted. Those portions of the proposal not submitted will be regarded as unchanged. Please provide a revised technical proposal by 4 PM EST on 1 September 2016 in an electronic format to the General Services Administration's Contracting Officer, Raymond J. Porter.

3. The General Services Administration is requesting that your firm submit a revised pricing proposal by 4 PM EST on 1 September 2016 in an electronic format to the General Services Administration's Contracting Officer, Raymond J. Porter. Please be advised that the revised pricing proposal shall not be considered a Best and Final proposal.

4. The NASA Langley Research Center MSL Project revised bid form is incorporated with this amendment.

5. All other terms and conditions remain unchanged.

W. M. Jordan Company
[redacted] (b) (6)
Business Development Manager
11010 Jefferson Ave
P.O. Box 1337
Newport News, VA 23601
Phone: [redacted] (b) (6)
[redacted] (b) (6)

25 August 2016

Project Title: Measurement Systems Laboratory (MSL) for the National Aeronautics and Space Administration (NASA)

Location: Langley Research Center in Hampton, Virginia

Mr. [redacted] (b) (6)

The General Services Administration is requesting that your firm submit a revised technical proposal to address the summary of those areas of your proposal that were determined to be deficient, weak or in need of additional information or clarification. Only the changed portions of the proposal need be submitted, with changes clearly highlighted. Those portions of the proposal not submitted will be regarded as unchanged.

Inclusive of the revised technical proposal please submit a revised pricing proposal to the General Services Administration's Contracting Officer, Raymond J. Porter. Please be advised that the revised pricing proposal shall not be considered a Best and Final proposal.

The revised technical proposal and revised pricing proposal is due by 4 PM EST on 1 September 2016 in an electronic format.

Offeror is reminded that price is an important factor in evaluating the proposal.

If you have any questions or need additional information, please contact me on (215) 756-3439. Thank you for your interest in this project.

Sincerely,

[redacted] (b) (6)

Raymond J. Porter
Contracting Officer

Project Title: **Measurement Systems Laboratory (MSL) for the National Aeronautics and Space Administration (NASA)**
Location: **Langley Research Center in Hampton, Virginia**

Solicitation No.: RJP-NASA_MSL-0001-8-11-2015

PROPOSER: **WM Jordan**

EVALUATION CRITERIA: Project Management and Delivery Plan

(b) (5), (b) (4)

[redacted]

(b) (5), (b) (4)

[redacted]

EVALUATION CRITERIA: Oral Presentations (Sub-Factor for No.1)

(b) (5), (b) (4)

[redacted]

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0025

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 25 August 2016 to incorporate the following:

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5. All other terms and conditions remain unchanged.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0025	08/25/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

CODE | FACILITY CODE

(X) ☐ 9A. AMENDMENT OF SOLICITATION NO.

☐ 9B. DATED (SEE ITEM 11)

☐ 10A. MODIFICATION OF CONTRACT/ORDER NO.

☐ 10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

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12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

[redacted] (b) (3) (A)

25 August 2016

Project Title: Measurement Systems Laboratory (MSL) for the National Aeronautics and Space Administration (NASA)

Location: Langley Research Center in Hampton, Virginia

Mr. [redacted] (b) (6)

The General Services Administration is requesting that your firm submit a revised technical proposal to address the summary of those areas of your proposal that were determined to be deficient, weak or in need of additional information or clarification. Only the changed portions of the proposal need be submitted, with changes clearly highlighted. Those portions of the proposal not submitted will be regarded as unchanged.

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The revised technical proposal and revised pricing proposal is due by 4 PM EST on 1 September 2016 in an electronic format.

Offeror is reminded that price is an important factor in evaluating the proposal.

If you have any questions or need additional information, please contact me on (215) 756-3439. Thank you for your interest in this project.

Sincerely,

[redacted] (b) (6)

Raymond J. Porter
Contracting Officer

Project Title: **Measurement Systems Laboratory (MSL) for the National Aeronautics and Space Administration (NASA)**

Location: **Langley Research Center in Hampton, Virginia**

Solicitation No.: RJP-NASA_MSL-0001-8-11-2015

PROPOSER: [redacted] (b) (3) (A)

EVALUATION CRITERIA: Project Management and Delivery Plan

[redacted] (b) (5), (b) (4)

EVALUATION CRITERIA: Oral Presentations (Sub-Factor for No.1)

(b) (5), (b) (4)

[redacted]

EVALUATION CRITERIA: Project Team Qualifications

(b) (5), (b) (4)

[redacted]

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0025

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 25 August 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0025.

2. The General Services Administration is requesting that your firm submit a revised technical proposal to address the summary of those areas of your proposal that were determined to be deficient, weak or in need of additional information or clarification which are incorporated with this amendment. Only the changed portions of the proposal need be submitted, with changes clearly highlighted. Those portions of the proposal not submitted will be regarded as unchanged. Please provide a revised technical proposal by 4 PM EST on 1 September 2016 in an electronic format to the General Services Administration's Contracting Officer, Raymond J. Porter.

3. The General Services Administration is requesting that your firm submit a revised pricing proposal by 4 PM EST on 1 September 2016 in an electronic format to the General Services Administration's Contracting Officer, Raymond J. Porter. Please be advised that the revised pricing proposal shall not be considered a Best and Final proposal.

4. The NASA Langley Research Center MSL Project revised bid form is incorporated with this amendment.

5. All other terms and conditions remain unchanged.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0025	08/25/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	
	9A. AMENDMENT OF SOLICITATION NO.
☐	9B. DATED *(SEE ITEM 11)*
	10A. MODIFICATION OF CONTRACT/ORDER NO.
☐	10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

[redacted] (b) (3) (A)

25 August 2016

Project Title: Measurement Systems Laboratory (MSL) for the National Aeronautics and Space Administration (NASA)

Location: Langley Research Center in Hampton, Virginia

Mr. [redacted] (b) (6)

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The revised technical proposal and revised pricing proposal is due by 4 PM EST on 1 September 2016 in an electronic format.

Offeror is reminded that price is an important factor in evaluating the proposal.

If you have any questions or need additional information, please contact me on (215) 756-3439. Thank you for your interest in this project.

Sincerely,

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Raymond J. Porter
Contracting Officer

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NASA Langley Research Center
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(Signature of person authorized to sign)		(Signature of Contracting Officer)	

(b) (3) (A)

[redacted]

25 August 2016

Project Title: Measurement Systems Laboratory (MSL) for the National Aeronautics and Space Administration (NASA)

Location: Langley Research Center in Hampton, Virginia

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EVALUATION CRITERIA: Project Team Qualifications

(b) (5), (b) (4)

[redacted]

(b) (5), (b) (4)

[redacted]

BASE BID

MSL

GC Price Proposal Form

CONSTRUCTION		
Spec Division	**Spec Description**	**Price Proposal**
01	General Requirements/General Conditions	
02	Existing Conditions	
03	Concrete	
04	Masonry	
05	Metals	
06	Wood, Plastics, & Composites	
07	Thermal & Moisture Protection	
08	Openings	
09	Finishes	
10	Specialties	
11	Equipment	
12	Furnishings	
13a	Special Construction	
13b	RQ Drawings & ETS Report (allowance)	$ 1,600,455.00
14	Conveying Equipment	
21	Fire Suppression	
22	Plumbing	
23a	Heating, Ventilating, & Air Conditioning	
23b	Building Controls (Only)	
23c	Bldg Control Integration into Campus BAS (Only)	
26	Electrical	
27	Communications	
28	Electronic Safety & Security	
31	Earthwork	
32	Exterior Improvements	
33	Utilities	
43	Process Gas	
	TOTAL BASE BID	$ 1,600,455.00
	TOTAL OPTIONS (NET):	$ -
	TOTAL VE OPTIONS (NET):	$ -
	TOTAL EVALUATED PRICE:	$ 1,600,455.00

NAME SIGNATURE DATE

BID ITEMS

MSL

GC Price Proposal Form

CONSTRUCTION						
Spec	**Paragraph**	**Item**	**Unit**	Unit Price	No. Units	Extension
002213	0001A	Entire Work less Bid Items 0001B, 0001C, and 0001D				$ -
002213	0001B	Test Piling	Linear Feet	$ -		$ -
002213	0001B	Driven Piling	Linear Feet	$ -		$ -
002213	0001B	Batter Piling	Linear Feet	$ -		$ -
002213	0001C	Pile Load Test	Each	$ -		$ -
002213	0001D	Unsuitable Soil	Cubic Yard	$ -	3,000	$ -
					TOTAL BASE BID	$ -

OPTIONS

MSL

OPTIONS as per Spec Section 012360

Option #	Option Title	Days Option Open from Award Date	Overall DEDUCT Amount (negative #s)	Overall ADD Amount (positive #s)
Deduct Alternerate				
1	Delete Cove Light Fixtures	60	$ -	$ -
2	Delete Terrazzo & Stair Tread	60	$ -	$ -
3	Delete Glass Marker Boards	60	$ -	$ -
4	Delete Vibration Points	60	$ -	$ -
5	Delete 10 VCC & Ductwork	60	$ -	$ -
6	Delete BIM Requirements	60	$ -	$ -
7	Delete COBie Requirements	60	$ -	$ -
8	Downgrade to LEED USGBC Silver Rating	60	$ -	$ -
9	Delete Clean Rooms	60	$ -	$ -
10	Remove BAS Integration Requirement	60	$ -	$ -
Add Alternate				
1	Parking Lot	240	$ -	$ -
2	Cleanroom Capability	60	$ -	$ -
3	Telecom Cabling & Equipment	240	$ -	$ -
4	AV Cabling & Equipment	240	$ -	$ -
5	Security Cabling & Equipment	240	$ -	$ -
6	Provide Trane BAS system	60	$ -	$ -

Sub-total DEDUCT and ADD amounts:	$ -	$ -

Total combined DEDUCT and ADD amounts:	$ -

VE OPTIONS

MSL
Please provide pricing for the value engineering and re-scoping options described below:

VE Option #	VE Option Title	VE Option Scope	Days Option Open from Award Date	Overall DEDUCT Amount (negative #s)	Overall ADD Amount (positive #s)
VE01	Change for Insulation Type 3	In Specification Section 07 21 13 BOARD AND BLOCK INSULATION, 2.1.3 i. - For INS3, after the phrase "product by Thermafiber or approved equal" add the following: "or formaldehyde-free unfaced fiberglass batt insulation, R-25, as manufactured by Owens Corning, Johns Manville, or Knauf Insulation, or approved equal"	60	$ -	$ -
VE02	Change for Black Scrim at Insulation Type 2	At Specification section 07 21 13 BOARD AND BLOCK INSULATION, 2.1.3 g - For INS2, add the following sentence after the phrase "or approved equal.": "Mechanically attached black scrim material shall be equivalent to Revealshield IT by Vaproshield including integrated tape, Delta-Fassade S by Cosella-Dorken, or approved equal." At Specification section 07 21 13 BOARD AND BLOCK INSULATION, 2.1.3 g - For INS2, add the following at the end of the Paragraph: "Black scrim facer to extend 8' above adjacent walkways at south face (column line D.7) of Stair 2 and Stair 3 only. See Elevation 2/A-202 for reference. No other locations require black scrim facing at cavity insulation."	60	$ -	$ -
VE03	Eliminate Level 5 Finishes	In Specification Section 09 29 00 GYPSUM BOARD, 3.3 FINISHING OF GYPSUM BOARD: Change Sixth Sentence to read: "Unless otherwise specified, finish all exposed gypsum board walls, partitions and ceilings to Level 4 in accordance with GA 214." Delete section 3.3.1 Uniform Surface	60	$ -	$ -
VE04	Allow Schedule 40 PVC in lieu of PVC Coated Conduit for Underslab Electrical	Revise Spec 26 20 00 Paragraph 3.1.4.4 Underground Conduit Revise From: Plastic-coated rigid steel; Type EPC-40. Plastic coating: extend minimum 6 inches above floor. To: Schedule 40 PVC for all concrete encased conduit runs. Schedule 80 PVC for all direct buried conduit runs. All stub-ups shall be rigid galvanized steel extending a minimum of 6" above finished floor or grade. Revise Paragraph 3.1.4.6 Conduit for Circuits Rated Greater Than 600 Volts Revise to Read: Use Rigid metal conduit or IMC for all above grade portions of conduit runs for circuits over 600 V. See Paragraph 3.1.4.4 for below grade conduit runs. Paragraph 3.1.4.7 Conduit Installed Under Floor Slabs Revise to Read: Conduit run under floor slab shall be located a minimum of (b) (5) below the vapor barrier and in accordance with paragraph 3.1.4.4 above. Seal around conduits at penetrations through vapor barrier.	60	$ -	$ -
VE05	Allow ENT in Elevated Slabs	Revise Spec 26 20 00 Add Paragraph 2.2.6 Electrical Non-Metallic Tubing - Type ENT ENT Raceways shall comply with NEMA TC 13 and UL 1653.2. EMT Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Paragraph 2.2.6.1 Fittings for ENT: Comply with NEMA TC 3; match to conduit or tubing type and material. Add Paragraph 3.1.4.17 Raceways Embedded in Slabs For power conduits, lighting circuits and receptacle circuits use (b) (5) (b) (5) Conduit. For special systems, low voltage systems and telecommunications systems use (b) (5) (b) (5) Conduit. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum (b) (5) intervals. Arrange raceways to cross building expansion joints at right angles with expansion fittings. Arrange raceways to keep a minimum of (b) (5) of concrete cover in all directions. Do not embed threadless fittings in concrete unless specifically approved by Owner for each specific location. Change from (b) (5) before rising above floor.	60	$ -	$ -
VE06	Eliminate Removal of Existing Duct Banks	Where it will not conflict with new building foundations, utilities or site infrastructure, existing duct bank indicated for demolition in the drawings can be abandoned in place rather than removed. Manholes to be demolished as indicated in the drawings. Follow instructions regarding the removal of feeders and other existing cabling. Update the as-built record drawings clearly indicating each electrical duct bank that has been abandoned in place.	60	$ -	$ -
VE07	Change Metal Ceiling Panels	For CLG-1, CLG-1A and CLG-2, use basis of design as follows: Armstrong Metalworks Vector, Silver Grey, M1 for solid and M2 for perforated, 2x2 panels, grid to be 1/4" Reveal with 15/16" Vector, .90 NRC.	60	$ -	$ -
VE08	Eliminate Reveals in Walls	Delete drywall reveals and recessed integrated functional reveal rails at interior face of building South Wall, see 2/A-731.	60	$ -	$ -
VE09	Change Wood Species Anigre to Cherry	In Specification Section 06 20 00 FINISH CARPENTRY, 2.1.5 Hardwood Plywood: Change "Anigre" to "Cherry" In Specification Section 08 14 00 WOOD DOORS, 2.1.1.1 Interior Flush Doors: Change "Anigre" to "Cherry"	60	$ -	$ -
VE10	Eliminate PT2 Scuffmaster	Where PT-2 is shown in the drawings, PT-1 shall be substituted. See Finish Schedule on A-701.	60	$ -	$ -
VE11	Replace Terracotta with Alternate Material	Replace the terracotta panel system with a ventilated facade rain screen system using decorative high-pressure compact laminated (HPL) solid exterior grade phenolic panels, not less than 1/2 inch thick. System shall have the following characteristics: Concealed fasteners, color to match terracotta, overall depth of system as shown in the drawings, panel size and orientation as shown in drawings, mitered corner detail with metal trim similar to that shown in drawings, full implementation of black scrim facing at insulation, overall thermal, air, water, and vapor performance as specified. Manufacturers include, but are not limited to, the following: TRESPA and Fundermax.	60	$ -	$ -
VE12	Replace Metal Panels with Alternate Material	Replace the metal panel system with a ventilated facade rain screen system using decorative high-pressure compact laminated (HPL) solid exterior grade phenolic panels, not less than 1/2 inch thick. System shall have the following characteristics: Concealed fasteners, color to match both "white" and "silver" colors as indicated for metal panels in the Contract Documents, overall depth of system as shown in the drawings, panel sizes and orientation as shown in drawings but with additional horizontal and vertical joints as required to meet maximum panel size constraints, closed fixed corner detail similar to that shown in the drawings, full implementation of black scrim facing at insulation, overall thermal, air, water, and vapor performance as specified. Manufacturers include, but are not limited to, the following: TRESPA and Fundermax.	60	$ -	$ -
VE13	Use PVC for Underground Sanitary Waste and Vent	For under-building slab to 5' outside the building footprint, revise the Pipe and Fitting Materials Schedule, Table 1 of specification 22 00 00 paragraph 3.14, to allow the use of PVC schedule 40 DWV pipe (ASTM D2665) and fittings.	60	$ -	$ -
VE14	Carpet Specification Clarification	In Specification Section 09 68 00 CARPET, in Article 2.5 add the following sentence: "Manufacturers listed are only intended to define the quality, color and style of products to be provided. Other manufacturers who meet the specifications can be submitted pending approval of Contracting Officer."	60	$ -	$ -
VE15	Clarification of Factory Enamel Paint and Indoor AHUs	Factory enamel paint for indoor AHUs is an acceptable substitute to galvanized steel. Enamel paint is not required per specification section 23 73 13.00 40, item 2.3. In Specification Section 23 73 13.00 40, item 2.3: Delete paragraphs 1 and 2, and replace with the following: Provide AHU cabinet that is suitable for pressure class shown and that has leaktight joints, closures, penetrations, and access provisions. Provide cabinet that does not expand or contract perceptibly during starting and stopping of fans and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.0028 of unsupported span prior to acceptance. Stiffen pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, to raise natural frequency to an easily attenuated level. Fabricate enclosure from continuous hot-dipped galvanized steel no lighter than 22 gage thickness, to match industry standard. Provide mill-galvanized sheet metal that conforms to ASTM A653/A653M and that is coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion protect cut edges, burns, and scratches in galvanized surfaces.	60	$ -	$ -
VE16	Change Units of Measurement Signage to an Option	Delete the "Units of Measurement" signs as shown on 1/A-541, 21/A-622 and 22/A-622, items 23 and 24. Ceiling soffit and continuous metal slot item 25 to remain unchanged. Also see Specification Section 10 14 02, 2.2.5 for information.	60	$ -	$ -
VE17	Concrete Shrinkage Requirements	On Sheet S-001, in section 4. C., revise Structural General Note 4 to read as follows: Concrete mix designs shall be proportioned as follows: Horizontal Concrete Elements (Beams, Slabs, etc.) shall have concrete mix designs proportioned for a maximum allowable unit shrinkage of 0.04% as determined by ASTM C157 (measured at 28 days after curing in lime water with air storage). All other concrete elements (foundations, walls, columns, etc.) do not need to meet specific unit shrinkage rates per ASTM C157.	60	$ -	$ -
		Sub-total DEDUCT and ADD amounts:		$ -	$ -
		Total combined DEDUCT and ADD amounts:		$ -	

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☐	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		(Signature of Contracting Officer)	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0026

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 31 August 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0026.

2. Please be advised that the due date for the revised technical proposal and revised pricing proposal is extended to 8 September 2016 by 4 PM EST in an electronic format to the General Services Administration's Contracting Officer, Raymond J. Porter.

3. All other terms and conditions remain unchanged.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0027	09/30/2016		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC	GSA PBS - Region 3 The Dow Building 100 S. Independence Mall West Philadelphia, PA 19106	3PQC

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE | FACILITY CODE

(X)	
☐	9A. AMENDMENT OF SOLICITATION NO. 9B. DATED *(SEE ITEM 11)*
☐	10A. MODIFICATION OF CONTRACT/ORDER NO. 10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☒ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
☐	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
☐	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
☐	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
☐	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Measurement Systems Laboratory (MSL) Project
NASA Langley Research Center
Hampton, Virginia

Please see attached

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		Raymond J. Porter	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Solicitation Number: RJP-NASA_MSL-0001-8-11-2015

Amendment Number: 0027

Please be advised that the Measurement Systems Laboratory (MSL) Project solicitation at the NASA Langley Research Center located in Hampton, Virginia is hereby amended effective 30 September 2016 to incorporate the following:

1. Standard Form 30 – Amendment 0027.

2. The General Services Administration is requesting that your firm submit a Best and Final Pricing Proposal by 4 PM EST on 10 October 2016 in an electronic format to the General Services Administration's Contracting Officer, Raymond J. Porter. Please utilize the attached NASA Langley Research Center MSL Project bid form.

3. All other terms and conditions remain unchanged.

BASE BID

MSL

GC Price Proposal Form

CONSTRUCTION		
Spec Division	**Spec Description**	**Price Proposal**
01	General Requirements/General Conditions	
02	Existing Conditions	
03	Concrete	
04	Masonry	
05	Metals	
06	Wood, Plastics, & Composites	
07	Thermal & Moisture Protection	
08	Openings	
09	Finishes	
10	Specialties	
11	Equipment	
12	Furnishings	
13a	Special Construction	
13b	RQ Drawings & ETS Report (allowance)	$ 1,600,455.00
14	Conveying Equipment	
21	Fire Suppression	
22	Plumbing	
23a	Heating, Ventilating, & Air Conditioning	
23b	Building Controls (Only)	
23c	Bldg Control Integration into Campus BAS (Only)	
26	Electrical	
27	Communications	
28	Electronic Safety & Security	
31	Earthwork	
32	Exterior Improvements	
33	Utilities	
43	Process Gas	
	TOTAL BASE BID	$ 1,600,455.00
	TOTAL OPTIONS (NET):	$ -
	TOTAL VE OPTIONS (NET):	$ -
	TOTAL EVALUATED PRICE:	$ 1,600,455.00

NAME SIGNATURE DATE

BID ITEMS

MSL

GC Price Proposal Form

CONSTRUCTION						
Spec	**Paragraph**	**Item**	**Unit**	Unit Price	No. Units	Extension
002213	0001A	Entire Work less Bid Items 0001B, 0001C, and 0001D				$ -
002213	0001B	Test Piling	Linear Feet	$ -		$ -
002213	0001B	Driven Piling	Linear Feet	$ -		$ -
002213	0001B	Batter Piling	Linear Feet	$ -		$ -
002213	0001C	Pile Load Test	Each	$ -		$ -
002213	0001D	Unsuitable Soil	Cubic Yard	$ -	3,000	$ -
					TOTAL BASE BID	$ -

OPTIONS

MSL

OPTIONS as per Spec Section 012360

Option #	Option Title	Days Option Open from Award Date	Overall DEDUCT Amount (negative #s)	Overall ADD Amount (positive #s)
Deduct Alternerate				
1	Delete Cove Light Fixtures	60	$ -	$ -
2	Delete Terrazzo & Stair Tread	60	$ -	$ -
3	Delete Glass Marker Boards	60	$ -	$ -
4	Delete Vibration Points	60	$ -	$ -
5	Delete 10 VCC & Ductwork	60	$ -	$ -
6	Delete BIM Requirements	60	$ -	$ -
7	Delete COBie Requirements	60	$ -	$ -
8	Downgrade to LEED USGBC Silver Rating	60	$ -	$ -
9	Delete Clean Rooms	60	$ -	$ -
10	Remove BAS Integration Requirement	60	$ -	$ -
Add Alternate				
1	Parking Lot	240	$ -	$ -
2	Cleanroom Capability	60	$ -	$ -
3	Telecom Cabling & Equipment	240	$ -	$ -
4	AV Cabling & Equipment	240	$ -	$ -
5	Security Cabling & Equipment	240	$ -	$ -
6	Provide Trane BAS system	60	$ -	$ -

Sub-total DEDUCT and ADD amounts:	$ -	$ -

Total combined DEDUCT and ADD amounts:	$ -

VE OPTIONS

MSL

Please provide pricing for the value engineering and re-scoping options described below:

VE Option #	VE Option Title	VE Option Scope	Days Option Open from Award Date	Overall DEDUCT Amount (negative #s)	Overall ADD Amount (positive #s)
VE01	Change for Insulation Type 3	In Specification Section 07 21 13 BOARD AND BLOCK INSULATION, 2.1.3 i. - For INS3, after the phrase “product by Thermafiber or approved equal” add the following: “or formaldehyde-free unfaced fiberglass batt insulation, R-25, as manufactured by Owens Corning, Johns Manville, or Knauf Insulation, or approved equal”	60	$ -	$ -
VE02	Change for Black Scrim at Insulation Type 2	At Specification section 07 21 13 BOARD AND BLOCK INSULATION, 2.1.3 g - For INS2, add the following sentence after the phrase “or approved equal.”: “Mechanically attached black scrim material shall be equivalent to Revealshield IT by Vaproshield including integrated tape, Delta-Fassade S by Cosella-Dorken, or approved equal.” At Specification section 07 21 13 BOARD AND BLOCK INSULATION, 2.1.3 g - For INS2, add the following at the end of the Paragraph: "Black scrim facer to extend 8' above adjacent walkways at south face (column line D.7) of Stair 2 and Stair 3 only. See Elevation 2/A-202 for reference. No other locations require black scrim facing at cavity insulation."	60	$ -	$ -
VE03	Eliminate Level 5 Finishes	In Specification Section 09 29 00 GYPSUM BOARD, 3.3 FINISHING OF GYPSUM BOARD: Change Sixth Sentence to read: “Unless otherwise specified, finish all exposed gypsum board walls, partitions and ceilings to Level 4 in accordance with GA 214.” Delete section 3.3.1 Uniform Surface	60	$ -	$ -
VE04	Allow Schedule 40 PVC in lieu of PVC Coated Conduit for Underslab Electrical	Revise Spec 26 20 00 Paragraph 3.1.4.4 Underground Conduit Revise From: Plastic-coated rigid steel; Type EPC-40. Plastic coating: extend minimum 6 inches above floor. To: Schedule 40 PVC for all concrete encased conduit runs. Schedule 80 PVC for all direct buried conduit runs. All stub-ups shall be rigid galvanized steel extending a minimum of 6" above finished floor or grade. Revise Paragraph 3.1.4.6 Conduit for Circuits Rated Greater Than 600 Volts Revise to Read: Use Rigid metal conduit or IMC for all above grade portions of conduit runs for circuits over 600 V. See Paragraph 3.1.4.4 for below grade conduit runs. Paragraph 3.1.4.7 Conduit Installed Under Floor Slabs Revise to Read: Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier and in accordance with paragraph 3.1.4.4 above. Seal around conduits at penetrations through vapor barrier.	60	$ -	$ -
VE05	Allow ENT in Elevated Slabs	Revise Spec 26 20 00 Add Paragraph 2.2.6 Electrical Non-Metallic Tubing - Type ENT ENT Raceways shall comply with NEMA TC 13 and UL 1653.2. EMT Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Paragraph 2.2.6.1 Fittings for ENT: Comply with NEMA TC 3; match to conduit or tubing type and material. Add Paragraph 3.1.4.17 Raceways Embedded in Slabs For power conduits, lighting circuits and receptacle circuits use [redacted] (b) (5) [redacted] For special systems, low voltage systems and telecommunications systems use [redacted] (b) (5) [redacted] Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals. Arrange raceways to cross building expansion joints at right angles with expansion fittings. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions. Do not embed threadless fittings in concrete unless specifically approved by Owner for each specific location. Change from ENT or PVC to Rigid Galvanized Steel before rising above floor.	60	$ -	$ -
VE06	Eliminate Removal of Existing Duct Banks	Where it will not conflict with new building foundations, utilities or site infrastructure, existing duct bank indicated for demolition in the drawings can be abandoned in place rather than removed. Manholes to be demolished as indicated in the drawings. Follow instructions regarding the removal of feeders and other existing cabling. Update the as-built record drawings clearly indicating each electrical duct bank that has been abandoned in place.	60	$ -	$ -
VE07	Change Metal Ceiling Panels	For CLG-1, CLG-1A and CLG-2, use basis of design as follows: Armstrong Metalworks Vector, Silver Grey, M1 for solid and M2 for perforated, 2x2 panels, grid to be 1/4" Reveal with 15/16" Vector. .90 NRC.	60	$ -	$ -
VE08	Eliminate Reveals in Walls	Delete drywall reveals and recessed integrated functional reveal rails at interior face of building South Wall, see 2/A-731.	60	$ -	$ -
VE09	Change Wood Species Anigre to Cherry	In Specification Section 06 20 00 FINISH CARPENTRY, 2.1.5 Hardwood Plywood: Change “Anigre” to “Cherry” In Specification Section 08 14 00 WOOD DOORS, 2.1.1.1 Interior Flush Doors: Change “Anigre” to “Cherry”	60	$ -	$ -
VE10	Eliminate PT2 Scuffmaster	Where PT-2 is shown in the drawings, PT-1 shall be substituted. See Finish Schedule on A-701.	60	$ -	$ -
VE11	Replace Terracotta with Alternate Material	Replace the terracotta panel system with a ventilated facade rain screen system using decorative high-pressure compact laminated (HPL) solid exterior grade phenolic panels, not less than 1/2 inch thick. System shall have the following characteristics: Concealed fasteners, color to match terracotta, overall depth of system as shown in the drawings, panel size and orientation as shown in drawings, mitered corner detail with metal trim similar to that shown in drawings, full implementation of black scrim facing at insulation, overall thermal, air, water, and vapor performance as specified. Manufacturers include, but are not limited to, the following: TRESPA and Fundermax.	60	$ -	$ -
VE12	Replace Metal Panels with Alternate Material	Replace the metal panel system with a ventilated facade rain screen system using decorative high-pressure compact laminated (HPL) solid exterior grade phenolic panels, not less than 1/2 inch thick. System shall have the following characteristics: Concealed fasteners, color to match both "white" and "silver" colors as indicated for metal panels in the Contract Documents, overall depth of system as shown in the drawings, panel sizes and orientation as shown in drawings but with additional horizontal and vertical joints as required to meet maximum panel size constraints, closed fixed corner detail similar to that shown in the drawings, full implementation of black scrim facing at insulation, overall thermal, air, water, and vapor performance as specified. Manufacturers include, but are not limited to, the following: TRESPA and Fundermax.	60	$ -	$ -
VE13	Use PVC for Underground Sanitary Waste and Vent	For under-building slab to 5' outside the building footprint, revise the Pipe and Fitting Materials Schedule, Table 1 of specification 22 00 00 paragraph 3.14, to allow the use of PVC schedule 40 DWV pipe (ASTM D2665) and fittings.	60	$ -	$ -
VE14	Carpet Specification Clarification	In Specification Section 09 68 00 CARPET, in Article 2.5 add the following sentence: “Manufacturers listed are only intended to define the quality, color and style of products to be provided. Other manufacturers who meet the specifications can be submitted pending approval of Contracting Officer.”	60	$ -	$ -
VE15	Clarification of Factory Enamel Paint and Indoor AHUs	Factory enamel paint for indoor AHUs is an acceptable substitute to galvanized steel. Enamel paint is not required per specification section 23 73 13.00 40, item 2.3. In Specification Section 23 73 13.00 40, item 2.3: Delete paragraphs 1 and 2, and replace with the following: Provide AHU cabinet that is suitable for pressure class shown and that has leaktight joints, closures, penetrations, and access provisions. Provide cabinet that does not expand or contract perceptibly during starting and stopping of fans and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.0028 of unsupported span prior to acceptance. Stiffen pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, to raise natural frequency to an easily attenuated level. Fabricate enclosure from continuous hot-dipped galvanized steel no lighter than 22 gage thickness, to match industry standard. Provide mill-galvanized sheet metal that conforms to ASTM A653/A653M and that is coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion protect cut edges, burns, and scratches in galvanized surfaces.	60	$ -	$ -
VE16	Change Units of Measurement Signage to an Option	Delete the "Units of Measurement" signs as shown on 1/A-541, 21/A-622 and 22/A-622, items 23 and 24. Ceiling soffit and continuous metal slot item 25 to remain unchanged. Also see Specification Section 10 14 02, 2.2.5 for information.	60	$ -	$ -
VE17	Concrete Shrinkage Requirements	On Sheet S-001, in section 4. C., revise Structural General Note 4 to read as follows: Concrete mix designs shall be proportioned as follows: Horizontal Concrete Elements (Beams, Slabs, etc.) shall have concrete mix designs proportioned for a maximum allowable unit shrinkage of 0.04% as determined by ASTM C157 (measured at 28 days after curing in lime water with air storage). All other concrete elements (foundations, walls, columns, etc.) do not need to meet specific unit shrinkage rates per ASTM C157.	60	$ -	$ -
			Sub-total DEDUCT and ADD amounts:	$ -	$ -
			Total combined DEDUCT and ADD amounts:	$ -	