SDMS DocID 2232117

ORIGINAL (Red)

[redacted]

ECKENFELDER INC.

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REMEDIAL DESIGN SUBMISSION

LORD-SHOPE LANDFILL SITE
GIRARD TOWNSHIP, PENNSYLVANIA

VOLUME VI
ATTACHMENT E
SPECIFICATIONS FOR
THE LORD-SHOPE SITE

Prepared for:

LORD CORPORATION
2000 West Grandview Boulevard
Erie, Pennsylvania 16512

Prepared by:

ECKENFELDER INC.®
227 French Landing Drive
Nashville, Tennessee 37228
(615) 255-2288

ECKENFELDER INC.®
1200 MacArthur Boulevard
Mahwah, New Jersey 07420
(201) 529-0800

April 1994

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DIVISION 0

INTRODUCTORY AND FRONT-END DOCUMENTS

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PROJECT MANUAL

including Specifications
for construction of:

REMEDIATION FACILITY
6262 Pieper Road
Girard, PA

Prepared By:

LORD CORPORATION
Facilities Services
4917 Pittsburgh Ave.
P. O. Box 10038
Erie, Pennsylvania 16514
(814) 868-0924

Engineering job number:
008-94-LF

Date of issue:
April 22, 1994

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SECTION 00002
PROJECT DIRECTORY

Owner:

Lord Corporation
2000 W. Grandview Blvd.
P. O. Box 10038
Erie, Pa. 16514-0038
(814) 868-0924

Owner's Authorized Representatives:

D. Marshall Fryer
Facilities Project Manager
4917 Pittsburgh Ave.
P. O. Box 10038
Erie, Pa. 16514-0038
(814) 868-0924 ext. 3520

Eugene A. Miller
Manager, Environmental Services
4917 Pittsburgh Ave.
P. O. Box 10038
Erie, Pa. 16514-0038
(814) 868-0924 ext. 3504

Ronald Churley
Manager, Maintenance Services
2000 West Grandview Blvd.
P. O. Box 10038
Erie, Pa. 16514-0038
(814) 868-0924 ext. 3333

END OF PROJECT DIRECTORY

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END OF TABLE OF CONTENTS

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SECTION 00020
INVITATION TO BID

1.0 INVITATION

Notice is hereby given that

LORD CORPORATION

will accept bids for the construction of:

REMEDIATION FACILITY

to be located at:

LORD / SHOPE LANDFILL
6262 PIEPER ROAD
GIRARD, PA 16417

according to Drawings and Specifications prepared by the Owner, and described in general as:

consisting of an approximate 3,900 sq. ft., single story building, groundwater and ground vapor remediation equipment, wells, pipelines, and power and control wiring.

2.0 BID SUBMITTAL

Sealed bids will be recieved at the office of the Owner until:

(insert DAY, DATE, TIME here.)

3.0 PRE-BID CONFERENCE

No group pre-bid conference is scheduled for this project. Prospective bidders are expected to contact the Owner and make arrangements for individual site visits.

4.0 BID OPENING

There will be no public opening or reading of bids received for this project. Bids will be opened privately and reviewed by the Owner.

5.0 BID BOND

A Bid Surety Bond is required for this Contract.

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6.0 PERFORMANCE BOND AND PAYMENT BOND

A Performance Bond and Payment Bond is required for this Contract.

7.0 OWNER'S ADDRESS AND PROJECT CONTACT

Submit bids to, obtain additional bid documents from, and direct all other correspondence to:

LORD CORPORATION
Facilities Services Department
P. O. Box 10038
Erie, PA 16514-0038

Attention: Mr. D. Marshall Fryer
Facilities Project Manager

Phone: (814) 868-0924, extension 3520
Fax: (814) 838-8779

For any deliveries requiring a street number, use the following address instead:

LORD CORPORATION
Facilities Services Department
4917 Pittsburgh Avenue
Erie, PA 16509

END OF INVITATION TO BID

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SECTION 00050
ACKNOWLEDGEMENT OF INQUIRY

Contractors are requested to complete, sign, and return this form WITHIN THE NEXT THREE (3) DAYS to the address below, indicating whether or not you intend to submit a proposal.

Due Date: **SHOW DATE HERE**

Project: Lord Corporation
Remediation Facility
6262 Pieper Road
Girard, PA

Return Form to: Lord Corporation
P. O. Box 10038
Erie, PA 16514-0038

Attention: D. Marshall Fryer

We hereby acknowledge receipt of this Request for Proposal and accompanying documents, drawings, and specidfications.

☐ We intend to submit a proposal.

☐ We do not intend to submit a proposal. We are returning this inquiry and all attachments with this form.

Please indicate your reasons for declining to submit a proposal:

_____

_____

_____

Company: _____

Signed By: _____

Title: _____

Date: _____

END OF SECTION

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SECTION 00100
INSTRUCTIONS TO BIDDERS

The Instructions to Bidders for this Contract are the American Institute of Architects (A. I. A.) Standard Document No. A701, titled **"Instructions to Bidders"**, 1987 Edition, hereinafter referred to as the "Instructions to Bidders", and are hereby made a part of the Contract Documents with the same force and effect as though set forth in full.

END OF SECTION

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SECTION 00300
PROPOSAL FORM

Project: Remediation Facility
Lord / Shope Landfill
6262 Pieper Road
Girard, PA 16417

Contract: General Construction Contract

Bids Due: **(Enter Date and Time Here)**

Owner: Lord Corporation
P. O. Box 10038
Erie, PA 16514

Contact: D. Marshall Fryer
Facilities Project Manager
Facilities Services Department

Proposal of _____
hereinafter called "Bidder", a _____
(Corporation, Partnership, or Individual) doing business as _____
_____.

The Bidder, in compliance with the Invitation for Bids for the construction of the above project, having examined the Plans and Specifications with related documents and the site of the proposed Work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct the project in accordance with the Contract Documents, within the times set forth therein, and at the price stated below. These prices are to cover all expenses including shipping and taxes incurred in performing the work required under the Contract Documents, of which this proposal is a part.

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Bidder agrees to commence work under this Contract on or before **(insert date here)** and to fully complete the project no later than (insert date here) or state the earliest guaranteed completion date on this Proposal Form.

Earliest Guaranteed Completion Date: _____

Receipt of the following addenda is hereby acknowledged:

No.	Date

BASE BID:

For all work required for the Remediation Facility, Lord / Shope Landfill, Girard, PA,
The sum of: _____
_____ (written), $_____ (numeric).

BID BREAKDOWN:

Notes:

1. Incidental items, and any items not specifically listed in the Bid Breakdown table below, shall be included to provide a complete project in accordance with the Drawings and Specifications.
2. Bid Quantities shown on this form are intended as approximate for the purposes of bidding. Actual quantities of items required by the Owner and installed in accordance with the Contract Documents, will be used along with the indicated Unit Prices to determine the final Contract Sum.
3. Bid Quantities should be verified by the Contractor prior to site work and ordering of materials.

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Bid Item	Units	Bid Qty.	Unit Price	Lump Sum Price or Extended Price
Remediation Building Construction:				
Div. 1 - General Requirements Including, but not limited to: engineering, permits and fees, mobilization, coordination, overhead & profit.	lump sum	n/a	n/a	$.
Div. 2 - Site Work	lump sum	n/a	n/a	$.
Div. 3 - Concrete	lump sum	n/a	n/a	$.
Div. 4 - Masonry	lump sum	n/a	n/a	$.
Div. 5 - Metals	lump sum	n/a	n/a	$.
Div. 6 - Wood & Plastics	lump sum	n/a	n/a	$.
Div. 7 - Thermal & Moisture Protection	lump sum	n/a	n/a	$.
Div. 8 - Doors & Windows	lump sum	n/a	n/a	$.
Divs. 9 Through 14 Inclusive - Finishes, Specialties, etc.	lump sum	n/a	n/a	$.
Div. 15 - Mechanical Excluding process equipment mechanical.	lump sum	n/a	n/a	$.
Div. 16 - Electrical Excluding process equipment electrical.	lump sum	n/a	n/a	$.
Remediation Building Construction Subtotal:	n/a	n/a	n/a	$.
In-Situ Vapor Stripping System:				
Mobilization / Demobilization	lump sum	n/a	n/a	$.
Extraction Well (Drilling) Including but not limited to: exposure of existing geomembrane, drilling, installation of well, and backfill.	lin. ft.	40	$.	$.
Well Head Assembly and Boot Installation & materials, including but not limited to: valves, gauges, and boot; backfill and reseeding.	each	3	$.	$.

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Bid Item	Units	Bid Qty.	Unit Price	Lump Sum Price or Extended Price
ISVS Header Pipe (Landfill & Crest Areas) Installation & materials, including but not limited to: pipe material, insulation, heat tracing, pipe supports, valves, gauges, and pipe fittings.	lin. ft.	1,175	$.	$.
ISVS Extraction Pipe (Toe Area) Installation & materials, including but not limited to: pipe, valves, gauges, and fittings.	lin. ft.	350	$.	$.
Trench Excavation / Backfill (Toe area)	cu. yd.	120	$.	$.
Condensate Collection Tank Installation & materials, including but not limited to: level controls, pump, piping, valves, foundation, insulation, heat tracing, and discharge line installation.	lump sum	n/a	n/a	$.
Vapor Extraction / Emission Control Unit	lump sum	n/a	n/a	$.
Temperature Probes (Quantity 12) Installation & materials.	total lin. ft.	144	$.	$.
In-Situ Vapor Stripping System Subtotal:	n/a	n/a	n/a	$.
Groundwater Recovery System:				
Mobilization / Demobilization (Test Boring Drilling Equipment)	lump sum	n/a	n/a	$.
Test Borings (Quantity 23) Installation & materials, including but not limited to: drilling, soil sample collection & analysis, grouting, and cuttings disposal.	total lin. ft.	1,380	$.	$.
Renovate Existing Wells / Piezometers	each	22	$.	$.
Installation of Monitoring Well/Piezometer 10 inch diameter	lin. ft.	120	$.	$.
Installation of Monitoring Well/Piezometer 6 inch diameter	lin. ft.	360	$.	$.
Recovery Well Installation Including, but not limited to: materials, well development, cuttings disposal, pumps, level controls, and decontamination.	lin. ft.	180	$.	$.

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Bid Item	Units	Bid Qty.	Unit Price	Lump Sum Price or Extended Price
Mobilization / Demobilization (Recovery Well Drilling Equipment)	lump sum	n/a	n/a	$.
Pump Tests: Operate Pump, Monitor Flow & Water Levels.	lump sum	n/a	n/a	$.
Installation of Temporary Force Main.	lin. ft.	1,820	$.	$.
Groundwater Extraction Forcemain Install. (Permanent below ground) Including, but not limited to: piping, manholes, valves, rip-rap, trenching, bedding material, installation of seep collars, and revegetation.	lin. ft.	2,500	$.	$.
Recovery Well Head Including, but not limited to: materials, gauges, metals, valves, pump, and pump controls.	lump sum	n/a	n/a	$.
Groundwater Recovery System Subtotal:	n/a	n/a	n/a	$.
Groundwater Treatment System:				
Equalization Tank Including installation & materials.	each	1	$.	$.
Permanganate Mix Tank Including installation & materials.	each	1	$.	$.
Effluent Holding Tank Including installation & materials.	each	1	$.	$.
Sludge Holding Tank Including installation & materials.	each	1	$.	$.
Filtrate Tank Including installation & materials.	each	1	$.	$.
Mixers (Quantity 2) Installation & materials, including but not limited to: equalization tank mixer and permanganate feed tank mixer.	lump sum	n/a	n/a	$.
Air Stripper Package Installation & materials, including but not limited to: stack blower, space blower, controls, piping, roof opening, and stack supports.	lump sum	n/a	n/a	$.

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Bid Item	Units	Bid Qty.	Unit Price	Lump Sum Price or Extended Price
Filter Press Package Including installation & materials.	lump sum	n/a	n/a	$.
Automatic Sampler Including installation & materials.	lump sum	n/a	n/a	$.
Centrifugal Pumps, Pump Motors, & Controls Including installation & materials.	lump sum	n/a	n/a	$.
Metering Pumps Including installation & materials.	lump sum	n/a	n/a	$.
Pressure Filter Package	lump sum	n/a	n/a	$.
Piping, Valves, and Pipe Supports Including installation & materials.	lump sum	n/a	n/a	$.
Instrumentation and Controls Installation & materials, including but not limited to control / telemetry system, flow sensor, flow monitor / totalizer, pH sensor, pH analyzer, conductivity sensor and analyzer, recorder, level switches and alarms, sludge level indicator, pressure indicator, and timer.	lump sum	n/a	n/a	$.
Effluent Discharge Line Including installation & materials.	lump sum	n/a	n/a	$.
Groundwater Treatment System Miscellaneous components not itemized above, including, but not limited to: equipment, tanks, baffles, access ladders, platforms, covers, mixer, air stripper, pressure filters, filter press, pumps, pipes, valves, pipe supports, controls, and instrumentation.	lump sum	n/a	n/a	$.
Groundwater Treatment System Subtotal:	n/a	n/a	n/a	$.
Miscellaneous Items:				
Project Mobilization / Demobilization	lump sum	n/a	n/a	$.
Sediment Barriers Materials & installation.	lump sum	n/a	n/a	$.

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Bid Item	Units	Bid Qty.	Unit Price	Lump Sum Price or Extended Price
Protection of Wetlands	lump sum	n/a	n/a	$.
Culvert Materials & installation.	lump sum	n/a	n/a	$.
Project Survey	lump sum	n/a	n/a	$.
Additional Items (Provide Itemized List)	lump sum	n/a	n/a	$.
Electrical Service (Hook Up) Including, but not limited to: electrical service, hook up of the project electrical components including motors, gauges, meter, telemetry system, alarms, sensors, switches, timers, and controls.	lump sum	n/a	n/a	$.
Health & Safety Compliance Including, but not limited to: protective clothing, decontamination (i.e., compliance with Health and Safety Plan); Health and Safety Plan, Decontamination Plan, and Contingency Plan preparation.	lump sum	n/a	n/a	$.
Excavated Soils / Drill Cuttings Disposal **Non-hazardous.**	cu. yd.	100	$.	$.
Excavated Soils / Drill Cuttings Disposal **Hazardous.** Including, but not limited to: containerizing, and waste characterization for disposal.	cu. yd.	5	$.	$.
Preparation of Operation and Maintenance Manual	lump sum	n/a	n/a	$.
Other Miscellaneous Items - See Note #1. (Provide Itemized List)	lump sum	n/a	n/a	$.
Miscellaneous Items Subtotal:	n/a	n/a	n/a	$.
TOTAL OF ALL SUBTOTALS: Insert this amount also, as the Base Bid amount on Page 2 of this Proposal Form.				$.

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Bidder understands that Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

Bidder agrees that this Bid shall be good and may not be withdrawn for a period of thirty (30) calendar days after the scheduled closing time for receiving bids.

Submitted By:

_____
Signature

_____
Printed Name

_____
Title

_____
_____
_____
Business Address

_____
Date of Submittal

SEAL - if Bid is by a Corporation

END OF SECTION

ORIGINAL (Red)

SECTION 00500
FORM OF AGREEMENT

The Form of Agreement of this Contract is the Engineers Joint Contract Documents Committee (EJCDC) Standard Document No. 1910-8-A-1, titled **"Standard Form of Agreement Between Owner and Contractor on the Basis of a Stipulated Price"**, 1990 Edition, hereinafter referred to as the "Form of Agreement", and is hereby made part of the Contract Documents with the same force and effect as though set forth in full.

END OF SECTION

ORIGINAL (Red)

SECTION 00700
GENERAL CONDITIONS

The General Conditions of this Contract are the Engineers Joint Contract Documents Committee (EJCDC) Standard Document No. 1910-8, titled **"Standard General Conditions of the Construction Contract"**, 1990 Edition, hereinafter referred to as the "General Conditions", and are hereby made part of the Contract Documents with the same force and effect as though set forth in full.

END OF SECTION

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SECTION 00800
SUPPLEMENTAL CONDITIONS

PART 1 SUPPLEMENTAL CONDITIONS

1.1 GENERAL

A. Contractor is required to abide by the terms of the USEPA Consent Decree, a copy of which has been provided to the Contractor. Contractor's schedules provided under Section 01310 of the Specifications must be in concurrence with the project deadlines contained in the Consent Decree.

END OF SECTION

ORIGINAL (Red)

SECTION 00850
DRAWING INDEX

PART 1 ECKENFELDER DRAWINGS:

Drawing No.	6759-001	Title: Existing Site Conditions
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	6759-011	Miscellaneous Details
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	6759-013	Treatment Building Floor Plan
	6759-014	Groundwater Treatment System P & I Diagram
	6759-015	Groundwater Treatment System Sections 1 & 2
	6759-016	Groundwater Treatment System Sections 3 & 4
	6759-107	Groundwater Treatment System Details
	6759-018	Groundwater Treatment System Details
	6759-019	Groundwater Treatment System Discharge Line Profiles
	6759-020	Groundwater Treatment System Discharge Line Sections and Details

PART 2 LORD CORPORATION DRAWINGS:

Drawing No.	A-1	Title: New Floor Plan
	A-2	Construction Plan
	A-3	Elevations
	A-4	Wall Sections
	C-1	Plot Plan
	E-1	Electrical Plan
	E-2	Control and Monitoring Schematic
	S-1	Structural Plan
	S-2	Structural Sections
	S-3	Foundation Plan
	S-4	Foundation Sections
	S-5	Slab Plan
	S-6	Slab Sections

END OF SECTION

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DIVISION 1

GENERAL REQUIREMENTS

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SECTION 01010
SUMMARY OF THE WORK

The site is a rural parcel of land, situated off Pieper Road in Girard, Pennsylvania, and containing an inactive industrial waste landfill covered by a membrane and clay cap.

The Work of this Contract consists of providing a complete remediation facility, as specified herein, and to the satisfaction of governmental agencies having jurisdiction; including but not limited to construction of an approx. 3,300 square foot, single story, metal-frame building, and the procurement, installation, and testing of wells, pipelines, groundwater treatment and vapor stripping remediation equipment to be located within the building and about the site.

This is a general construction contract. All trades necessary for complete and proper building construction, site work, and equipment installation in accordance with the Contract Documents are included. In addition, certain trades are designated to be completed on a design-build basis; that is, the contractor will be responsible for qualified engineering design of certain systems and subsystems, to be completed in accordance with the requirements and design guidelines contained within the Contract Documents.

Such design build activities include, but are not necessarily limited to:

1. Building structural steel frame design, procurement and installation.
2. Building electrical equipment design, procurement and installation for power distribution, lighting, and process control systems.
3. Building HVAC equipment design, procurement and installation.
4. Building plumbing system design, procurement and installation.
5. All building permits and associated inspections and approvals, including preparation of any additional necessary documents, P.E. and/or R.A. stamps, and application fees.

END OF SECTION

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SECTION 01050
CONTRACTOR FIELD ENGINEERING

PART 1 GENERAL

1.1 SUMMARY

A. Provide such field engineering services as are required for proper completion of the Work including, but not necessarily limited to:
   1. Establishing and maintaining survey control points, lines and levels;
   2. Structural design of shores, forms, and similar items provided by the Contractor as part of his means and methods of construction.
   3. As-built documentation.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.
   2. Additional requirements for field engineering also may be described in other Sections of these Specifications.
   3. As described in the General Conditions, the Owner will furnish a survey describing the physical characteristics, legal limitations, utility locations, and legal description of the site.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Submit for Owner's approval:
   1. Names, addresses, and qualifications of persons proposed to be engaged to provide land survey and/or field engineering services, along with evidence for each of previous successful performance of projects of similar magnitude.
   2. A Survey Plan, to include project staffing, scheduling, and types of equipment to be used in completing the Work.
   3. Documentation verifying accuracy of field engineering and survey work.
   4. Certification, signed by the Contractor's retained field engineer, certifying that elevations and locations of improvements are in conformance or non-conformance with requirements of Contract Documents.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Retain the services of an independent registered Land Surveyor licensed in the Commonwealth of Pennsylvania to provide survey control for construction, and to provide survey for record drawings for various components of construction.

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1.4 PROCEDURES

A. In addition to procedures directed by the Contractor for proper performance of the Contractor's responsibilities,:

1. Locate and protect control points before starting work on the site. Promptly notify the Owner of any discrepancies found.
2. Preserve permanent reference points during progress of the Work.
3. Do not change or relocate reference points or items of the Work without specific approval from the Owner.
4. Promptly advise the Owner when a reference point is lost or destroyed, or requires relocation because of other changes in the Work.
   a. Upon direction of the Owner, require the field engineer to replace reference stakes or markers.
   b. Locate such replacements according to the original survey control.
5. Maintain lines and levels in accordance with recognized engineering survey practices.
6. Reference all record drawings to the Pennsylvania Plane Coordinate System.

1.5 TOLERANCES

A. Tolerances shall be as given in the various Sections of these Specifications, and as shown on the Drawings.

END OF SECTION

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SECTION 01160

HEALTH AND SAFETY PLAN (HASP)

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Health and Safety Plan

B. Personnel Requirements

C. Task/Operation Safety and Health Risk Analysis

D. Personnel Training Requirements

E. Personal Protective Equipment

F. Medical Surveillance Requirements

G. Air Monitoring and Personnel Air Sampling

H. Site Control Measures

I. Decontamination Plan

J. Emergency Response/Contingency Plan

K. Spill Containment Program

L. Additional Requirements

1. The objective of these procedures is to minimize the risk of exposure to hazardous substances by identifying, evaluating, and controlling potential safety and health hazards. CONTRACTOR shall be responsible for preparing and implementing the HASP. This HASP shall apply to all personnel on site during construction including but not limited to the CONTRACTOR's employees and subcontractor's employees, CQA consultant and OWNER.

2. CONTRACTOR must also familiarize himself and CONTRACTOR's employees and subcontractor's employees with OWNER's site-specific Health and Safety plans and procedures.

1.02 RELATED SECTIONS

A. Section 01560 - Decontamination Plan

B. Section 01340 - Shop Drawings, Product Data, and Samples

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1.03 REFERENCES AND STANDARDS

A. Federal OSHA Standards

1. *Air Contaminants - Permissible Exposure Limits*; OSHA 3112; 1989.

2. *General Industry Standards and Interpretations*; Volumes 1 - 3- OSHA 2077; U.S. Department of Labor, Occupational Safety and Health Administration; Specifically Sections: 29 CFR 1910.1000-1050 (air contaminants), 1910.120 (Hazardous Waste Operations and Emergency Response), 1910.1200 (Hazard Communication), 1910.301 Subpart S (Electrical), 1910.146 (Permit Required Confined Space) 1910.147 (Control of Hazardous Energy (Lockout/Tagout), 1904 (Recordkeeping and Reporting Occupational Injuries and Illnesses), 1990 (Identification, Classification and Regulation of Potential Occupational Carcinogens), and 1926 (Safety and Health Regulations for Construction).

3. *Hazardous Waste Inspections Reference Manual*; U.S. Department of Labor; Occupational Safety and Health Administration; 1986.

4. *OSHA Field Operations Manual*; 2nd Edition; U.S. Department of Labor; Occupational Safety and Health Administration; 1987.

B. Other References and Standards.

1. *A Guide to the Safe Handling of Hazardous Materials Accidents*; STP 825; American Society for Testing and Materials; 1983.

2. *Air Sampling Instruments*; 6th Edition; American Conference of Governmental Industrial Hygienists (ACGIH); 1983.

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1.04 PLAN DESCRIPTION

A. CONTRACTOR shall provide a Health and Safety Plan (HASP) which establishes policies and procedures to protect workers and the public from the potential hazards posed by the work. The HASP must be developed before site activities proceed.

1. At a minimum the plan shall:

   a. Name key personnel and alternates responsible for site safety.

   b. Describe risks associated with each operation conducted.

   c. Confirm that personnel are adequately trained to perform their job responsibilities and to handle the specific hazardous situations they may encounter.

   d. Describe the protective clothing and equipment to be worn by personnel during various site operations.

   e. Describe any site-specific medical surveillance requirements.

   f. Describe the program for periodic air monitoring, personnel monitoring, and environmental sampling (if needed).

   g. Describe the actions to be taken to mitigate existing hazards to make the work environment less hazardous.

   h. Define site control measures and include a site map.

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i. Establish decontamination procedures for personnel and equipment.

j. Set forth the site's Standard Operating Procedures for Health and Safety.

B. Definitions

As used in the HASP, the following terms are defined:

- Active Operations - Activities resulting in disturbance of soil, buildings, or equipment at a work area.

- Authorized Personnel - Any person, such as task-specific personnel, project personnel, oversight personnel, contractors, and consultants whose presence is authorized at the Project Site by OWNER.

- Contamination Reduction Zone (CRZ) - The area that borders the Exclusion Zone before entering the Support Zone. This is the area where decontamination takes place.

- CONTRACTOR/Subcontractor - Any person or firm, retained or hired by CONTRACTOR, to carry out and/or supervise any portion of the activities conducted at the Project Site.

- Exclusion Zone - The area in which all personnel entering must be directly involved in the ongoing work, have designated personal protective equipment (PPE), and meet training and medical monitoring requirements. The exclusion zone will be defined by an approximate 25 feet radius around the work area or an appropriate physical barrier, which will be suitably marked.

- MSDS - Material Safety Data Sheets, which provide information on the physical, chemical, and hazardous properties of chemical compounds.

- Oversight Personnel - Any person, designated by the State, Federal Government, or OWNER who is assigned to carry out oversight work.

- PPM - Parts per million; expressed as PPM(v) for gases and vapors.

- Project Personnel - Any person or contractor, assigned by OWNER, its consultants, its contractors or subcontractors, to carry out work at the Project

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Site (e.g., Project Director, Project Manager, etc.).

- Project Health and Safety Officer - The designated person responsible for overall implementation of the Health and Safety Plan.

- Project Site - The area defined by a specific project Work Plan, as well as contiguous areas to which access is required for the execution of the field tasks which may be set forth in a Work Plan.

- Site Safety Officer - The person(s) designated by CONTRACTOR who is responsible for supervising the Health and Safety Plan.

- Support Zone - The area outside the exclusion zone that is considered clean for the purpose of the Health and Safety Plan. It is used for transfer of equipment and materials (i.e., support) into the secure area.

- Task-Specific Site Personnel - Any person or subcontractor assigned by CONTRACTOR to carry out work at the Project site.

- Secure Zone - The area within a radius of approximately 50 feet established from the center of the work area, or an appropriate physical barrier (e.g. remediation site) and indicated by a visible surface device.

1.05 SUBMITTALS

A. Submit plans in accordance with Section 01340.

B. In accordance with time frame outlined in Submittal Schedule:

1. Written HASP containing all requirements under 29 CFR 1910.120. The plan shall be written to avoid misinterpretation, ambiguity, and mistakes that verbal orders cause.

2. HASP approvals by appropriate and qualified CONTRACTOR personnel for review by OWNER, CQA Consultant, and by regulatory agencies.

3. Documentation of medical monitoring.

4. Documentation of personnel training.

5. Documentation of personnel respirator qualification and fit testing.

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C. During Construction Activities:

1. All required forms and OSHA records will be kept on site as applicable.

1.06 PRODUCT

A. CONTRACTOR shall provide a HASP consistent with the recommended format as outlined in reference No. B25, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. Minimum HASP requirements are described according to the following sample outline:

i. Table of Contents
ii. Tables and Figures
iii. Addenda

1.0 INTRODUCTION

1.1 Scope and Applicability of the HASP

A. Identify, evaluate, and control potential safety and health hazards.

B. Provide emergency response provisions for accidents during work operations.

1.2 Definition

A. To avoid misunderstanding on site, list the following items:

1. List of terms referenced in HASP.
2. List of term definitions.

1.3 Visitor Requirements on Site

A. Visitors may periodically visit the site. The visitors must:

1. Be able to identify the secure zone and understand procedures.

2. Know and follow sign in/sign out procedures.

3. Show documentation of appropriate training and medical monitoring which is required in secure work zones.

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2.0 KEY PERSONNEL/IDENTIFICATION OF HEALTH SAFETY PERSONNEL

A. Identify key personnel (and alternates) and organizational responsibilities for site safety. Also identify key personnel assigned to various operations. List telephone numbers, addresses, and organizations of these people.

2.1 Key Personnel

A. List and define key project personnel on site and off site. Include names, title, and office phone number.

2.2 Site Specific Health and Safety Personnel

A. List site health and safety personnel and alternates. Include name, title, and office phone number.

2.3 Organization Responsibilities

A. Specify minimum responsibilities of key project and health and safety personnel.

3.0 TASK/OPERATION SAFETY HEALTH RISK ANALYSIS

3.1 Historical Overview of Site

A. Include a site history.
B. Include a site map to provide an understanding of the geographical area.

3.2 Task/Risk Analysis

A. Identify and evaluate any potential physical, biological, radiological, or chemical hazards. Express potential impact on workers or the public.

B. Instructions

1. Identify chemical hazards including:

   a. respirable dust
   b. skin contact/absorption hazards
   c. accidental ingestion

2. Identify electrical hazards including:

   a. overhead electrical lines
   b. buried electrical lines
   c. de-energize electrical lines as required

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3. Identify mechanical hazards including:

   a. moving equipment and vehicles
   b. rotating machine parts
   c. lockout/tagout moving machinery, as required

4. Identify fire/explosion hazards including:

   a. gasoline powered equipment
   b. smoking
   c. flammable fumes and vapors

5. Identify heat and cold stress hazards including:

   a. extremely hot, humid weather
   b. extremely cold, windy weather

6. Identify acoustical hazards including:

   a. noisy equipment/machinery

7. Identify physical hazards including:

   a. slippery or uneven walking surfaces
   b. tripping hazards

8. Identify construction hazards:

   a. confined space
   b. trenching/shoring

9. Identify unanticipated hazards.

4.0 PERSONNEL TRAINING REQUIREMENTS

4.1 Training and Briefing Topics

A. Pre-project briefing meeting covering the following HASP topics:

   - site characterization
   - hazards
   - medical surveillance requirements
   - symptoms of overexposure to hazards
   - site control
   - training requirements
   - monitoring equipment

B. Have all site workers sign an acknowledgment form attesting to attendance at the pre-project meeting, understanding of safety rules and documentation and understanding of respirator fit test.

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C. Hold a daily safety meeting to be held by the designated site safety officer to discuss specific current safety issues and as a daily safety reminder.

1. Suggested topics to be covered:

a. personal protective equipment
b. hazards
c. any injuries or close calls
d. weather related issues

5.0 PERSONAL PROTECTIVE EQUIPMENT TO BE USED

A. Define levels of protection required for work activities in terms of work location and/or work function. Define specific types of respirators and protective clothing for each level.

5.1 to 5.5 <u>Level A, B, C and D Personal Protective Equipment</u>

A. After review of hazards and the greatest expected exposure, select levels A-D personal protective equipment. Due to the identified contaminants, level A is not likely to be required. Describe levels of protection worn by personnel and delineate specific job functions.

5.1 Level A - worn when the highest level of respiratory, skin, and eye protection is needed.

5.2 Level B - worn when the highest level of respiratory protection is needed, but a lesser level of skin protection.

5.3 Level C - worn when the criteria for using air-purifying respirators are met based on toxins and/or air monitoring results.

5.4 Level D - worn only as work uniform and not on any site with respiratory or skin hazards. (Note: Modified Level D is sometimes worn and includes wearing a Tyvek coverall.)

5.5 The level of protection is selected based on:

- Type and measured concentration of the chemical substances in the ambient atmosphere and their toxicity.

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- Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done.

5.6 Reassessment of Protection Program

A. Levels of protection shall be upgraded or downgraded based upon changes in site conditions or later findings.

5.7 Work Mission Duration

A. The anticipated duration of the work mission is established.

B. Conditions that affect work mission duration to be addressed in this section are:

- cold and heat
- capacity to work in full face respirators
- air supply consumption of SCBAs

5.8 Chemical Resistance and Integrity of Protective Material

A. Personal protective equipment must be specific for the tasks performed in the HASP.

B. The Quick Selection Guide to Chemical Protective Clothing provides a quick reference.

5.9 Standard Operating Procedures for Respiratory Protection Devices

A. Checklists for pre-use inspection, reinspection, and periodic inspection.

5.10 Standard Operating Procedures for Personal Protective Clothing

A. Checklists for pre-use inspection and reinspections.

5.11 Specific Levels of Protection for Site

A. Based on anticipated hazards, the specific levels of protection are listed.

1. Level A
2. Level B
3. Level C
4. Level D (or Modified Level D)

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B. List all types of personal protective equipment to be used on site for each level.

6.0 MEDICAL SURVEILLANCE REQUIREMENTS

A. Develop a medical surveillance program by a Board Certified or Qualified to be Board Certified Occupational Physician.

6.1 Baseline or Pre-assignment Monitoring

A. Document medical monitoring for all personnel working in the Secure Zone.

B. Examinations to include:

- complete medical and work histories
- physical examination
- pulmonary function
- chest X-ray
- electrocardiogram
- eye exam and visual acuity
- audiometry
- urinalysis
- blood chemistry (hematology, serum analyses, heavy metals toxicology)

C. The medical monitoring physical must certify the ability of personnel to use air purifying respirators and to be medically able to perform specific tasks.

6.2 Periodic Monitoring

A. Perform periodic monitoring (medical physical) for personnel working in the secure zone required within the last 12 months.

B. Monitoring documentation maintained on Site.

6.3 Specific Medical Monitoring

A. Monitoring for symptoms related to the possible exposure of harmful chemical compounds.

B. Physical injuries during performance of tasks covered by HASP.

C. Visually monitor personnel for signs of heat or cold overexposure.

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6.4 Exposure/Injury/Medical Support

A. Make provisions for special circumstances which may require medical attention of a physician.

7.0 FREQUENCY AND TYPES OF AIR MONITORING AND PERSONNEL AIR SAMPLING

A. The purpose is to identify and quantify airborne contaminants in order to verify and determine the level of personal protection required.

B. Two principal methods are used:

- Continuous air monitoring using direct reading instrument, (e.g. HNU, combustible gas/oxygen meter.)

- Composite air monitoring obtained by sorbent (e.g. charcoal and silica gel tubes collected by a personal pump).

7.1 Direct-Reading Monitoring Instruments

A. Direct Reading Instruments are used in the Secure Zone.

B. Determine Direct Reading Instrument based on anticipated contaminants and confined space entry requirements.

C. Calibrate instruments each morning and each afternoon.

7.2 Personal Sampling

A. Based on contaminants, identify personal sampling pumps with collection tubes that may be used.

7.3 Specific Contaminants that may be Monitored at Site Location

A. Inorganic Constituents
(Arsenic, Barium, Cadmium, Chromium, Lead)

B. Organic Constituents (Using an 10.2 eV HNU)
(Acetone, Benzene, 2-Butanol, Cyclohexanone, 1,1-Dichlorethylene, trans 1,2-Dichloroethylene, Ethyl Benzene, Isopropyl Alcohol, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, 4-methyl-2-pentanone, Tetrachlorethylene, Tetrahydrofuran, Toluene, Trichlorethylene, Vinyl Chloride, Xylene)

C. Organic Constituents (Using an 11.7 eV HNU)

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(Carbon Tetrachloride, Chloroform, 1,1-Dichloroethane, Methyl Chloride, Methylene Chloride, 1,1,1-Trichlorethane)

D. Other Constituents (Methane)

8.0 SITE CONTROL MEASURES

8.1 Buddy System

A. Work in the Secure Zone shall be scheduled to assure no person works alone.

B. Visual contact shall be maintained at all times.

C. Buddy system shall be required when working on or near water hazards including the use of a life line.

D. Appropriate trained personnel (authorized entrants, attendants, entry supervisors and rescue and emergency services) for permit required confined space.

8.2 Site Communications Plan

A. Provide a communication system which includes the following elements.

1. telephones
2. 2-way radios
3. hand signals
4. verbal communication
5. other (horns, whistles)

8.3 Work Zone Definition and Site Access

A. Work zone definition incorporates the following elements:

1. Exclusion Zone

2. Secure Zone

3. Contamination Reduction Zone

4. Support Zone

5. Control procedures to prevent unauthorized access. Require a check-in and check-out system to control and record each employee and piece of equipment in each area.

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6. Site security procedures - (fences, signs, sign in/sign out procedures)

B. Identify on the site map:

1. Exclusion zone, secure zone, contamination reduction zone, and support zone.

2. Indicate the sizes of zones, zone boundaries, and access control points into each zone.

8.4 Nearest Medical Assistance

A. Provide the name, address and telephone of nearest medical assistance and location of on site medical assistance (if appropriate).

B. Provide a map to nearest medical facility.

C. Provide written directions to nearest medical facility.

8.5 Safe Work Practices

A. List safe work practices that are mandatory and enforceable at site location.

8.6 Emergency Alarm Procedure

Address site emergencies or occurrences that require immediate actions to prevent additional problems or harm to responders, the public, property or the environment.

A. Establish Site Emergency Procedures

1. List names and emergency functions of on site personnel responsible for emergency actions. Indicate training they have received.

2. Provide communication plan and alternate means for emergency communications.

3. List names, telephone numbers, and locations of emergency organizations that might be needed.

4. Address and define procedures for rapid evacuation of personnel.

5. List emergency equipment.

6. Address emergency medical care.

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7. Advise site-personnel of their duties in an emergency.

8. Provide for emergency decontamination of injured personnel.

9. Provide a map(s) with route(s) to nearby hospital(s) and pre-arrangements for emergency medical treatment.

10. Coordinate with rescue and emergency services prior to permit entry confined space.

9.0 DECONTAMINATION PLAN

9.1 Standard Operating Procedures

A. Establish decontamination procedures for personnel and equipment.

B. Arrange for proper disposal of contaminated material, solutions and equipment.

Follow specifics as stated in *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. NIOSH/OSHA/USCG/EPA; US Department of Health and Human Services, Public Health Service, Center for Disease Control, NIOSH; 1985.

9.2 Levels of Decontamination Protection Required for Personnel

A. Establish the level of decontamination based on anticipated levels of contaminants.

9.3 Equipment Decontamination

A. Establish decontamination procedures for equipment and arrange for disposal of solutions and/or equipment.

9.4 Disposition of Decontamination Wastes

A. Establish decontamination waste disposal. This includes solutions and/or equipment.

10.0 EMERGENCY RESPONSE/CONTINGENCY PLAN

A. Provide an Emergency Response/Contingency Plan established with the following objectives:

1. Pre-Emergency Planning

2. Personnel Roles and Lines of Authority

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3. Emergency Recognition and Prevention

4. Evacuation Routes and Procedures/Safe Distances

5. Site Security and Control

6. Emergency Decontamination Procedures

7. Emergency Contact/Notification System and Alerting Procedures including alternate means of communication

8. Emergency Medical Treatment Procedures

9. Fire or Explosion Response Procedures

10. Spill or Leak Response Procedures

11. Personal Protective Equipment and Emergency Equipment

12. Rescue and Emergency Services

11.0 SPILL CONTAINMENT PROGRAM

A. Provide a spill containment program identifying possible spill potential and containment procedures and equipment.

1. List emergency contacts and phone numbers

2. List types and location of spill containment materials

END OF SECTION

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SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.1 DESCRIPTION

1. Work included: To enable orderly review during progress of the Work, and to provide for systematic discussion of problems, the Owner will conduct project meetings throughout the construction period.

A. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.
2. The Contractor's relations with his subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility and normally are not part of the project meeting's content.

1.2 SUBMITTALS

A. Agenda items: To the maximum extent practicable, advise the Owner at least 24 hours in advance of project meetings regarding items to be added to the agenda.

B. Minutes: The Owner will compile minutes of each project meeting, and will furnish a copy to the Contractor for his use.

1.3 QUALITY ASSURANCE

A. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority to commit the Contractor to solutions agreed upon in project meetings.

PART 2 PRODUCTS

(No products required in this Section)

PART 3 EXECUTION

3.1 MEETING SCHEDULE

A. Except as noted for the preconstruction meeting, project meetings will be held weekly.

B. Coordinate as necessary to establish a mutually acceptable schedule for meetings.

3.2 MEETING LOCATION

1. The Owner will establish the meeting locations, generally to be at either the jobsite or at the Owner's offices in Erie, PA.

3.3 PRECONSTRUCTION MEETING

A. Preconstruction meetings will be scheduled to be held within 15 working days after the Owner has issued Notice to Proceed.

1. Provide attendance by authorized representatives of the Contractor and major Subcontractors.
2. The Owner will advise other interested parties, including its consultants, and request their attendance.

B. Minimum agenda: Data will be distributed and discussed on at least the following items.
1. Organizational arrangement of Contractor's forces and personnel, and those of subcontractors and major material suppliers.
2. Channels and procedures for communication.
3. Construction schedule, including sequence of critical work.
4. Contract Documents, including distribution of required copies of original Documents and revisions.
5. Processing of Shop Drawings and other data submitted to the Owner for review.
6. Processing of Bulletins, Field Decisions, and Change Orders.
7. Rules and regulations governing performance of the Work; and
8. Procedures for safety and first aid, security, quality control, housekeeping, and related matters.

3.4 PROJECT MEETINGS

A. Attendance:
1. To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout the progress of the Work.
2. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the Work is involved.

B. Minimum agenda:
1. Review, revise as necessary, and approve minutes of previous meetings.
2. Review progress of the Work since last meeting, including status of submittals for approval.
3. Identify problems which impede planned progress.
4. Develop corrective measures and procedures to regain planned schedule,
5. Complete other current business.

C. Revisions to minutes:
1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, they will be accepted as properly stating the activities and decisions of the meeting.
2. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
3. Challenge to minutes shall be settled as a priority item at the next regularly scheduled meeting.

END OF SECTION

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SECTION 01310
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SUMMARY

A. To assure adequate planning and execution of the Work so that the Work is completed within the number of calendar days allowed in the Contract, and to assist the Owner in appraising the reasonableness of the proposed schedule and in evaluating progress of the Work, prepare and maintain the schedules and reports described in this Section.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.
   2. Requirements for progress schedule: General Conditions.
   3. Construction period: Form of Agreement.

C. Definitions:
   1. "Day", as used throughout the Contract unless otherwise stated, means "calendar day".

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Preliminary analysis: Within 14 days after the Contractor has received the Owner's Notice to Proceed, submit a preliminary construction schedule prepared in accordance with Part 3 of this Section.

C. Construction Schedule: Within one month after the Contractor has received Owner's Notice to Proceed, submit a construction schedule prepared in accordance with Part 3 of this Section.

D. Periodic Reports: On the first working day of each month following the above Construction Schedule submittal, submit a revised version of the Construction Schedule, updated in accordance with Part 3 of this Section.

1.3 QUALITY ASSURANCE

A. Employ a scheduler thoroughly trained and experienced in compiling construction schedule data, and in preparing and issuing periodic reports as required below.

B. Perform data preparation, analysis, charting, and updating in accordance with standards approved by the Owner.

C. Reliance upon the approved schedule:
   1. The construction schedule as approved by the Owner will be an integral part of the Contract and will establish interim completion dates for the various activities under the Contract.

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2. Should any activity not be completed within 14 days after the stated scheduled date, the Owner shall have the right to require the Contractor to expedite completion of the activity by whatever means the Owner deems appropriate and necessary, without additional compensation to the Contractor.
3. Should any activity be 28 days or more behind schedule, the Owner shall have the right to perform the activity or have the activity performed by whatever method the Owner deems appropriate.
4. Costs incurred by the Owner in connection with expediting construction activity under this Article shall be reimbursed by the Contractor.
5. It is expressly understood and agreed that failure by the Owner to exercise the option either to order the Contractor to expedite an activity or to expedite the activity by other means shall not be considered to set a precedent for any other activities.

PART 2 PRODUCTS

2.1 CONSTRUCTION ANALYSIS

A. Graphically show by bar chart, or other means acceptable to the Owner, the order and interdependence of all activities necessary to complete the Work, and the sequence in which each activity is to be accomplished, as planned by the Contractor and his project field superintendent in coordination with all subcontractors.

B. Include, but do not necessarily limit indicated activities to:
   1. Project mobilization;
   2. Submittal and approval of Shop Drawings and Samples;
   3. Procurement of equipment and critical materials;
   4. Fabrication of special material and equipment, and its installation and testing;
   5. Final cleanup;
   6. Final inspection and testing; and
   7. All activities by the Owner that affect progress, required dates for completion, or both, for all and each part of the Work.

PART 3 EXECUTION

3.1 PRELIMINARY ANALYSIS

A. Contents:
   1. Show all activities of the Contractor under this Work for the period between receipt of Notice to Proceed and submittal of required Construction Schedule;
   2. Show the Contractor's general approach to the remainder of the Work;
   3. Show cost of all activities scheduled for performance before submittal and approval of the Construction Schedule.

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3.2 CONSTRUCTION SCHEDULE

A. As soon as practicable after receipt of Notice to Proceed, complete the construction analysis in preliminary form. meet with the Owner, review contents of the proposed construction schedule, and make all revisions agreed upon.

3.3 PERIODIC REPORTS

A. Update the approved construction schedule:
   1. Indicate "actual" progress in percent completion for each activity;
   2. Provide written narrative summary of revisions causing delay in the program, and an explanation of corrective actions taken or proposed.

3.4 REVISIONS

A. Make only those revisions to the approved Construction Schedule as are approved in advance by the Owner.

END OF SECTION

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SECTION 01340
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.1 SUMMARY

A. Make submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements, all as described in this Section.

B. Related Work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Individual requirements for submittals also may be described in pertinent Sections of these Specifications.
   3. The process for securing approval of proposed substitutions is described in Section 01630, "Product Options and Substitutions".

C. Work not included:
   1. Unrequired submittals will not be reviewed by the Owner.
   2. The Contractor may require his subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the Work, but such data shall remain between the Contractor and his subcontractors and will not be reviewed by the Owner unless specifically called for within the Contract Documents.

1.2 SUBMITTALS

A. Make submittals of Shop Drawings, Samples, substitution requests, and other items in accordance with the provisions of this Section.

1.3 QUALITY ASSURANCE

A. Coordination of submittals:
   1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
   2. Verify that each item and the submittal for it conform in all respects with the specified requirements.
   3. By affixing the Contractor's signature to each submittal, certify that this coordination has been performed.

PART 2 PRODUCTS

2.1 SHOP DRAWINGS

A. Scale and measurements: Make Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.

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B. Submit three copies of all Shop Drawings.

C. Owner will return one copy of each Shop Drawing to the Contractor with review comments.

2.2 MANUFACTURER'S LITERATURE

A. Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, clearly show which portion of the contents are being submitted for review.

B. Submit three copies of all manufacturer's literature.

C. Owner will return one copy of each document to the Contractor with review comments.

2.3 SAMPLES

A. Provide Samples identical to the precise article proposed to be provided. Identify as described under "Identification of submittals" below.

B. Provide a single sample which will be retained by the Owner.

C. Where appropriate, approved Samples may be installed in the Work at a location agreed upon by the Owner.

2.4 COLORS AND PATTERNS

A. Unless the precise color and pattern is specifically called out in the Contract Documents, and wherever a choice of color or pattern is available in the specified products, submit accurate color and pattern charts to the Owner for selection.

PART 3 EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

A. Consecutively number all submittals.
   1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.
   2. On resubmittals, cite the original transmittal number for reference.

B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.

C. On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included.

D. Submittal log:
   1. Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times.
   2. Make the submittal log available to the Owner for review upon request.

3.2 GROUPING OF SUBMITTALS

A. Unless otherwise specified, make submittals in groups containing all associated items to assure that information is available for checking each item when it is received.

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1. Partial submittals may be rejected as not complying with the provisions of the Contract.
2. The Contractor may be held liable for delays so occasioned.

3.3 TIMING OF SUBMITTALS

A. Make submittals far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

B. In scheduling, allow at least five working days for review by the Owner following the Owner's receipt of the submittal.

END OF SECTION

ORIGINAL (Red)

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. This Section describes testing and inspecting to be provided by the Contractor, plus cooperation required from the Contractor with the Owner's selected testing agency and others responsible for testing and inspecting the Work.

B. Related Work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Testing requirements may be described in various Sections of these Specifications.
   3. Where no testing requirements are described, but the Owner decides that testing is required, the Owner may require that such testing be performed under current pertinent standards for testing. Payment for such testing will be made as described in this Section.

C. Work not included:
   1. Selection of testing laboratory: The Owner will select a prequalified independent testing laboratory.
   2. Selection of construction soil engineer: The Owner will select a prequalified independent soil engineer to observe performance of work in connection with excavating, trenching, filling, backfilling, and grading, and to perform compaction tests.

1.2 QUALITY ASSURANCE

A. The testing laboratory will be qualified to the Owner's approval in accordance with ASTM E329.

B. Testing, when required, will be in accordance with all pertinent codes and regulations, and with selected standards of the American Society for Testing and Materials.

C. All work performed under this Section will also be in accordance with the Construction Quality Assurance Plan, Attachment L of the Final Design Submission for the Lord-Shope Landfill Site, Girard Township, Pennsylvania, prepared by Eckenfelder, Inc. for the Owner.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Promptly process and distribute required copies of test reports and related instructions to assure necessary retesting and replacement of materials with the least possible delay in progress of the Work.

PART 2 PRODUCTS

2.1 PAYMENT FOR TESTING

A. Initial services of testing laboratory:
   1. The Owner will pay for initial services requested by the Owner.
   2. When initial tests indicate non-compliance with the Contract Documents, the costs of all tests associated with that non-compliance will be deducted by the Owner from the Contract Sum.

B. Initial services of construction soil engineer:
   1. The Owner will pay for initial services requested by the Owner, including but not necessarily limited to, observing performance of work in connection with excavating, trenching, filling, backfilling, and grading.
   2. The Owner will pay for compaction tests performed by the construction soil engineer, but will deduct from the Contract Sum the costs for compaction tests performed to prove compliance with codes or ordinances.

C. Retesting: When initial tests indicate non-compliance with the Contract Documents, subsequent retesting occasioned by the non-compliance shall be performed by the same testing agency, and costs thereof will be deducted by the Owner from the Contract Sum.

2.2 CODE COMPLIANCE TESTING

A. Inspections and tests required by codes or ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

2.3 CONTRACTOR'S CONVENIENCE TESTING

A. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

PART 3 EXECUTION

3.1 COOPERATION WITH TESTING LABORATORY

A. Representatives of the testing laboratory shall have access to the Work at all times and at all locations where the Work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

3.2 TAKING SPECIMENS

A. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.3 SCHEDULES FOR TESTING

A. Establishing schedule:

1. By advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings.
2. Provide all required time within the construction schedule.

B. Revising schedule: When changes of construction schedule are necessary during construction, coordinate all such changes with the testing laboratory as required.

C. Adherence to schedule: When the testing laboratory is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra charges for testing attributable to the delay may be back-charged to the Contractor and shall not be borne by the Owner.

END OF SECTION

ORIGINAL (Red)

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This Section describes construction facilities and temporary controls required for the Work.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.
2. Except that equipment furnished by subcontractors shall comply with requirements of pertinent safety regulations, such equipment normally furnished by the individual trades in execution of their own portions of the Work are not part of this Section.
3. Permanent installation and hookup of the various utility lines are described in other Sections.

1.2 REQUIREMENTS

A. Provide construction facilities and temporary controls needed for the Work including, but not necessarily limited to:

1. Temporary utilities such as heat, water, electricity, and telephone;
2. Field office for the Contractor's personnel;
3. Sanitary facilities; and
4. Enclosures such as tarpaulins, barricades, and canopies.

1.3 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Maintain temporary facilities and controls in proper and safe condition throughout progress of the Work.

PART 2 PRODUCTS

2.1 UTILITIES

A. Water:

1. Provide necessary temporary piping and water supply and, upon completion of the Work, remove such temporary facilities.
2. Provide and pay for any water brought in from sources other than the onsite well.

B. Electricity:

1. Provide necessary temporary wiring and, upon completion of the Work, remove such temporary facility.

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2. Provide area distribution boxes so located that the individual trades may furnish and use 100 foot maximum length extension cords to obtain power and lighting at points where needed for work, inspection, and safety.
3. Provide and pay for electricity used in construction.

C. Heating: Provide and maintain heat necessary for proper conduct of operations needed in the Work.

D. Telephone:
1. Make necessary arrangements and pay costs for installation and operation of telephone service to the Contractor's office at the site.

2.2 FIELD OFFICE AND SHEDS

A. Contractor's facilities:
1. Provide a field office building and sheds adequate in size and accommodation for Contractor's office, supply, and storage.

B. Sanitary Facilities:
1. Provide temporary sanitary facilities in quantity sufficient for use by all personnel.
2. Maintain in a sanitary condition at all times.

2.3 ENCLOSURES

A. Provide and maintain for the duration of construction all scaffolds, tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of the Work in compliance with pertinent safety and other regulations.

2.4 TEMPORARY FENCING

A. Maintain and protect the existing permanent site fencing.

B. In areas not already protected by permanent fencing, provide and maintain for the duration of construction temporary fencing of type needed to prevent entry onto the Work by the public.

2.5 PROJECT SIGN

A. A project sign is not required. Signage at the Pieper Road entrance for gate identification and other directional information shall be minimized, and be of a form acceptable to the Owner. Other signage or advertising will not be permitted.

PART 3 EXECUTION

3.1 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the Work.

B. Remove such temporary facilities and controls as rapidly as progress of the Work will permit, or as directed by the Architect.

END OF SECTION

SECTION 01560

DECONTAMINATION PLAN

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section includes minimum requirements for the Decontamination Plan to be developed, implemented, and adhered to by the Contractor.

1.02 RELATED SECTIONS

A. Section 01160 - Health and Safety Plan

B. Section 01340 - Shop Drawings, Product Data, and Samples

1.03 SUBMITTALS

A. The CONTRACTOR shall develop and submit the Decontamination Plan in accordance with Section 01340.

B. The Decontamination Plan must be approved before site activities proceed.

C. Submit shop drawings and details of decontamination pads, collection sumps, or other containment systems or structures.

1.04 DESCRIPTIONS

A. The Decontamination Plan shall include, at a minimum, the following:

1. Standard Operating Procedures

   a. Establish decontamination procedures for personnel and equipment.

   b. Arrange for proper disposal of contaminated material, solutions, and equipment.

   c. Follow specifics as stated in *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. NIOSH/OSHA/USCG/EPA; US

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Department of Health and Human Services, Public Health Service, Center for Disease Control, NIOSH; 1985.

2. Levels of Decontamination Protection Required for Personnel

   a. Establish the level of decontamination based on anticipated levels of contaminants.

3. Equipment Decontamination

   a. Establish decontamination procedures for equipment and arrange for disposal of solutions and/or equipment.

4. Disposition of Decontamination Wastes

   a. Establish and complete decontamination waste disposal. This includes solutions and/or equipment.

END OF SECTION·

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SECTION 01565

PROTECTION OF WETLANDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section includes requirements to be adhered to by the CONTRACTOR for the protection of wetland areas during construction.

B. Remedial action components requiring construction within wetland areas shall include portions of the following: extraction wells, well header installation, and the underground discharge forcemain installation. Wetlands areas are delineated on the Drawings.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 02110 - Clearing, Grubbing, and Topsoil Removal

C. Section 02200 - Earthwork

D. Section 02220 - Excavation and Subgrade Preparation

E. Section 02225 - Trenching

F. Section 02271 - Rip Rap

1.03 REFERENCES AND STANDARDS

A. Soil Erosion and Sediment Control Plan

1.04 SUBMITTALS

A. The CONTRACTOR shall submit a list of excavating, earth moving, and well installation equipment to be used in wetland areas for approval by the CQA Consultant.

B. The CONTRACTOR shall submit plans for earth disturbance activities and methods for minimizing disturbances in wetland areas.

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1.05 DESCRIPTIONS

A. Work within wetland areas shall be avoided to the greatest extent practicable. Where work in wetland areas is required, the CONTRACTOR shall keep any disturbance to an absolute minimum.

B. Access to wetland areas shall be by equipment suitable to travel and not disturb low strength saturated soils. Access routes shall be kept to existing clearings whenever possible. No access road construction shall be allowed in designated wetlands.

C. Limits of work shall be delineated in accordance with the Drawings. Limits of work and limits of wetlands shall be identified (flagged) by the CONTRACTOR prior to construction and shall be maintained throughout construction.

D. The treatment system discharge line shall be constructed with seep collars in wetland areas in accordance with Section 02225-Trenching and the Drawings to prevent pipe bedding from acting as a dewatering drain.

E. Construction in wetland areas shall be in accordance with the Soil Erosion and Sediment Control Plan developed for the project. Associated items shall include but not be limited to the installation of hay bales or silt fences along all downgradient limits of work.

F. At the completion of construction in wetland areas, the CONTRACTOR shall restore all disturbed areas to their pre-existing condition. Restoration shall include backfilling excavations with excavated soils and replanting disturbed areas with vegetation similar to existing vegetation.

END OF SECTION

ORIGINAL (Red)

SECTION 01620
STORAGE AND PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Protect products scheduled for use in the Work by means including, but not necessarily limited to, those described in this Section.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Additional procedures also may be prescribed in other Sections of these Specifications.

1.2 QUALITY ASSURANCE

A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.3 MANUFACTURER'S RECOMMENDATIONS

A. Except as otherwise approved by the Owner, determine and comply with manufacturer's recommendations on product handling, storage, and protection.

1.4 PACKAGING

A. Deliver products to the job site in their manufacturer's original container, with labels intact and legible.

1. Maintain packaged materials with seals unbroken and labels intact until time of use. Repack and reseal any items opened for receipt inspection.
2. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

B. The Owner may reject as non-complying such material and products that do not bear identification satisfactory to the Owner as to manufacturer, grade, quality, and other pertinent information.

1.5 PROTECTION

A. Protect existing structures and equipment, including but not necessarily limited to the storage building, wells and pipelines, and the landfill membrane and cap structure.

B. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.

C. Provide protection for finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.

D. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Owner.

1.6 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs to the approval of the Owner and at no additional cost to the Owner.

B. Additional time required to secure replacements and to make repairs will not be considered by the Owner to justify an extension in the Contract Time of Completion.

END OF SECTION

SECTION 01630
PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 GENERAL

1.1 SUMMARY

A. This Section describes product options available to bidders and the Contractor, plus procedures for securing approval of proposed substitutions.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Make submittals in accordance with pertinent provisions of Section 01340.

1.2 PRODUCT OPTIONS

A. The Contract is based on standards of quality established in the Contract Documents.

1. In agreeing to the terms and conditions of the Contract, the Contractor has accepted a responsibility to verify that the specified products will be available and to place orders for all required materials in such a timely manner as is needed to meet his agreed construction schedule.
2. The Owner has not agreed to the substitution of materials or methods called for in the Contract Documents, except as may otherwise be stated in writing.

B. Materials and/or methods stated by name:

1. Where materials and/or methods are specified by naming one single manufacturer and/or model number, without stating that equal products will be considered, only the material and/or method named is approved for incorporation into the Work.
2. Should the Contractor demonstrate to the approval of the Owner that the specified material or method was ordered in a timely manner and will not be available in time for incorporation into this Work, the Contractor shall submit to the Owner such data on proposed substitute materials and/or methods as are needed to help the Owner determine suitability of the proposed substitution.

C. Where materials and/or methods are specified by name and/or model number, followed by the words "or an equal approved in advance by the Owner":

1. The material and/or method specified by name establishes the required standard of quality;
2. Materials and/or methods proposed by the Contractor to be used in lieu of materials and/or methods so specified by name shall in all ways equal or exceed the qualities of the named materials and/or methods.
3. Proposed substitutions shall be described on form 00440 submitted at time of General Contract bid.

D. The following products do not require further approval except for interface within the Work:
   1. Products specified by reference to standard specifications such as ASTM and similar standards;
   2. Products specified by manufacturer's name and catalog model number.

E. The decision of the Owner shall be final.

1.3 DELAYS

A. Delays in construction arising by virtue of the non-availability of a specified material and/or method will not be considered by the Owner as justifying an extension of the agreed Time of Completion.

END OF SECTION

ORIGINAL (Red)

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SUMMARY

1. This Section describes an orderly and efficient transfer of the completed Work to the Owner.

A. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.
2. Activities relative to Substantial Completion and Contract closeout are described in the General Conditions.

1.2 QUALITY ASSURANCE

A. Prior to requesting inspection by the Owner, use adequate means to assure that the Work is completed in accordance with the specified requirements and is ready for the requested inspection.

1.3 PROCEDURES

A. Substantial completion, final inspection, and final application for payment:

1. Refer to the applicable sections of the General Conditions.

B. Closeout submittals: Include, but are not necessarily limited to:

1. Project Record Documents;
2. Operation and maintenance data for items so listed in pertinent other Sections of these Specifications;
3. Warranties and bonds;
4. Keys and keying schedule;
5. Spare parts and material extra stock;
6. Evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to:
   a. Certificates of Inspection
   b. Certificates of Occupancy
   c. PA Dept. of Labor and Industry final inspection.
7. Evidence of payment and release of liens;
8. List of subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service.

C. Final adjustment of accounts:

1. Submit a final statement of accounting to the Owner, showing all adjustments to the Contract Sum.

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2. If so required, the Owner will prepare a final Change Order showing adjustments to the Contract Sum which were not made previously by Change Orders.

1.4 INSTRUCTION

A. Instruct the Owner's personnel in proper operation and maintenance of systems, equipment, and similar items which were provided as a part of the Work.

END OF SECTION

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DIVISION 2

SITE WORK

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SECTION 02010
SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.1 SUMMARY

A. This section describes soils investigation at the site, and use of data resulting from that investigation.

1.2 SOILS INVESTIGATION REPORT

A. General:

1. A soils investigation report has been prepared for the site of this Work by the soil investigation engineer selected by the Owner.
2. A copy of the soils investigation report may be obtained upon request addressed to the Owner's Representative.

B. Use of data:

1. This report was obtained only for the Owner's use in design, and is not a part of the Contract Documents.
2. The report is available for bidder's information, but is not a warranty of subsurface conditions.
3. Bidders should visit the site and acquaint themselves with existing conditions.
4. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but such investigations may be performed only under time schedules and arrangements approved in advance by the Owner's Representative.

1.3 QUALITY ASSURANCE

A. A construction soil engineer may be retained by the Owner to observe performance of work in connection with excavation, trenching, filling, backfilling, and grading, and to perform compaction tests.

B. Readjust work performed that does not meet technical or design requirements, but make no deviation from the Contract Documents without specific and written approval from the Owner's Representative.

END OF SECTION

ORIGINAL (Red)

SECTION 02070
SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. In accordance with pertinent provisions of this Section, carefully demolish and remove from the site those items scheduled to be so demolished and removed.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

(No products are required in this Section.)

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 DEMOLITION

A. By careful study of the Contract Documents, determine the location and extent of selective demolition to be performed.

B. In company with the Owner's representative, visit the site and verify the extent and location of selective demolition required.

1. Carefully identify limits of selective demolition.
2. Mark interface surfaces as required to enable workmen also to identify items to be removed and items to be left in place intact.

C. Prepare and follow an organized plan for demolition and removal of items.

1. Shut off, cap, and otherwise protect existing public utility lines in accordance with the requirements of the public agency or utility having jurisdiction.

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2. Completely remove items scheduled to be so demolished and removed, leaving surfaces clean, solid, and ready to receive new materials specified elsewhere.
3. In all activities, comply with pertinent regulations of governmental agencies having jurisdiction.

D. Demolished material shall be considered to be property of the Contractor and shall be completely removed from the job site.

E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

3.3 REPLACEMENTS

A. In the event of demolition of items not so scheduled to be demolished, promptly replace such items to the approval of the Owner's Representative and at no additional cost to the Owner.

END OF SECTION

ORIGINAL (Red)

SECTION 02110
CLEARING, GRUBBING, AND TOPSOIL REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Clear and grub the site, dispose of cleared materials, strip, stockpile, protect, and replace topsoil, as shown on the Drawings and specified in this Section.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 02220: Excavation and Subgrade Preparation
3. Section 02925: Fertilizing and Seeding
4. Section 02931: Erosion Control.

1.2 DEFINITIONS

A. The following are brief definitions of terminology associated with earthwork at this site.

1. Topsoil. Those materials consisting of imported or onsite soil, having an organic content suitable to promote growth of grass or other vegetation.
2. Soil. Those materials which underlie the ground surface and any topsoil.
3. Subgrade. Consists of prepared, compacted soil surface on which another soil component is placed.
4. Grading. Operations required to smooth and "dress" disturbed areas to achieve design lines, profiles, and grades.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials, not specifically described but required for proper completion of the work of this Section, as selected by the Contractor subject to the approval of the Owner.

B. Material to be cleared includes trees, shrubs, and any debris or other foreign matter that is neither topsoil nor suitable for inclusion in the subgrade foundation, as determined by the Architect or CQA Consultant.

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C. Where topsoil is specified, provide surficial material consisting of organic soils.

D. Provide seed, mulch, and other soil amendments complying with Section 02925.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PROTECTION

A. Protect existing utilities indicated or made known.
   1. Coordinate with utility companies and agencies as required.
   2. Where utility cutting, capping, or plugging is required, perform such work in accordance with requirements of the utility company or governmental agency having jurisdiction.

B. Protection of persons and property:
   1. Barricade open depressions and holes occurring as part of this Work, and post warning lights on property adjacent to or with public access.
   2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
   3. Support and protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this Section.

C. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

D. Maintain access to the site at all times.

3.3 CLEARING AND GRUBBING

A. Perform clearing and grubbing only in areas identified on the Drawings within the construction limits and limits of grading, as approved by the Architect or CQA Consultant.

B. Install erosion and sedimentation controls complying with Section 02931 prior to the start of clearing.

C. Do not perform clearing operations during periods of unsuitable weather, as determined by the Architect or CQA Consultant.

D. Clear all areas required for access to the site and execution of the Work. Clear, and grub as necessary, in the stockpile and borrow areas.

E. Remove and cut trees into sections. Dispose of trees, downed timber, snags, brush, rubbish and other vegetation designated for removal, in a satisfactory manner

F. Clean out stumps, roots, and debris 1" in diameter and larger to a depth of at least 12" below the existing ground surface or subgrade of new graded surface, whichever is

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lower. Treat roots remaining in the soil with a weed killer approved by the Owner's Representative.

3.4 CONSERVATION OF TOPSOIL

A. After the area has been cleared of vegetation, strip the existing topsoil in a manner to avoid lifting of, and contamination with subsoils.

B. Stockpile in an area clear of new construction, and separate from other materials.
   1. Maintain the stockpile in a manner which will not obstruct the natural flow of drainage.
   2. Maintain stockpile free from debris and trash.
   3. Maintain erosion and sedimentation control.
   4. Temporarily seed and mulch the stockpile immediately after final shaping, in a manner complying with Section 02925.
   5. Keep the topsoil damp to prevent dust and drying out.

3.5 FINISH GRADING

A. Uniformly grade the areas within the limits of grading

B. Provide finish surfaces free from irregular surface changes.

3.6 PROTECTION OF WETLANDS

A. Strictly limit and minimize any disturbance of wetland areas.

3.7 DISPOSAL

A. General:
   1. Remove brush, grass, roots, trash, and other material from clearing operations.
   2. Dispose of in a legal manner, as directed by the Architect or CQA Consultant.
   3. Do not store or permit debris to accumulate on the job site.

B. Do not burn debris at the site.

END OF SECTION

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SECTION 02150
SHORES

PART 1 GENERAL

1.1 SUMMARY

A. As specified in this Section, provide shoring at excavations and elsewhere as required to protect workmen, materials, other properties, and the public.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. As established in the General Conditions of the Contract, the Contractor is solely responsible for means and methods of construction and for the sequences and procedures to be used.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Prior to submitting shoring design for approval of governmental agencies having jurisdiction, submit the design to the Owner for review.

1. The Owner's review will be for space coordination purposes only, and will not relieve the Contractor of his responsibilities under the Contract.
2. Should changes in the shoring design be required subsequent to the Owner's review, coordinate all such changes with the Owner and secure the Owner's approval of changes in space allocations.

C. Upon completion of construction of this portion of the Work, submit to the Owner two copies of a letter signed by the approved shoring engineer stating that, to the best of the shoring design engineer's knowledge, the shoring system was constructed in accordance with the arrangement reviewed by the Owner.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Employ a qualified engineer, properly permitted to provide such services at the location of the Work, to design the shoring system and to inspect and report on the quality of its construction.

C. Comply with pertinent requirements of governmental agencies having jurisdiction.

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PART 2 PRODUCTS

2.1 DESIGN

A. Design a shoring system which will safely and adequately prevent collapse of adjacent materials and which will permit construction of the Work to the arrangement shown on the Drawings.

B. Secure all needed approvals, including those of governmental agencies having jurisdiction and of adjacent property owners if required, at no additional cost to the Owner.

2.2 MATERIALS

A. Provide materials of all kinds as required for execution of the approved shoring system.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Construct and install the shoring system in strict accordance with the design approved by the governmental agencies having jurisdiction, and in strict accordance with the space arrangement approved by the Owner.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary to perform all earthwork as specified herein, as shown on the Drawings, and as necessary to complete installation.

B. The CONTRACTOR shall be prepared to perform earthwork in conjunction with other construction activities.

C. The work of this section shall include, but not necessarily be limited to: hauling, backfilling, compacting, and grading structural fill materials for swales, access roads, buried pipes, buried utilities, manholes, and pipes; disposal and stockpiling of surplus materials; and all related work such as slope protection. Earthwork shall conform to the dimensions, lines, grades, and sections specified on the Drawings.

D. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

1.02 RELATED SECTIONS

A. Section 01565 - Protection of Wetlands

B. Section 01050 - Contractor Field Engineering

C. Section 02110 - Clearing, Grubbing, and Topsoil Removal

D. Section 02220 - Excavation and Subgrade Preparation

E. Section 02271 - Riprap

F. Section 02925 - Fertilizing and Seeding

G. Section 02931 - Erosion Control

1.03 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. Latest version of American Society for Testing and Methods (ASTM).

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a. D 422 Test Method for Particle-Size Analysis of Soils.

b. D 698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).

c. D 1140 Test Method for Amount of Material in Soils Finer than the No. 200 Sieve.

d. D 1556 Test Method for Density of Soil In Place by the Sand-Cone Method

e. D 1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3).

f. D 2216 Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.

g. D 2487 Test Method for Classification of Soils for Engineering Purposes.

h. D 2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

i. D 4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

2. Commonwealth of Pennsylvania, Department of Transportation (PADOT) Specifications, Publication 408.

1.04 QUALITY CONTROL

A. Laboratory Testing

1. In place density tests shall be made by an approved independent testing laboratory hired by the CONTRACTOR. The moisture density relationship for backfill will be determined by ASTM D698 and compaction curves for the full range of material used shall be developed.

B. Permits and Regulations

1. The CONTRACTOR shall perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

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1.05 SUBMITTALS

A. The CONTRACTOR shall prepare and submit drawings as necessary to complete the required work. If drawings are necessary (i.e., sheeting, shoring, bracing, etc.), the drawings shall be prepared by a professional engineer recognized as expert in the specialty involved. The drawings shall be submitted to the CQA Consultant for purposes of establishing that the terms of the Specifications are complied with. Calculations shall not be submitted unless requested in writing by the CQA Consultant. Drawing submissions will not be checked and will not imply approval by the Engineer of the work involved. The CONTRACTOR shall be wholly responsible for designing, installing, and operating whatever system is necessary to accomplish the required work and protection of the completed work.

B. Test Reports - Earth Materials:

1. Submit copies of the following reports directly to the CQA Consultant from the testing service, with a copy to the CONTRACTOR:

   a. Tests on earth materials.
   b. Field density tests (if required).
   c. Compaction curves.

C. Submit samples of all earth materials as required within this specification.

D. Submit information on compaction equipment to be used on the Project.

1.06 EXISTING CONDITIONS

A. Subsurface Information: Information pertaining to data on subsurface conditions is referenced in the Phase II Remedial Investigation Report prepared by ECKENFELDER INC. (1990). It is not intended as a representation or warranty of continuity of such conditions between soil borings. The OWNER will not be responsible for interpretations or conclusions drawn therefrom by the CONTRACTOR. Data are made available for the convenience of the CONTRACTOR.

1. Additional test borings and other exploratory operations may be made by the CONTRACTOR at no cost to the OWNER.

B. Existing Structures: Shown on the Drawings are certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is

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shown for the convenience of the CONTRACTOR. The CONTRACTOR shall explore ahead of the required excavation to determine the exact location of all structures. They shall be supported and protected from injury by the CONTRACTOR. If they are broken or injured, they shall be restored immediately by the CONTRACTOR at no cost to the OWNER.

C. Existing Utilities: Locate existing underground utilities in the areas of Work. The approximate locations of known underground and above ground utility lines and structures are shown on the Drawings. The CONTRACTOR shall verify the locations with OWNER prior to construction. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the CQA Consultant immediately for directions as to procedure. Cooperate with the OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility OWNER.

2. Do not interrupt existing utilities serving facilities occupied and used by the OWNER or others, except when permitted in writing by the CQA Consultant and then only after acceptable temporary utility services have been provided.

3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

E. Dust Control: The CONTRACTOR shall conduct all of his operations and maintain the work area including sweeping and sprinkling of roadways, so as to minimize creation and dispersion of dust. Calcium chloride or other chemical methods shall not be used for dust control. Severe dust problems shall be controlled with mulch, gravel, or other temporary restoration methods subject to the approval of the CQA Consultant.

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PART 2 PRODUCTS

A. Structural Fill

1. The structural fill materials (e.g., fill for trenches, berms, swales, and access roads) shall consist of relatively homogeneous, natural soils that are free of debris, foreign objects, excess silt, roots, and organics. The structural fill shall be classified according to the USCS as GC, GM, SP, SM, SW, SC, or CL material. Maximum particle size shall not exceed 2 inches in any dimension. Structural fill shall be capable of meeting the compaction requirements specified in Part 3 of this specification.

2. Structural fill material having a USCS classification of SM, SC, or CL shall have a maximum plasticity index of 25.

3. Material Sources:

   a. The CONTRACTOR shall employ an independent testing laboratory approved by the CQA Consultant to carry out the following tests on the proposed material source and shall submit the test data to the CQA Consultant.

i.	Mechanical Gradation (Sieve Analysis)	ASTM D 422
ii.	Hydrometer Analysis	ASTM D 422
iii.	Atterberg Limits	ASTM D 4318
iv.	Standard Proctor Compaction Curve	ASTM D 698
v.	Classification	ASTM D 2487

   b. The final approval of a source for structural fill will be at the sole discretion of the CQA Consultant.

   c. Following borrow source approval, tests shall be performed once per 5,000 cy of material or when material changes are observed by the CQA Consultant.

B. Pipe and Manhole Bedding

1. The CONTRACTOR shall furnish and place bedding fill beneath piping to the springline of the pipe or structures in addition to that required under other sections. This material shall be placed at such locations as shown on the Drawings and as the CQA Consultant shall specifically order in writing to replace material unsuitable for the foundations of the pipe or structure or to increase the load carrying

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capacity of the pipe. It shall also be used to refill over excavations by the CONTRACTOR.

2. The material shall conform to the requirements specified in PADOT Specifications 703.2(c), Table C AASHTO Number 8. Test data on the proposed material shall be submitted to the CQA Consultant for approval prior to use and at least one week in advance of its use. A minimum of two tests shall be performed.

C. Topsoil

1. The topsoil material shall consist of imported or on-site soil that is capable of supporting vegetative growth, free of any metals, trees, stumps, concrete, construction debris, or any other deleterious material, and meet the requirements specified in PADOT Specifications for topsoil. Topsoil from on-site sources will have been excavated (as described in Sections 02110 and 02200) and stored on-site before spreading.

2. If on-site sources of topsoil are depleted, off-site sources conforming to the above requirements shall be identified by the CONTRACTOR at no cost to the OWNER.

PART 3 EXECUTION

3.01 INSPECTION

A. The CONTRACTOR shall provide the CQA Consultant with sufficient time and means to examine the areas and conditions under which excavating, filling, and grading are to be performed. The CQA Consultant will examine the areas and conditions under which excavating, trenching, filling, and grading are to be performed and notify the CONTRACTOR of conditions he may find that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 SITE PREPARATION

A. All areas to be occupied by permanent construction or embankments shall be cleared of all trees, brush, roots, stumps, logs, wood, and other materials and debris. Subgrades for fills and embankments shall be cleaned and stripped of vegetation, sod, topsoil, and organic matter.

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3.03 STRUCTURAL FILL PLACEMENT

A. The subgrade, berms, access roads, and other features requiring structural fill shall be constructed to the lines and grades shown on the Drawings.

B. The structural fill shall meet the requirements of Part 2 of this Specification.

C. Structural fill shall be placed only on unfrozen subgrade surfaces that meet the requirements of Section 02220.

D. Structural fill is to be placed in loose lifts that results in a compacted lift thickness of six inches.

E. Each lift of structural fill shall be compacted to 90 percent maximum dry density as measured by ASTM D698. Field compaction tests shall be performed each lift at a maximum spacing of 100 linear feet.

3.04 PIPE BEDDING PLACEMENT

A. Bedding shall be spread in layers of uniform thickness not exceeding six inches and shall be thoroughly compacted with suitable power driven tampers or other power driven equipment. Special care shall be taken when placing pipe bedding to ensure continuous and thorough compaction.

B. Pipe shall be protected from lateral displacement or damage resulting from superimposed backfill loads, impact of unbalanced loading during backfill operations by being adequately embedded in suitable pipe embedment materials.

3.05 TOPSOIL PLACEMENT

A. The topsoil material shall be placed directly on top of either existing and previously disturbed subgrade, or structural fill as shown on the construction drawings.

B. Topsoil shall be placed loosely using tracked earthwork equipment to provide a suitable surface for seedbed preparation.

C. The topsoil layer shall have a minimum thickness of 6 inches or the depth of existing topsoil if it was greater than 6 inches prior to construction, and prepared in accordance with Section 02925 - Fertilizing and Seeding.

3.06 SURVEYING AND CONSTRUCTION TOLERANCES

A. The CONTRACTOR shall retain a licensed Surveyor (Certifying Surveyor) who shall be responsible for all surveying associated with the CONTRACTOR'S work. All

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surveying shall be performed in accordance with Section 01050 of these Specifications.

B. The CONTRACTOR shall construct the cover systems to the tolerances given in Section 01050 of these Specifications.

C. The Certifying Surveyor shall prepare as-built documentation for all earthworks in accordance with the requirements and schedule given in Section 01050 of these Specifications.

3.07 PROTECTION OF WETLANDS

A. Disturbance to wetlands shall be minimized. Excavation shall be kept to an absolute minimum and access to areas in wetland shall be by equipment suitable to travel and not disturb low strength saturated soils.

B. All work in wetlands shall be in accordance with Section 01565 - Protection of Wetlands.

3.08 PROTECTION OF WORK

A. The CONTRACTOR shall use all means necessary to protect all prior work, including all materials and completed work of other sections.

B. In the event of damage, the CONTRACTOR shall immediately make all repairs and replacements necessary to the approval of the CQA Consultant and at no additional cost to the OWNER.

END OF SECTION

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SECTION 02220

EXCAVATION AND SUBGRADE PREPARATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform excavation of unconsolidated surface soils and preparation of site subgrade soils as a foundation for placement of fill material or other structures/facilities. All work shall be performed as specified herein, as shown on the Drawings, or as necessary for a complete installation.

B. Work described in this section includes (but is not limited to) preparation of subgrade for placement of fill, other structures/facilities excavation, excavation for storm water drainage systems, and site dewatering (if needed). Work in this section does not include placement of any earth fill material.

1.02 RELATED SECTIONS

A. Section 10500 - Contractor Field Engineering

B. Section 01500 - Construction Facilities and Temporary Controls

C. Section 01565 - Protection of Wetlands

D. Section 02110 - Clearing, Grubbing, and Topsoil Removal

E. Section 02200 - Earthwork

F. Section 02225 - Trenching

G. Section 02931 - Erosion Control

1.03 EXISTING CONDITIONS

A. Approximate existing site surface and subsurface conditions are indicated on the Drawings. The CONTRACTOR shall review these documents and become familiarized with the site soil and groundwater conditions as indicated in Section 02200, Section 1.06, Existing Conditions.

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PART 2 - PRODUCTS

2.01 MATERIALS

None

2.02 EQUIPMENT

A. Appropriate equipment shall be used to perform excavation and subgrade preparation.

B. Equipment shall comply with the requirements of Section 01500.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Subsurface material shall be removed from work areas to the limits and elevations indicated on the construction drawings. All excavation work shall be carried out in compliance with all appropriate federal, state, local and OSHA regulations.

B. Transport excavated soil to either an active soil construction area, as shown on the Drawings (i.e., structural fill area, etc.) or to an area previously approved by the CQA Consultant for stockpiling (borrow area).

C. Excavated material shall not be removed from site, but either placed in the stockpiles on-site or used for construction. All stockpiles shall be maintained in a neat condition with 3H:1V maximum side slopes. The CONTRACTOR shall fertilize and hydroseed any stockpile that will not be disturbed within the following three months, as directed by OWNER.

D. The CONTRACTOR shall provide all equipment and personnel needed to keep excavations free of surface water.

E. The CONTRACTOR shall proof roll the bottom of excavations in the presence of the CQA Consultant to identify any soft or loose areas. Soft areas shall be excavated and the excavation backfilled with structural fill material, as described in Section 02200 - Earthwork.

F. The CONTRACTOR shall perform all excavation required to complete the Work as shown and specified. Excavations shall include earth, sand, clay, gravel, hardpan, boulders, rock, pavements, rubbish, refuse material, and all other materials within the excavation limits.

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G. Excavations for structures and pipelines shall be open excavations, shored and braced where necessary to prevent possible injury to workmen and to new and existing structures or pipelines. Side slopes of excavations and shoring and bracing shall comply with the requirements of OSHA.

H. Where the structure or pipeline is to be placed below the groundwater table, dewatering shall be used to permit construction of said structure or pipeline under dry conditions. Water level shall be maintained below top of backfill at all times. Where dewatering is required, the CONTRACTOR shall provide adequate methods to the CQA Consultant for approval. CONTRACTOR shall perform dewatering required at no additional cost to OWNER.

I. Subgrades for roadways, structures, and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with gravel. The finished elevation of established subgrades shall not be above subgrade elevations shown.

J. Stability of Excavations: All excavation work shall be carried out in compliance with all OSHA regulations, as well as any other applicable regulations. The CONTRACTOR shall maintain sides and slopes of excavations in a safe condition until completion of backfilling.

K. Where the existing material beneath pipe bedding material is considered unsuitable by the CQA Consultant, the CONTRACTOR shall remove and replace it with structural fill.

L. All excavation outside the lines and grades shown, and which is not approved by the CQA Consultant, together with the removal and disposal of the associated material, shall be at the CONTRACTOR'S expense. The unauthorized excavation shall be filled and compacted with select backfill by the CONTRACTOR at no additional cost to the OWNER.

M. At all times during construction the CONTRACTOR shall provide and maintain proper equipment and facilities to remove all water entering excavations, and keep such excavations dry so as to obtain a satisfactory subgrade to allow construction. Drainage shall be disposed of only in an area approved by the CQA Consultant. Drainage shall be disposed of in a manner approved by the CQA Consultant. Drainage shall be disposed of in a manner

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which prevents flow or seepage back into the excavated area. All work and equipment necessary to remove water from the CONTRACTOR'S construction area shall be performed and obtained at no cost to the OWNER.

N. Handling, containerizing, characterizing, and disposal of water shall be in accordance with applicable federal, state, and local regulations and laws.

3.02 SUBGRADE PREPARATION

A. Subgrade shall be prepared as needed to make subgrade suitable, as approved by the CQA Consultant, as a foundation for placement and compaction of the subsequent lift of material or structure.

B. In areas where dewatering is required, the CONTRACTOR shall take measures to remove water from the subgrade in a manner that presents loss of material and disturbance to proposed bearing surfaces. Resulting subgrade surface shall be free of standing water and shall be suitable as a foundation for compaction of fill material or other construction, as determined by the CQA Consultant. Maintain all dewatered areas in such a condition until the subsequent lift of material is placed or construction completed in the area.

C. All on-site surface water shall be managed as described in Section 02931 - Erosion Control.

3.03 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations shall be hauled to an area on-site designated by the OWNER. The stockpiling of excavated materials on-site shall be in a manner satisfactory to the CQA Consultant. All excavated materials stockpiled on-site shall be tested in accordance with federal and state requirements for characterization of soils for disposal including but not limited to, Toxicity Characteristics Leaching Procedure (TCLP) as defined in 40 CFR 261 at a minimum. Disposal of soils classified as waste shall be in accordance with the specifications outlined in Section 3.04 - Disposal of Excavated Waste Materials in this specification. Material not classified as waste which meets the requirements for fill may be used as backfill.

B. The CONTRACTOR is advised that the disposal of excess excavated material in wetlands, stream corridors, and flood plains is strictly prohibited even if the permission of the property OWNER is obtained. CONTRACTOR will be brought to the immediate attention of the responsible regulatory agencies with a request that appropriate action be taken against the CONTRACTOR.

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Further, the CONTRACTOR will be required to remove the fill at his own expense and restore the area impacted.

C. The CONTRACTOR shall be aware that permitting agencies are concerned about the erosion of wind and water of excess excavated materials disposed of on private lands by the CONTRACTOR. When obtaining releases from private land OWNERS, the CONTRACTOR shall include a statement from the land OWNER that he has been apprised by the CONTRACTOR of this need for erosion control and accepts complete responsibility for its implementation.

3.04 DISPOSAL OF EXCAVATED WASTE MATERIALS

A. CONTRACTOR shall test, containerize, handle, transport, and dispose of waste material off-site in accordance with applicable federal, state, and local laws and regulations.

B. CONTRACTOR shall submit the name and location of disposal facilities to be used and shall obtain approval of such facilities by the OWNER prior to off-site disposal.

3.05 PROTECTION OF WETLANDS

A. Work in Wetlands shall be in accordance with Section 01565 - Protection of Wetlands.

3.06 TEMPORARY FENCING

A. The CONTRACTOR shall furnish and install a temporary fence surrounding his excavations and work area. It shall have openings only at vehicular, equipment, and pedestrian access points.

B. The fence shall be a snow fence type enclosure, 48 inches tall, and constructed of vertical hardwood slats measuring 1-1/2 by 1/4-inch interwoven with strands of horizontal wire. Posts shall be of steel, either U, Y, T, or channel section, and shall have corrugations, knobs, notches, or studs so placed and constructed as to engage a substantial number of fence line wires in the proper position. Posts shall have tapered anchors weighing 0.67 pounds or more, each firmly attached by means of welding, riveting, or clamping. Posts shall have a nominal weight of 1/3 pound per linear foot exclusive of the anchor. Each post shall be furnished with a sufficient number of galvanized wire fasteners or clamps, of not less than 0.120 inch in diameter for attaching fence wire to the post.

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3.07 SURVEYING AND CONSTRUCTION TOLERANCES

A. The CONTRACTOR shall retain the certifying Surveyor who shall be responsible for all surveying associated with the CONTRACTOR'S work. All surveying shall be performed in accordance with Section 01050 of these Specifications.

B. The CONTRACTOR shall perform all excavation and subgrade preparation to the tolerances given in Section 01050 of these Specifications.

C. The certifying Surveyor shall prepare as-built documentation in accordance with the requirements and schedule given in Section 01050 of these Specifications.

3.08 PRODUCT PROTECTION

A. The CONTRACTOR shall use all means necessary to protect all prior work, including all materials and completed work of other Sections.

B. In the event of damage, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the CQA Consultant and at no additional cost to the OWNER.

END OF SECTION

ORIGINAL (Red)

SECTION 02225

TRENCHING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment to perform all trenching work as specified herein, as shown on the Drawings and as necessary for a complete installation.

B. The CONTRACTOR shall be prepared to construct all trenches in conjunction with other aspects of the work.

C. Work of this section includes (but is not necessarily limited to) trenching and backfilling for groundwater extraction and treatment plant discharge piping.

1.02 RELATED SECTIONS

A. Section 01565 - Protection of Wetlands

B. Section 02200 - Earthwork

C. Section 02220 - Excavation and Subgrade Preparation

D. Section 02700 - Pipe, Fittings, and Related Materials

PART 2 PRODUCTS

2.01 EXCAVATED MATERIALS

A. Excavated materials shall be used as backfill within trenches and excavations when possible for groundwater extraction and treatment plant discharge piping, with prior approval by the CQA Consultant.

2.02 PIPE COLLARS

A. Pipe collars installed on buried pipe located in wetlands shall be 100 mil high density polyethylene (HDPE) pipe boots sized to prevent seepage within the wetland and as shown on the Contract Drawings.

PART 3 EXECUTION

3.01 PREPARATION

A. The CONTRACTOR shall identify required lines, levels, contours, and datum.

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B. The CONTRACTOR shall maintain and protect existing utilities, which may pass through the work area.

C. The CONTRACTOR shall protect bench marks and existing structures from excavation equipment and vehicular traffic.

D. Protect above and below grade utilities which are to remain.

E. Pipe Trench Preparation

1. No more than 100 feet of trench may be opened in advance of pipe laying.

2. Trench width shall be minimized to greatest extent practical but shall conform to the following:

a. Sufficient to provide room for installing, jointing, and inspecting piping, but in no case wider at top of pipe than pipe barrel O.D. plus 2 feet.

b. Enlargements at pipe joints may be made if required and approved by the CQA Consultant.

c. Sufficient for sloping and dewatering.

d. Sufficient to allow thorough compacting of backfill around the pipe.

e. Do not use excavating equipment which requires the trench to be excavated to excessive width.

3. Depth of trench shall be as indicated. If required and approved by the CQA Consultant, depths may be revised.

3.02 EXCAVATION

A. Excavate subsoil to the depth required for placement of piping.

B. Cut trenches sufficiently wide to enable installation of piping and to allow inspection; dewater trench if necessary.

C. Soft or loose areas shall be excavated and backfilled with either pipe bedding material or structural fill in accordance with Section 02220. Loose matter shall be removed from the excavation and stockpiled in the preapproved stockpile area.

D. Correct unauthorized or mistaken excavation at no cost to the OWNER.

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3.03 PROTECTION OF WETLANDS

A. Trenching in wetland areas shall be in accordance with Section 01565 - Protection of Wetlands.

B. Pipe seep collars shall be installed and spaced at 40 foot centers maximum.

C. Pipe collars shall be sized a minimum of six inches in width and in height greater than the area of the trench backfilled with granular bedding material.

D. Pipe collars shall extend into undisturbed earth a minimum of three inches on both sides and a minimum of three inches into the bottom of the trench and above the pipe bedding material at each location.

E. CONTRACTOR shall submit and obtain approval from CQA Consultant on method of backfill to be used around collars extending into undisturbed earth.

F. Pipe boots must be sized to fit snug around piping.

G. The CONTRACTOR shall use lightweight trenching equipment in wetland areas that is capable of being supported on saturated low strength soils without disturbing the ground surface.

H. No access road construction will be allowed to facilitate pipe construction.

3.04 BACKFILLING

A. Trenches shall be backfilled to contours and elevations with unfrozen materials. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

B. Pipe Bedding: Pipe bedding material to meet the requirements of Section 02200-Earthwork. Place and compact in continuous layers simultaneously on both sides of pipe. Place in lifts not exceeding 6 inches compacted thickness until entire pipe is covered with pipe bedding material.

C. Structural Fill: Place and compact in continuous layers over the pipe bedding to the top of the trench and/or compact to the specific requirements as specified in 3.03B of Section 02200-Earthwork.

D. The CONTRACTOR shall employ a placement method that does not disturb or damage piping in the trench. Do not use heavy compaction equipment over piping or culverts that are covered by less than 1 ft of backfill material.

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E. Surplus backfill materials shall be removed to an approved stockpile area as shown on the Drawings if material will not be used for further construction.

3.05 TOLERANCE

A. Top Surface of Trench Backfill: Plus or minus 0.10 ft from required elevations.

3.06 SAFETY PROVISIONS

A. All trenching shall be performed in strict accordance with OSHA and all other applicable laws and regulations.

END OF SECTION

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SECTION 02271

RIP-RAP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The work shall consist of furnishing all labor, tools, transportation, materials, supervision and installation equipment to perform rip rap work as specified herein, as shown on the Drawings, and as necessary for a complete installation.

B. The work shall be done in accordance with Commonwealth of Pennsylvania, Department of Transportation (PADOT) Specifications, Publication 408 and Erie County Conservation District, Erosion and Sediment Control Guidelines.

1.02 RELATED SECTIONS

A. Section 01565 - Protection of Wetlands

B. Section 02200 - Earthwork.

C. Section 02220 - Excavation and Subgrade Preparation

1.03 SUBMITTALS

A. Name and location of the source material.

B. Samples and test reports of the material including gradation and stone size weight.

PART 2 - PRODUCTS

2.01 MATERIAL

A. The material shall be sound, tough, and durable stone, not lumpy or frozen, and free from slag, cinders, ashes, rubbish, or other deleterious material. The Rip-Rap shall have a D_{50} (size which 50 percent of stones by weight are smaller than) and/or minimum stone size weight, as indicated on the Contract Drawings.

B. The soundness of the material shall be in accordance with PADOT æ 850-Rock Lining.

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2.02 STONE SIZING

A. All stones used for Rip-Rap shall have a D_{50} equal to 3 inches and/or a stone size weight of 165 pcf.

PART 3 - EXECUTION

3.01 PLACING

A. The surface on which stones are to be placed shall be free of brush, trees, stumps, and other objectionable materials.

B. Rip-Rap shall be placed with a minimum thickness of 12 inches. Lateral placement of rip-rap shall be in accordance with dimensions provided on the Drawings.

C. The stones shall be placed so that the weight of the stone is carried by the underlying material and not by the adjacent stones. On slopes, the largest of stones shall be at the bottom. Rip-Rap shall be of proper size as shown on drawings to form a compact solid blanket to protect the slopes.

D. Rip-Rap may be placed in location by equipment; however, care shall be taken in placing to obtain a good gradation of materials so that the Rip-Rap will be firm and solid. Surfaces shall be leveled to the required alignment and slopes by hand placing the stone so as to fill large voids and to make the surface even.

E. Protection of wetlands shall be performed in accordance with Section 01565 - Protection of Wetlands.

END OF SECTION

ORIGINAL (Red)

SECTION 02600

IN SITU VAPOR STRIPPING EXTRACTION WELLS AND TEMPERATURE PROBES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Work of this section includes mobilization, setups, boreholes, casings, screens, pea gravel, bentonite seal, water for construction, and miscellaneous, associated work to complete the installation of in situ vapor stripping (ISVS) extraction wells, the toe area horizontal extraction pipe, and the temperature probes as specified herein, as directed by the CQA Consultant, and as shown on the Drawings.

B. Perform the work of this section in conjunction with the other components of the project.

1.02 RELATED SECTIONS

A. Section 01050 - Contractor Field Engineering

B. Section 02110 - Clearing, Grubbing, and Topsoil Removal

C. Section 02225 - Trenching

D. Section 02700 - Pipe, Fittings, and Related Materials

E. Section 15971 - Control Systems-Barber Colman Network 8000

F. Section 15971A - Appendices to Section 15971

G. Section 16400 - Electrical

1.03 REFERENCES

A. Prefinal Design Submission, Volume I, Engineering Report, ECKENFELDER INC., November 1993.

B. All applicable federal, state, and local rules and regulations.

C. ANSI/ASME - Section 8D - Pressure Vessels

D. ANSI/AWWA A100 - Standard for Wells

E. ASTM D1785 - Standard Specification for PVC pipe Schedules 40, 80, and 120.

ORIGINAL (Red)

F. NEMA MG 1 - Motors and Generators

G. Commonwealth of Pennsylvania, Department of Transportation (PADOT), Specifications, Publication 408, 1990, or the latest edition.

H. Project Construction Quality Assurance Plan (CQAP).

1.04 SUBMITTALS

A. Submit laboratory test results for pea gravel grain-size analysis to the CQA Consultant.

B. Submit samples, as requested by the CQA Consultant for the materials to be used for the well construction.

C. Submit proposed methods of compaction to the CQA Consultant for approval.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately survey location and ground surface elevation of well.

B. Accurately record depth, subsoil strata, and drilling difficulties encountered.

C. Submit signed copy of driller's log book statements.

D. Submit log of Drilling and Well Log:

1. Keep accurate geologic records; record depth of top and bottom of each stratum.

2. Submit records to CQA Consultant; show material encountered, depth drilled, casing placed, grouting completed, and other pertinent data requested by the CQA Consultant.

E. Measure depth from existing ground surface at well site. Set reference point to establish datum.

F. Measure and record each size of hole or type of construction completed.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ANSI/AWWA A100.

B. Perform work in accordance with the project CQAP.

ORIGINAL (Red)

1.07 QUALIFICATIONS

A. Drilling firm: Company specializing in performing the work of this section with minimum of 10 years of documented experience.

B. Submit proof of Pennsylvania license to perform this work.

1.08 REGULATORY REQUIREMENTS

A. Conform to all applicable federal, state, and local regulations for construction of wells.

PART 2 PRODUCTS

2.01 MATERIALS

A. Well Casing (PVC): ASTM A53 4-inch internal diameter Schedule 40 flush joint.

B. Well Screen (PVC): 4-inch inner diameter, from Schedule 40 flush jointed. Machine-slotted PVC well screen with a slot size of 0.020 inches.

C. Well Screen End Plug (PVC): Schedule 40, flush-threaded joint.

D. Pea Gravel:

1. Pea Gravel: clean, washed, pea-gravel composed of well-rounded grains that are smooth and uniform and shall, at a minimum, meet the requirements set forth in PADOT specifications § 703.2(c), Table C, AASHTO #8. Submit alternate materials for consideration by the Design Engineer.

2. Place pea gravel in annular space between borehole and well screen from bottom of borehole to elevation shown on the Drawings, and as determined by the CQA Consultant on site.

E. Bentonite Seal:

1. Bentonite chips or pellets.

2. Place bentonite seal in annular space between borehole and well screen from top of gravel pack to elevation as determined by the CQA Consultant in the field.

3. Place bentonite seal in uniform and continuous operation by tremie pipes, or by pumping to ensure proper placement.

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2.02 OTHER MATERIALS

A. Geotextile: to be used in toe-area horizontal extraction pipe and ISVS main header pipe tie-in shall be 100 percent continuous filament, polyester, non-woven, needlepunched, and as manufactured by Hoechst Celanese Corporation, Trevia 1135 or Design Engineer approved equal.

B. Bedding Material: to be used in the toe-area horizontal extraction pipe and ISVS main header pipe tie-in shall be as specified in Section 2.01 (D)(1) "Pea Gravel" of this specification.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect structures near the well from damage. Damage to existing structures will be repaired and replaced at no cost to the Owner.

B. Drill a borehole in the locations shown on the construction drawings. Before drilling, excavate the soil in a five-foot diameter area centered around the proposed location to expose the existing PVC liner. Cut an opening through the existing PVC prior to drilling the borehole.

C. Care must be taken to protect and minimize any damages to the underlying PVC liner. Any damages to the existing liner shall be repaired to the satisfaction of the CQA Consultant and at no additional cost to the Owner.

D. Store the excavated material on site at a location acceptable to the Owner and in a manner approved by the CQA Consultant.

3.02 DRILLING

A. Drill 12-inch diameter borehole, using a hollow steam method. Drill borehole to top of groundwater table or to the bottom of waste, whichever is higher. Drill well to depth determined by the CQA Consultant.

B. Collect continuous split-spoon samples from ground surface to the bottom of each boring, using a two-foot long, two-inch inner diameter split-spoon sampler. Place soil samples into glass jars labeled with well identification and sample depth. The CQA Consultant shall visually classify soil using the Burmister method to describe each sample.

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C. Lower casing, screen, and end fitting cap inside the auger to the bottom of the borehole. The well screen length is anticipated to be approximately 5-feet. The final depth of the screen will be determined by the CQA Consultant.

D. For the ISVS Extraction wells, suspend the casing. Place the pea gravel material in the annular space from the bottom of the borehole to 12 inches above the top of the screen, place a 12-inch bentonite seal in the annular space above the pea-gravel and fill the space between the top of bentonite seal to the bottom of the existing clay cap layer with pea gravel. Fill the remainder of the annular space to the bottom of the existing geomembrane with bentonite.

E. For the temperature probes, suspend the casing. Place the pea-gravel material in the annular space from the bottom of the borehole to 12-inches above the top of the screen, and place bentonite seal in the annular space above the pea gravel to the existing PVC geomembrane.

F. Dispose of soil cuttings in 55-gallon drums to be provided by the Contractor. Place drums at the site in accordance with the Owner's direction. The Contractor shall be responsible for testing and disposal of soil cuttings at an approved facility. The Contractor shall comply with applicable federal, state, and local regulations for disposal of the soil.

G. Fabricate boots or use other seaming methods acceptable to the Design Engineer, so that the PVC geomembrane will fit snugly and seal easily to the well casing penetrations through the existing PVC liner.

H. Fill the excavated area, above the liner with the excavated material, as discussed in Section 3.01 D of this specification, and compact for visual observation by the CQA consultant for non-movement.

3.03 ALIGNMENT

A. Construct borehole and set well casing plumb and true to line.

B. Check for plumbness and alignment in presence of the CQA Consultant; test after completion of well.

C. Plumbness: maximum deviation: 2/3 inside diameter of well casing per 100 feet of depth.

D. Alignment: Check well casing alignment during construction; correct misalignment of welded or coupled joints prior to installation.

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E. If plumbness or alignment fail to meet specifications, correct at no expense to Owner.

3.04 ABANDONMENT

A. If boreholes or wells fail to conform to specifications for plumbness and alignment or in event driller is unable to construct boreholes or wells to depth specified, abandon well.

B. Construct boreholes or wells at points designated by the CQA Consultant; no payment will be made for abandoned wells, as determined in Section 3.04A.

C. Salvaged materials may be used in new wells if not damaged and suitabley decontaminated.

D. Abandon wells by removing casing and screen, fill with pea gravel to the bottom of the existing clay cap. Fill from the bottom of the clay to the top of clay cap with bentonite. Fill the excavation as discussed above in Section 3.02 G and H of this specification.

3.05 DECONTAMINATION OF DRILLING EQUIPMENT

A. Decontamination pad to be provided by Driller and staged in an area on site with prior approval of the Owner.

B. Drilling equipment shall be steam cleaned prior to mobilizing to the site and before leaving the site.

C. Drilling equipment which comes in contact with the soil will be decontaminated by steam cleaning prior to use in each borehole.

D. The Contractor shall collect, test, and dispose of washwater in accordance with applicable federal, state, and local regulations. The Contractor shall provide the 55-gallon drums.

[END OF SECTION]

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SECTION 02610

INSTALLATION OF GROUNDWATER RECOVERY WELLS AND OBSERVATION WELLS AND SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Work of this section includes mobilization, setups, boreholes, casings, screens, gravel and sand filter packs, bentonite seal, cement grout, water for construction, and miscellaneous associated work to complete the installation of Groundwater Recovery (GWR) and observation wells as specified herein, as directed by the CQA Consultant, and at locations as shown on the design drawings. Work also includes installation of pump, motor, level controls, and discharge head assembly at the selected borehole locations.

B. Select GWR wells by the "Observational Approach". The observational method of GWR well installation will be used to test the performance of installed wells and to optimize well locations, and is a means of dealing with the uncertainties associated with complicated, heterogeneous flow systems existing at the project site.

C. The Contractor shall be prepared to perform the work of this section in conjunction with the other components of the project.

D. The roles of the CQA Consultant, Design Engineer, and Contractor, regarding the execution of this scope of work, are identified and described in the project Construction Quality Assurance Plan

1.02 RELATED SECTIONS

A. Section 01050 - Contractor Field Engineering

B. Section 01565 - Protection of Wetlands

C. Section 02110 - Clearing, Grubbing, and Topsoil Removal

D. Section 02225 - Trenching

E. Section 02700 - Pipe, Fittings, and Related Materials

F. Section 15971 - Control Systems - Barber Colman Network 8000

G. Section 15971A - Appendices to Section 15971

H. Section 16400 - Electrical

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1.03 REFERENCES

A. Prefinal Design Submission, Volume I, Engineering Report, ECKENFELDER INC., November 1993.

B. All applicable federal, state, and local rules and regulations.

C. ANSI/ASME - Section 8D - Pressure Vessels

D. ANSI/AWWA A100 - Standard for Wells

E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

F. ASTM D1785 - Standard Specification for PVC pipe Schedules 40, 80, and 120.

G. ASTM D 5092-90 - Standard Practice for Design and Installation of Groundwater Observation Wells in Aquifers.

H. NEMA MG 1 - Motors and Generators

I. Commonwealth of Pennsylvania, Department of Transportation, Specifications, Publication 408, 1990, or the latest edition.

J. Project Construction Quality Assurance Plan

1.04 SUBMITTALS

A. Submit grain-size curve for primary and secondary filter pack materials.

B. Submit pump tests results to the CQA Consultant.

C. Submit samples, as requested by the CQA Consultant, for the materials to be used for the well construction.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately survey location and record ground surface elevation of boring/well, and elevation of end of well head.

B. Accurately record depth, subsoil strata, and drilling difficulties encountered.

C. Submit signed copy of driller's log book statements.

D. Submit log of Drilling and Well Log:

1. Keep accurate geologic records; record depth of top and bottom of each stratum.

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2. Submit records to CQA Consultant; show material encountered, depth drilled, casing placed, grouting completed, water level in well, and other pertinent data requested by the CQA Consultant.

3. File copies of Driller's Log with Agencies, as required.

E. Measure depth from existing ground surface at well site. Set reference point to establish datum.

F. Measure and record each size of hole and type of construction completed.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ANSI/AWWA A100.

B. Perform work in accordance with project CQAP.

1.07 QUALIFICATIONS

A. Drilling firm: Company specializing in performing the work of this section with minimum of 10 years of documented experience.

B. Submit proof of applicable license or certification to perform this work.

1.08 REGULATORY REQUIREMENTS

A. Conform to all applicable federal, state, and local regulations for construction of GWR and observation wells.

1.09 OBSERVATIONAL APPROACH TO RECOVERY WELL INSTALLATION

A. Prepare to interface with various on-site Quality Assurance (QA) procedures and personnel during the work of this section.

B. Mobilize test boring/observation well drilling equipment.

C. Renovate existing observation wells/piezometers, if needed.

1. Renovation shall include the following:

a. Re-development

b. Repair of protective casing.

c. Repair of protective concrete pad.

d. Replacement of well cap.

e. Replacement of observation well/piezometer.

D. Installation of observation well/piezometer:

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1. All to be constructed in accordance with ASTM D 5092-90 and with flush joint PVC. "*" denotes intermediate zone wells that will require a secondary steel casing.

   a. 2 - Observation well couplets (W-40A, W-40B, W-41A, W-41B*)

   b. 2 - Intermediate zone observation wells (W-42B, W-43B)

   c. 1 - "Plume" couplet observation well (W-44A, W-44B)

   d. 1 - "Perimeter-Detection" observation well couplet (W-45A, W-45B)

E. Test Borings:

1. Drill 17 borings at 50-foot intervals along the northern property line, with continuous (2-foot intervals) split spoon sample collection. The depth of the test boring shall be determined by the CQA Consultant.

2. Drill 3 borings at 50-foot intervals at each of two (2) targeted areas for intermediate zone perimeter recovery wells (IPE-2, IPE-3) with continuous (2-foot intervals) split spoon sample collection. The depth of the test boring shall be determined by the CQA Consultant.

3. Grout test borings.

4. Drill additional test borings as directed by the CQA Consultant (if needed) to supplement previous test borings prior to selecting boring locations for the installation of wells.

5. Perform grain size analyses of split spoon samples from each of the borings.

F. Mobilize recovery well drilling equipment.

G. Install the intermediate zone plume recovery well within boring selected by CQA Consultant (IPL-2).

H. Install two intermediate zone perimeter recovery wells (IPE-2, IPE-3).

I. Prepare for Pump Test:

1. Install pumps

2. Install temporary piping

3. Install flow meters

J. Conduct Pump Test:

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J. Conduct Pump Test:

1. Simultaneously pump the three (3) new recovery wells (IPL-2, IPE-2, IPE-3) and existing well (IPE-1).

2. Continue test until stabilized cone of depression is observed (> 1 week).

K. If required by the CQA Consultant, perform the following.

1. Install additional observation wells.

2. Install additional recovery well, by the following sequence of tasks:

a. Drill additional test borings.

b. Install additional recovery wells.

c. Conduct pump tests on <u>all</u> recovery wells.

3. Repeat aforementioned steps, until the lateral bound of the plume is defined and/or pump test indicates a sufficient zone of capture is achieved, as determined by the CQA Consultant.

PART 2 PRODUCTS

2.01 GWR WELL MATERIALS:

A. Well Casing:

1. Final lengths and elevations: as directed by CQA Consultant to conform with conditions encountered in drilling.

2. Casing pipe: new, Schedule 40 black steel pipe, ASTM A53, 6-inch diameter.

3. Place centralizers every 15 feet and with ventilated well cap.

4. Casing pipe may be welded or coupled to produce watertight connections.

5. Welded joints: bevel ends of pipe for welding; provide brace to insure proper alignment; weld in accordance with American Welding Society Standards.

6. Coupled joints: pipe threaded and couplings taper tapped with API threads; recessed couplings; ship with thread protectors and check tightness of factory-placed couplings.

7. Place casing pipe plumb; use centering guides to center casing pipe in borehole.

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8. Extend casing pipe from bottom of borehole to top of casing elevation shown on plans; weld 0.375-inch thick steel plate to bottom of casing.

9. Tap and drill well casings and install PVC drain line before grouting as shown on plans.

B. Well Screen:

1. Well Screen (Stainless Steel): Corrosion-resistant type 304 stainless steel continuous-slot, wire-wrapped screen, 6-inch inner diameter

2. Well Screen End Fittings (stainless steel): Corrosion-resistant type 304 stainless steel.

3. Provide welding rings at top and bottom of screen; weld screen to casing pipe.

4. Use centering guides to center screen in borehole.

5. Slot size, depth, and length of screen will be determined by the CQA Consultant after evaluation of sample of water-bearing strata and selection of primary filter pack.

6. Submit calculations and recommendations on slot size to CQA Consultant for review and approval.

C. Primary Filter Pack:

1. Primary filter pack shall consist of uniformerly graded, hard durable siliceous particles, washed and screened with a uniformity coefficient of approximately 2.5 or less.

2. Size and gradation of primary filter pack will be selected after evaluation of samples of water-bearing strata; submit sieve analysis, calculations and recommendations to CQA Consultant for review.

3. Place primary filter pack in annular space between borehole and well screen from bottom of borehole to elevation shown on the drawings and as determined by the CQA Consultant on site.

4. Place primary filter pack in uniform and continuous operation by tremie pipes or by pumping to insure proper placement.

D. Secondary Filter Pack:

1. The secondary filter pack shall be uniformly graded sand with a 100 percent by weight passing the No. 30 U.S. Standard sieve, and less than 20 percent by weight passing the 200 U.S. Standard sieve.

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2. Place secondary filter pack in annular space between borehole and well screen from top of gravel pack to elevation as determined by the CQA Consultant in the field.

3. Place secondary filter pack in uniform and continuous operation by tremie pipes, or by pumping to ensure proper placement.

E. Bentonite Seal:

1. Bentonite shall be chipped or pelleted sodium montmorillionite and free of impurities and additives, with a diameter less than one-fifth the width of the annular space.

2. Place bentonite seal in annular space between borehole and well screen from top of sand filter pack to elevation as determined by the CQA Consultant in the field.

3. Place bentonite seal in uniform and continuous operation by tremie pipes, or by pumping to ensure proper placement.

F. Cement/Bentonite Grout:

1. Grout: portland cement ASTM C150 mixed with sand in equal parts; maximum water content 7 gallons per 94-pound bag of cement.

2. Bentonite clay up to 3 to 6 percent by weight of portland cement may be added to increase fluidity.

3. Provide cement/bentonite grout in annular space between borehole and well casing from top of bentonite seal to elevation as determined by the CQA Consultant in the field.

4. Place cement/bentonite grout by pumping through grout pipe (e.g., using the tremie method) installed in annular space between borehole and well casing.

5. Extend grout pipe to bottom of annular space initially, and keep end submerged in cement grout during placement of grout.

6. Place grout in continuous operation to insure proper sealing.

7. Allow three days for cement/bentonite grout curing before resuming well construction operations.

G. Water:

1. Water to be used in drilling process, to prepare grout mixtures, and to decontaminate the well screen, riser, and annular sealant injection equipment shall be free of constituents that can compromise the integrity of the well installation.

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2.02 OBSERVATION WELL MATERIALS

A. Well Casing:

1. Final lengths and elevations: as directed by the CQA Consultant to conform with conditions encountered in drilling.

2. Casing Pipe:

   a. Single casing: new Schedule 40 PVC Pipe flush threaded, ASTM D 1784, 2-inch nominal diameter.

   b. Double casing:

      i. Inner casing: new Schedule 40 PVC Pipe flush threaded, ASTM D 1784, 2-inch nominal diameter.

      ii. Outer casing: new Schedule 40 black steel pipe, ASTM A53, 6-inch nominal diameter.

3. Place centralizers every 15 feet and with ventilated well cap.

4. Casing pipe may be welded or coupled to produce watertight connections.

5. Welded joints: bevel ends of pipe for welding; provide brace to insure proper alignment; weld in accordance with American Welding Society Standards.

6. Coupled joints: pipe threaded and couplings taper tapped with API threads; recessed couplings; ship with thread protectors and check tightness of factory-placed couplings.

7. Place casing pipe plumb; use centering guides to center casing pipe in borehole.

B. Well Screen:

1. 2-inch nominal diameter PVC Schedule 40 pipe flush threaded, ASTM D-1784, continuous slot, wire-wrapped screen with 0.010-inch slot openings, as specified on the drawings for both single and double casing observation wells.

C. Primary Filter Pack:

1. As specified in Section 2.01-C of this specification.

D. Secondary Filter Pack:

1. As specified in Section 2.01-D of this specification.

E. Bentonite Seal:

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1. As specified in Section 2.01-E of this specification.

F. Cement/Bentonite Grout:

1. As specified in section 2.01-F of this specification.

G. Water:

1. As specified in Section 2.01-G of this specification.

2.03 PUMPS

A. Selection of submersible pumps will be made on-site by the CQA consultant based on an evaluation of the field data.

2.04 LIQUID LEVEL CONTROLS

A. Conductive liquid level controls to be used with GWR shall be as specified below and shall be able to control the pumps for preset on, off, and high-level liquid level conditions.

1. Electrodes shall be as supplied by B/W Controls, Catalog No. 6013-W6, made of 303 S.S., Type E-1S, with shield, or Design Engineer approved equal.

2. Suspension wire to be used shall be Teflon insulated, and as supplied by B/W Controls, Catalog No. 6013-SW and of required length, or Design Engineer approved equal.

3. Cord grip holder to be used shall be made of Aluminum, for 1 or 2 electrodes, supplied by B/W Controls, Catalog No. 6012-CG-2 or Design Engineer approved equal.

4. Control relays to be used with electrodes shall be intrinsically safe, with Nema-4 weatherproof enclosure, and as supplied by B/W Controls, Catalog No. 5300-SV or Design Engineer approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions will support equipment for performing drilling operations.

3.02 PREPARATION

A. Protect structures near the well from damage. Damage to existing structures will be repaired and replaced at no cost to the Owner.

B. Verify that the below-ground utilities have been marked out by the Contractor. Provide sufficient notification to local Dig Safe Agency.

3.03 DRILLING AND FORMATION SAMPLES

A. The "Observational Approach" of extraction well installation will be used.

B. Test borings will be drilled in locations proposed by the CQA Consultant.

C. A series of test borings will be drilled at the proposed locations to determine the location in which to install a GWR well.

D. Observation wells will be installed as specified in Section 1.10-D of this specification.

E. Formation samples shall be obtained by split-spoon methods in accordance with the "Tentative Method for Penetration Test and Split-Barrel Samples of Soils", ASTM D-1586-58T.

F. Secure, protect, and deliver all test-hole formation samples to the laboratory, Design Engineer, or person designated by the Owner's Representative.

G. Samples shall be sent to an approved laboratory where the following tests will be conducted:

1. Formation samples

   a. Grain-size analysis using at least five standard sieves.

   b. Determination of uniformity coefficient.

2. Water samples:

   a. The Owner's laboratory shall obtain groundwater samples and shall perform chemical analysis for the testing of all constituents deemed necessary by the regulatory agencies.

H. The Contrator shall provide 55-gallon drums, place soil cuttings in 55-gallon drums and test and dispose of soil cuttings at an approved facility.

3.04 PUMP TESTS (ONLY FOR GWR WELLS)

A. Pump tests shall be performed by the Contractor to allow the CQA Consultant to estimate zone of capture, transmissivity, storage coefficient, and specific capacity. The pump test shall continue until a stabilized cone of depression is observed by the CQA Consultant (i.e., at least seven

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consecutive days). The Contractor shall allow time for coordination of this activity with other project activities. The Contractor shall maintain a pumping rate within ± 10 percent of the initial pumping rate.

B. The discharge of the test pump will be measured by a circular orifice meter, totalizing meter, flume, or other suitable device, and the water level measured electronically or by air line or tape to the nearest 0.5 inch. Measurements of the yield and water level will be made every 30 to 60 seconds for the first 10 minutes of the test, every minute for the next five minutes, every 5 minutes from 15 to 60 minutes, every 30 minutes from 60 to 300 minutes, every hour from 300 to 1,440 minutes, and every 8 hours from 1,440 minutes to the end of the test.

C. After the pump is shut down, recovery measurements of the water level shall be made for a period equal to at least three-fourths of the pumping period or until the water level has reached the original static level. The recovery measurements shall be made at the same time intervals that measurements were made during the pumping portion of the test.

D. The discharge from pump tests shall be conveyed to the on-site groundwater treatment plant via temporary discharge piping, made of 1.5-inch nominal diameter HDPE, or approved equal. Butt-fusion welding techniques shall be used to join HDPE pipe. Butt-fusion welding shall be in accordance with manufacturer's installation directions.

3.05 WELL INSTALLATION

A. Installation of GWR Wells:

1. Each extraction well will be constructed according to American Water Works Association (AWWA) well construction standards or in accordance with ASTM D 5092. Each well screen will have a 6-inch diameter sump 3 feet in length, constructed of black steel, welded to the bottom to collect any fine-grained sand or silt which may enter the well screen.

2. Because of the heterogeneous nature of the intermediate zone (Maumee IIIb), each well will be designed according to the site-specific data collected at each well site.

3. The completion depth of each GWR well, screen position, length, and slot size of the screen will be determined by the CQA Consultant based on the split-spoon soil sample analysis, from the entire depth of the aquifer.

4. Each of the well screens will have a sufficient length of 6-inch diameter black steel riser welded to the well screen to reach the land surface.

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5. Primary and secondary pack material, as specified in Section 2.01 and 2.02, will be slowly poured into the annulus until it extends, as specified on the drawings, above the top of the well screen. Periodically during the placement of the packs, measuring tape will be lowered down the annulus to confirm that the pack is reaching the desired location.

6. Once the primary and secondary packs are confirmed to extend the specified height above the top of the screen, bentonite pellets will be emplaced into the annulus as specified on the drawings. Again, periodically during the placement of the bentonite pellets a measuring tape will be lowered down the annulus to ensure the pellets have reached their desired location and that they have not breached the annulus at a higher location.

B. Installation of Observation Wells:

1. Each observation well be constructed in accordance with ASTM D-5092 specifications.

3.06 ALIGNMENT

A. Construct borehole and set well casing plumb and true to line.

B. Check for plumbness and alignment in presence of the CQA Consultant; test after completion of well.

C. Plumbness: maximum deviation: 2/3 inside diameter of well casing per 100 feet of depth.

D. Alignment: Check well casing alignment during construction; correct misalignment of welded or coupled joints prior to installation.

E. If plumbness or alignment fail to meet specifications, correct at no expense to Owner.

3.07 ABANDONMENT

A. If boreholes or wells fail to conform to specifications for plumbness and alignment or in event driller is unable to construct boreholes or wells to depth specified, abandon wells.

B. Construct boreholes or wells at points designated by the CQA Consultant; no payment will be made for abandoned wells, as defined in Section 3.07A.

C. Abandon wells by leaving casing and screen. If the location is not to be used in the future, abandon wells by removing casing and screen, fill with disinfected granular materials to level above primary and secondary filter packs; fill remainder with Cement/Bentonite grout.

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D. Salvaged materials may be used in new wells if not damaged and suitably decontaminated.

3.08 WELL DEVELOPMENT

A. Remove fine material at the bottom of each well using a bailer or sand pump.

B. Pump well to remove any fine-grained sand immediately surrounding the well screen. Periodically turn pump off and on to surge water through the well screen.

C. Run surge block up and down the cased section of the well above the screen. The initial surging motion should be relatively gentle, allowing any material blocking the screen to break up, go into suspension, and then move into the well. As water begins to move easily both into and out of the screen, lower the surge block in steps to just above the screen. Continue surging for several minutes, then pull the block from the well.

D. Remove any sediment from the bottom of the well with a bailer or sand pump.

E. Continue above process for approximately four to eight hours or if necessary, until the on-site CQA Consultant is satisfied that the well has reached its maximum yield.

F. The effectiveness of the well development will be monitored periodically by conducting specific capacity tests. This will be accomplished by pumping the well for a sufficient length of time for the water level in the well to stabilize. The pumping rate is then recorded along with the amount of drawdown observed.

G. When the specific capacity of the well is relatively unchanged after a development event and the well yield is reasonable for a well its size, the well development will be terminated.

3.09 DECONTAMINATION

A. Decontamination pad to be provided by Driller and staged in an area on-site with prior approval by the Owner.

B. Steam clean drilling equipment prior to mobilizing to the site.

C. Drilling equipment which comes in contact with the soil will be decontaminated by steam cleaning prior to use in each borehole.

D. The Contractor shall collect washwater in 55-gallon drums and store on-site as directed by the Owner.

[END OF SECTION]

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SECTION 02700

PIPE, FITTINGS AND RELATED MATERIALS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, tools, supervision, transportation, installation equipment and incidentals required for all the piping, valves, and fittings associated with the groundwater recovery (GWR) and treatment system, in situ vapor stripping (ISVS) extraction system, temperature probes, and groundwater treatment plant discharge as specified herein, as shown on the Drawings, and as necessary to complete the work.

B. Install this work in conjunction with the earthwork and other components of the project.

C. Supply all pipe, fittings, and any related materials associated with the GWR system within five working days after the pump tests and determination of required pipe sizes by the CQA Consultant during the observational approach to the GWR wells.

D. The work shall include procurement, installation, connection, and testing of all polyvinyl chloride (PVC) piping and related materials.

E. The work shall include procurement, installation, connection, and testing of all carbon steel (CS) piping and related materials.

F. The work shall include procurement, installation, and connections of corrugated metal pipe culverts and preparation of bedding for culverts and backfilling around and over culverts.

G. Provide all the necessary anchoring and supporting material to secure placement of the piping and to carry out the required work in a manner acceptable to the Design Engineer.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02225 - Trenching

1.03 REFERENCES

A. ASTM D-1784- Specification for rigid PVC and CPVC compounds.

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B. ASTM D-1785- Specifications for PVC pipe.

C. ASTM D-2774- Recommended practice for underground installation of thermoplastic pressure piping.

D. ANSI B31.1 - Pressure Piping Installation.

E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

1.04 WARRANTY

A. Furnish the Owner written warranties obtained from the manufacturer and the installer against defects in materials and workmanship. Warranty conditions proposed by the manufacturer or installer concerning limits of liability will be evaluated and must be acceptable to the Design Engineer and the Owner.

PART 2 PRODUCTS

2.01 PVC PIPE

A. General:

1. Pipe and fittings shall be made of polyvinyl chloride which meet or exceed the requirements of Type 1, Grade 1 per ASTM D 1784 and D 1785 (requirements for schedule 40 PVC pressure pipe).

2. The following shall be continuously indent printed on the pipe:

   - manufacturer's name
   - material designation code
   - nominal pipe size
   - schedule size with pressure rating in psi for water at 73°F
   - ASTM designation number D 1784 and D 1785, and
   - manufacturing date code

3. The pipe and fittings shall be free of foreign inclusion and visible defects.

4. The ends of the pipe shall be cut squarely and clearly so as not to adversely affect joining.

5. The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. Fittings supplied by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Design Engineer.

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6. The joints shall be made by solvent welding. Treated groundwater discharge pipe shall be gasketed bell and spigot.

2.02 GROUNDWATER RECOVERY SYSTEM

A. All pipes and fittings specified on the Drawings to be used in the GWR system are anticipated to be in the range of 1/2-inch to 1-1/2-inch nominal diameter and pipe sizes will be determined in the field by the CQA Consultant during the Observational Approach to GWR wells installation.

B. CS Pipe: The Contractor shall submit documentation to the Design Engineer which outlines the properties of the new CS pipe and the manufacturer's recommended procedures for installation, inspection, and testing of the pipe to be used in the GWR system, as shown on the Drawings.

C. PVC Pipe: As specified in Section 2.01 of this Specification.

D. Access Tube: Pipe and fittings shall be Schedule 40 PVC, 3/4-inch nominal diameter, solid, and as specified on the drawings.

E. Well Casing Vent Pipe: Pipe and fittings shall be Schedule 40 PVC, 1-inch nominal diameter, solid, and as specified on the drawings.

F. Forcemain: Pipe and fittings shall be Schedule 40 PVC, and solid.

G. Air Release Pipe: Pipe and fittings shall be Schedule 40 PVC and solid.

H. Discharge Pipe: Pipe and fittings shall be Schedule 40 PVC.

I. The transition fitting for CS pipe to PVC pipe in the GWR system shall be a 4-inch PVC Schedule 40 flanged (in accordance with ANSI standards).

J. All fittings from the GWR well bottom to transition of CS pipe to PVC pipe shall be compatible to CS or as otherwise specified on the Drawings.

2.03. ISVS EXTRACTION SYSTEM

A. Header Pipe:

1. Pipe and fittings to be used as main header pipe and crest header pipe shall be Schedule 40, PVC 4-inch

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nominal diameter, solid or slotted, and as specified on the drawings.

2. ISVS header pipe shall have a uniform slope (not less than 1 percent) as specified on the Drawings. Pipe shall either slope back to the ISVS extraction well or to the condensate tank.

B. 4-inch nominal diameter PVC Schedule 40 pipe to be used as toe-area extraction pipe, shall be slotted, slot openings 0.02-inch, and as supplied by TIMCO Mfg., Inc. or Design Engineer approved equal.

C. Culvert:

1. Corrugated Polyethylene Pipe (CPE)

a. CPE pipe shall be ADS N-12 as supplied by Advanced Drainage Systems, Inc. or Design Engineer approved equal. Pipe and fittings shall be made of polyethylene compounds which meet or exceed the requirements of Type III, Category 3, 4 or 5, Grade P33 or 34, Class C per ASTM D-1248, with the applicable requirements defined in ASTM D-1248.

b. The pipe and fittings shall be free of foreign inclusions and visible defects.

c. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining.

d. The nominal size for the pipe and fittings shall be as shown on the Drawings and is based on the nominal inside diameter of the pipe. Corrugated fittings may be either molded or fabricated by the Manufacturer. Fittings supplied by Manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Design Engineer.

e. Joints shall be made with split couplings, corrugated to engage the pipe corrugations, and shall engage a minimum of four corrugations, two on each side of the pipe joint. Where required by the Design Engineer, a neoprene gasket shall be utilized with the coupling to provide a soil-tight joint.

2.04 GROUNDWATER TREATMENT PLANT DISCHARGE PIPE

A. Pipe and fittings shall be made of polyvinyl chloride which meet or exceed the requirements of Type I, Grade 1 per ASTM D-1784 and ASTM D-2241.

B. Dimensions and tolerances shall be measured in accordance with ASTM D-2122.

C. Pipe and fittings shall be marked with the Manufacturer's name, material designation code, nominal pipe size, Schedule size with pressure rating in psi for water at 73°F, ASTM designator number D-1785, and manufacturing date code.

D. The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. Fittings supplied by Manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Design Engineer.

E. All pipes and fittings shall be two inches nominal diameter solid, as shown on the Drawings.

F. Pipe fittings and couplings shall conform to the requirements of the PVC pipe for classification and size.

G. Joint for pipe and fittings shall be elastometric type with rubber sealing gaskets in the bell sockets. Rubber gaskets for elastometric joints shall conform to ANSI/ASTM F477. The rubber gasket shall be factory installed in the pipe, fittings, and couplings.

H. The plain end of the pipe shall be marked by the manufacturer to show the depth of penetration into the bell or coupling.

I. The pipe and fittings shall be free of foreign inclusion and visible defects.

J. The ends of the pipe shall be cut squarely and clearly so as not to adversely affect joining.

K. Seep collars are presented in Section 02225 - Trenching.

2.05 VALVES AND GAUGES

A. GWR System: All valves to be used shall be flanged.

1. Air release valve to be used shall be manufactured by Val-matic Valve & Manufacturing Corp. Model No. 201-C, an air-vacuum valve for deep well service, or Design Engineer approved equal.

2. Pressure gauges to be used shall be bourdon-type with ± 2 percent accuracy, 0-160 psi range, drawn steel housing with glass window, 4.5-inch dial, and phosphor bronze bourdon tube.

3. Flowmeter/totalizer to be used shall be horizontal, non-resettable registering six digits, recommended for use with water, positive displacement, cast bronze split

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case with NPT Couplings, 32° - 100°F and 150 psi maximum pressure.

4. Globe valve to be used for flow throttling on GWR well head shall be made of bronze, in-line, maximum pressure rating of W.O.G. 200 psi and temperature rating of 450°F maximum, rising stem, screw -in bonnet.

5. Ball check valve to be used for vertical flow shall be made of CS, and for water applications.

6. Valve box shall be cast iron for use with extended nut, couplings and extension rod, use for well piping assemblies.

B. ISVS Extraction System: All valves to be used shall be flanged.

1. Sampling port to be used shall be PVC, and as supplied by Plastic Design Engineered Products, Inc., Part No. 30SMP, 1-1/2 inch size.

2. Vacuum gauge to be used shall be Bourdon-type with ± 2 percent accuracy, 0 to 10-inch mercury, 4.5-inch dial, and phosphor bronze bourdon tube, made of drawn steel with glass window.

3. PVC ball valves to be used shall have self-lubricating Teflon seats and Viton O-rings, fully parted, maximum working pressure of 150 psi, W.O.G. at 70°F.

4. Flow sensor/pitot tube to be used shall be constructed of 316 s.s. sensor tube and brass valve and head, and shall be as manufactured by Dwyer Instruments, Inc., Part No. Dwyer-DS-200-4" or Design Engineer approved equal.

5. The magnehelic differential pressure gauge to be used with the DS-200 flow sensor shall be as manufactured by Dwyer Instruments, Inc., Series 2000, or Design Engineer approved equal for measuring 0-160 scfm at 0-10 inches of mercury, gauge shall be diaphragm-actuated dial type, ± 2 percent of full-scale accuracy, with a die-cast aluminum housing. The gauge shall be able to read gas/air in cfm.

C. GTP Discharge Pipe:

1. Combination air valves shall be of the single housing style that combines the operating features of both an air/vacuum and air release valve.

2. The air/vacuum portion shall automatically exhaust quantities of air during the filling of the pipeline and

automatically allow air to re-enter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline, power outage, pipeline break, etc. The Air Release portion shall automatically release small pockets of air from the pipeline while the pipeline is in operation and under pressure.

3. The Combination Air Valve shall have 1 inch NPT inlet and outlet connections and a 1 inch diameter orifice for a maximum working pressure of 300 PSI.

4. The materials of construction shall be: Body, Cover and Baffle of Cast Iron; Float and all other trim shall be of Stainless Steel with the exception of the Buna-N Seat and adjustable Viton Orifice Button.

5. Valve shall be a Model 201C as manufactured by Val-Matic Valve & Manufacturing Corporation, Elmhurst, Illinois or approved equal.

2.06 ANCHORS AND SUPPORTS

A. Provide all the required anchoring and supporting materials for the above ground piping system, as supplied by Grinnell Supply Sales Company or Imperial Bolt and Supply Inc. or Design Engineer approved equal, and as shown on the Drawings.

B. All the materials shall be corrosion-resistant, such that the materials will not deteriorate over a long period of time.

2.07 BEDDING MATERIALS

A. The pipe and culvert bedding materials shall meet the requirements set forth in the Commonwealth of Pennsylvania Department of Transportation Specifications, Publication 408, 703.2(c), Table C, AASHTO #8.

2.08 BOOTING MATERIAL

A. Fabricate boots or use other sealing methods acceptable to the Design Engineer, so that the geomembrane will fit snugly and seal easily to pipe penetrations through the existing PVC geomembrane.

2.09 OTHER MATERIALS

A. Pipe insulation material to be used for 4-inch nominal diameter pipe shall be a rigid, heavy-density, fiberglass pipe insulation, as manufactured by Johns-Manville, Micro-Lok 650 or Design Engineer approved equal.

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B. Metal jacketing material shall be aluminum roll jacketing (with all necessary accessories for installation) as manufactured by Childers Products, Childers Aluminum Roll Jacketing, Type 3003 or 5005, or Design Engineer approved equal.

C. Conduit used for thermocoupling signal wire in temperature probe shall be made of galvanized steel and as specified on the Drawings.

D. Riser pipe and required fittings to be used in temperature probe shall be schedule 40 PVC, 4-inch nominal diameter, solid, and as specified on the Drawings.

E. Thermocouple Probe:

1. Thermocouple probe to be used within temperature probes, shall be as supplied by Cole-Parmer Instrument Company, Type J, General purpose probe, or Design Engineer approved equal, made of 316 stainless steel and for maximum temperature of 1,200°F.

2. Signal wire (extension cables) to be used with thermocouple probes shall be as supplied by Cole Parmer Instrument Company, for Type J, Catalog No. G-08517, to required length with PVC insulation, or Design Engineer approved equal.

3. Thermocouple feedthroughs to be used with signal wire shall be as supplied by Cole-Parmer Instrument Company, for Type J, Catalog No. G-93870 or Design Engineer approved equal.

F. Vacuum gauge to be used at the temperature probe shall be as specified in Section 2.05(B)(2) of this specification.

G. Monitoring wells protective casings shall be anodized aluminum and lockable.

H. Concrete to be 3000 psi.

I. Temperature gauge to be used at the ISVS well head shall be made of 304 stainless steel, adjustable angle, bi-metal dial, with a range of 0-100°C, with 4-inch stem, furnished with 304 ss thermowell, and as manufactured by TEL-TRV, Model # AA575.

J. Petcock to be used shall be as supplied by McMaster Carr, catalog No. 95, 5458K4 for 1/2-inch pipe size, and made of brass.

K. PVC expansion joints for ISVS header pipe shall be as supplied by Plastic Engineer Products Inc., for horizontal

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pipes, maximum piston travel of six inches for 4-inch pipe size, with viton O-ring.

L. The below ground insulation to be used at the GWR wells shall be Foam Glass® wrapped with waterproof jacketing (ie, Piltwrap®) or CQA consultant approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall exercise care when transporting, handling, and placing pipe and fittings, such that they will not be cut, kinked, twisted, or otherwise damaged.

B. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Under no circumstances shall pipe or fittings be dropped into trenches, or dragged over sharp and cutting objects.

C. Pipes shall be stored on clean, level ground, preferably on turf or sand, free of sharp objects which could damage the pipe. Stacking shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitable and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports. The pipes should be stored out of direct sunlight.

D. Carefully examine all pipe and fitting for cracks, damage, or defects before installation. Defective materials shall be immediately removed from the site and replaced at no cost to the Owner.

E. The interior of all pipe and fittings shall be inspected, and any foreign material shall be completely removed from the pipe interior before it is moved into final position.

F. Field-cutting of pipes, where required, shall be made with a machine specifically designed for cutting pipe.

G. All pipe and fittings shall be placed to the lines and grades shown on the Drawings.

H. Provide all necessary adapters and/or connection pieces required when connecting different types and sizes of pipe.

I. Installation of all pipe shall be in accordance with the manufacturers' recommended procedures.

3.02 TESTING OF PIPE AND FITTINGS

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A. General:

1. All pipe and fittings installed shall be tested prior to installation. All pipe and fittings testing shall be performed in accordance with the Manufacturer's recommendations for testing PVC or CS pipe and fittings. Test procedures shall be approved by the Design Engineer prior to testing.

2. The CQA Consultant shall be notified a minimum of 24 hours in advance of any testing.

3. Provide all testing apparatus, including pumps, hoses, gauges, taps, plugs, drains, temporary connections, and fittings.

4. All tests shall be performed in the presence of the CQA Consultant.

B. Repair:

1. If test results indicate that the installed pipe has leaked, the tested pipe section shall be either repaired to the satisfaction of the Owner's Representative or replaced at no cost to the Owner. Repaired or replaced pipe shall be successfully tested prior to filling over or insulating around the pipe.

2. Visible leaks shall be repaired and the pipe retested at no additional cost to the Owner.

3.03 PVC PIPE

A. Installation shall be in accordance with ASTM D-2774 (underground installation of thermoplastic pipes) or as specified by the manufacturer (for above-ground installations) or local approving agency.

B. The CQA Consultant shall inspect pipe after installation (but not limited to) for observation of alignment, grade, condition or anchoring.

C. All pipe, fittings and valves shall be tested in accordance with manufacturer's recommendations.

D. A manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Design Engineer upon completion of work.

3.04 CS PIPE

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A. Installation of all CS pipe shall be in accordance with the Manufacturer's recommended procedures.

B. The Contractor shall exercise care when transporting, handling, and placing CS pipe and fittings.

3.05 TREATMENT PLANT DISCHARGE PIPE

A. Installation:

1. Excavation and backfilling shall be in accordance with the applicable provisions of the Sections entitled "Trenching" and "Excavation and Subgrade Preparation".

2. Pipelines and appurtenances shall be located as shown on the Contract Drawings or as directed and as established from the control survey. Pipes shall be field adjusted as required to align pipe in accordance with the Contract Drawings.

3. Alignment shall be along the roadways (where they exist) and the minimum bending radius of pipe shall, in no circumstances, be less than 60 feet or per Manufacturer's recommendations, whichever is greater.

4. The alignment and grades shall be determined and maintained by a method acceptable to the Design Engineer.

5. Installation shall be in accordance with ASTM D2774 (underground installation of thermoplastic pipes) or as specified by the Manufacturer or the Design Engineer.

6. Blocking will not be permitted under pipe.

7. No pipe shall be laid upon pipe bedding in which frost exists; nor at any time when there is danger of the formation of ice or the penetration of frost at the bottom of the excavation.

8. Temporary bulkheads shall be placed in all open ends of pipe whenever pipe laying is not actively in progress. The bulkheads shall be designed to prevent the entrance of dirt, debris, or water.

9. Precautions shall be taken to prevent the flotation of the pipe in the event of water entering the trench.

10. Seep collars shall be installed on 40-foot centers in accordance with the Contract Drawings. The pipe shall be slipped through the boot provided in the collar. The seep collar shall be keyed into the undisturbed soil around the trench prior to backfilling and compacting.

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11. Connection to a manhole shall be provided through a rubber boot which after the carrier pipe has been installed, and shall be made watertight.

12. Pipe sleeves shall be in accordance with Section 15060.

13. Field cuts of pipes shall be in accordance with the Manufacturer's instructions.

B. Inspection, Testing, and Certification

1. The CQA Consultant shall inspect pipe after installation (but not limited to) for observation of alignment, grade, condition of pipe.

2. All testing shall be witnessed by the Design Engineer.

3. All pipe and fittings testings shall be performed in accordance with Manufacturer's recommendations. pressure tests shall be performed before the entire discharge line has been backfilled.

4. Pressure tests for the pipe shall be at 150 psi.

5. Test pressure shall be held on the piping for a period of at least two hours, unless a longer period is requested by the Design Engineer.

6. Equipment in or attached to the pipes being tested shall be protected. Any damage to such equipment during the test shall be repaired by the Contractor at his expense.

7. The leakage test shall be conducted concurrently with the pressure test. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure. The test shall proceed until the rate of leakage has stabilized or is decreasing below an allowable value, for three consecutive 15-minute intervals. After this, the test pressure shall be maintained for at least another 15 minutes.

8. At the completion of the test, the pressure shall be released at the furthermost point from the point of application.

9. All exposed piping shall be examined during the test and all leaks, defective material, or joints shall be repaired or replaced before repeating the tests.

10. The allowable leakage for pressure pipelines shall not exceed 0 gallons per 24 hours per inch of diameter per mile of pipe.

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11. A Manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Design Engineer or Owner upon completion of work.

3.06 CULVERT

A. Installation of culvert shall be in accordance with the Manufacturer's recommended procedures.

B. The Contractor shall exercise care when transporting, handling, and placing culverts and joints.

3.07 SURVEYING AND CONSTRUCTION TOLERANCES

A. Surveying and construction tolerances shall be in accordance with those outlined in Section 01050 - Contractor Field Engineering.

[END OF SECTION]

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SECTION 02710
FOUNDATION DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

A. Provide drainage of foundation where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 02010: Subsurface investigation.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Manufacturer's recommended installation procedures which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 MATERIALS

A. Drainage pipe and fittings:

1. Comply with recommendations contained in ASTM D1778 for extra strength ABS plastic pipe.
2. Use long-radius type bends where so required.
3. Provide 3/8" diameter perforations spaced 3" on center in four rows parallel to the axis of the pipe, with the two center rows at 90ø spacing and the outer rows at 35ø from the first. Effective equivalent perforations of different size and spacing,

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which are standard with the manufacturer, will be acceptable when so approved in advance by the Owner.

4. Provide ABS solvent for welding pipes and fittings.

B. Coarse filter aggregate: Provide clean well graded natural gravel or crushed stone; free from shale, clay, organic materials, and debris; graded within the following limits:

Sieve size:	% passing:
1-1/2"	100%
1"	90 - 100%
3/4"	45 - 100%
5/8"	30 - 85%
1/2"	13 - 55%
3/8"	0 - 30%
1/4"	0 - 15%
No. 4	0%

C. Fine filter aggregate: Provide clean well graded natural sand; free from silt, clay, loam, organic materials, and soluble materials; graded within the following limits:

Sieve size:	% passing:
No. 4	100%
No. 14	10 - 100%
No. 100	4 - 30%
No. 200	0%

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Excavate trenches to the lines and grades required for pipe positions, checking trenches by instrument to assure correct grade.

B. Place the bedding aggregate to the depths and arrangements shown on the Drawings, using special care to provide uniform and solid bearing the full length of the pipe.

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C. Install the pipe in the arrangements shown on the Drawings and, for conditions not shown on the Drawings, as required to achieve positive drainage of the required areas.
   1. Form the piping into a continuous system, using such fittings and accessories as are recommended by the manufacturer of the materials, starting at the highest required drainage elevation and continuing to the point of approved discharge.
   2. Take special care to prevent potential blockage of the system through inadvertent dirt intrusions.

3.3 INSPECTION

A. If so required by the Owner, demonstrate prior to backfill that the drainage system provides free drainage by pulling a ball through each line of the system, using a ball 1/2" less in diameter than the diameter of the pipe.

3.4 BACKFILL AND COVER

A. Install the aggregate backfill shown on the Drawings, taking special care to prevent crushing the pipe.

B. Provide required protection until placement of the next succeeding layer or increment of construction.

END OF SECTION

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SECTION 02925

FERTILIZING AND SEEDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to apply fertilizer, to apply seed and mulch, and maintain all seeded areas as specified herein, as shown on the Drawings, and as necessary for a complete installation.

B. The work shall include fertilizing and seeding for those areas shown on the Drawings and all areas disturbed by the CONTRACTOR except areas within the designated wetlands. Revegetation in wetlands will meet the terms of the Encroachment Permit application. All seeding shall be applied by hydroseeding, unless other methods are proposed by the CONTRACTOR and approved by the CQA Consultant. Fertilizing and seeding shall be in accordance with Erie County Conservation District Erosion and Sediment Control Guidelines.

1.02 RELATED SECTIONS

A. Section 02110 - Clearing, Grubbing, and Topsoil Removal

B. Section 02220 - Earthwork

1.03 SUBMITTALS

A. Prior to fertilizing and seeding, the CONTRACTOR shall confirm the fertilizer, seed, and mulch application rates. Results of the tests shall be available to the CQA Consultant at least two weeks before the start of fertilizing and seeding activities.

PART 2 - PRODUCTS

2.01 HYDROSEED MIXTURE

A. Hydroseed applied to topsoil shall conform to the following (or the CQA Consultant approved equal):

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Specia	Seeding Rate (lb/acre)
Birdsfoot trefoil	8
Red Top	3

B. The seed shall be furnished and delivered premixed in the proportions that will produce seeding rates specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer.

C. The material shall be delivered in packages of uniform weight and bear the name of the manufacturer, the net weight, and a supplemental statement of net weight content.

2.02 FERTILIZER

A. Liming and fertilization shall be applied to obtain a uniform erosion resistant perennial vegetative coverage or density of 70 percent across all disturbed areas. Use the following per acre rates:

- 1 ton agricultural limestone
- 30 lb nitrogen
- 30 lb phosphoric acid
- 30 lb potash

2.03 MULCH

A. Mulch shall be stalks of oats, wheat, rye or other approved crops free from noxious weeds, or mold, and shall be in an air dry condition when placed. Mulch shall also meet the requirements of PADOT Section 8.05.

PART 3 - EXECUTION

3.01 APPLICATION

A. The CONTRACTOR is responsible for cleaning all the structures and paved areas of unwanted deposits of the hydroseed mixture.

3.02 INSTALLATION

A. Previously established grades, as shown on the Drawings, shall be maintained in a true and even condition.

B. The CONTRACTOR shall hydroseed only on a calm day. No seeding shall be done on frozen ground or when the temperature is 32° F or lower. Schedules for seeding and

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fertilizing must be submitted to the CQA Consultant for approval prior to the work. Seeding shall be done within ten days following soil preparation. Mulch materials shall be applied on seeded areas within 48 hours after seeding, if a seeding method other than a hydroseeding method is used.

C. Before seeding, all gullies, washes, or disturbed areas that develop subsequent to final dressing of topsoil shall be repaired. All areas shall be loosened by discing, harrowing, or other approved methods immediately prior to seeding. For areas flatter than three horizontal: 1 vertical (3:1), the topsoil shall be loosened to a depth of three inches. For areas 3:1 and steeper, the topsoil shall be loosened to a depth of one inch.

D. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainage ways, the CONTRACTOR shall carry out seeding and mulching as soon as a portion of the project has been satisfactorily completed and/or as directed by the Engineer. When protection of newly topsoiled and graded areas are necessary, at a time which is outside the normal seeding seasons, the CONTRACTOR shall protect those areas by whatever means necessary, as approved by the CQA Consultant, and shall be responsible for prevention of siltation in the areas beyond the limit of work.

3.03 MAINTENANCE AND ACCEPTANCE

A. The CONTRACTOR shall keep all seeded areas watered and in good condition, reseeding all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded, and shall maintain all seeded areas in an approved condition until provisional acceptance.

END OF SECTION

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SECTION 02931

EROSION CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to provide erosion control during and upon completion of construction as specified herein, as shown on the Drawings, and as necessary for a complete installation.

B. The work shall include temporary erosion control (i.e., until permanent erosion control features have been established) for those areas shown on the Drawings and all areas disturbed by the CONTRACTOR. Work involves installation of silt fences, hay bales, erosion control and revegetation mats, etc.

C. Erosion control shall be in accordance with the Erie County Conservation District, Erosion and Sediment Control Guidelines and shall be in accordance with the Soil Erosion and Sediment Control Plan developed for the project.

1.02 RELATED SECTIONS

A. Section 01565 - Protection of Wetlands

B. Section 02110 - Clearing, Grubbing, and Topsoil Removal.

C. Section 02200 - Earthwork

D. Section 02271 - Rip-Rap

E. Section 02510 - Access Roads

F. Section 02925 - Fertilizing and Seeding

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 01340. Submit product data on silt fence material.

B. Submit layouts of erosion control measures and collection devices.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Silt fence fabric shall be woven.

1. Woven fabric shall consist of monofilaments of polypropylene treated with ultraviolet light stabilizers and shall weigh a minimum of 3.5 oz/sq yd.

2. Silt fence fabric shall be inert to chemicals commonly found in soils.

3. Silt fence fabric shall be resistant to mildew, rot, insects, and rodent attack.

4. Silt fence posts shall be 2 inch square and spaced as shown on the construction drawings. Silt fence fabric shall conform to the following test criteria:

Geotextile Properties

Property	Test Method	Average Value
Grab Tensile, lbs.	ASTM-D-4632	110 x 90
Grab Elongation, %	ASTM-D-4632	15
Mullen Burst, psi	ASTM 3786	275
Puncture, lbs.	ASTM 3787 (modified)	30
Trapezoidal Tear, lbs.	ASTM-D-4533	50
U.V. Resistance, % (Strength Retained)	ASTM-D-4355	70
E.O.S.	CW02215	20/30
Permittivity, (1/sec)	ASTM-4491	.2
gal/min/sq. ft.		15

B. Straw bales shall consist of undecayed firmly-packed straw of nominal size 14 inches by 18 inches by 36 inches as prepared by any standard hay-bailing machine and firmly bound by at least two separate circuits of rope or band material which will withstand weathering for a minimum of three months.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Silt fences shall be installed as shown on the Drawings by securely fastening silt fence fabric using wire ties. The silt fence fabric panels shall be installed loosely

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with adjacent panels overlapped a minimum of 12 inches. Silt fence material shall be embedded at least eight inches beneath ground surface and shall extend upward at least two feet above the disturbed area ground surface. The top edge of the fabric shall be reinforced or shall have a one inch tuck.

B. Straw bales shall be installed as shown on the Drawings in a row with ends tightly abutting. Each bale shall be embedded in the soil a minimum of four inches and placed so that the bale bindings are oriented horizontally. Bales shall be securely anchored in place by wood stakes, steel fence pickets, or rebars driven through the bale. Stakes shall be driven flush with the bale and shall extend at least 12 inches beneath the bale into the underlying soil.

C. Accumulated silt and debris shall be removed by the CONTRACTOR from behind the face of the silt fence as needed to provide proper silt fence operation. Clogged or damaged fabric shall be immediately replaced.

D. Accumulated silt and debris and damaged or deteriorated bales shall be removed by the CONTRACTOR.

3.02 PROVISIONS FOR EROSION CONTROL DURING CONSTRUCTION

A. The CONTRACTOR shall implement erosion control measures around all areas to be disturbed prior to disturbing ground in the area, to the satisfaction of the CQA Consultant.

B. The CONTRACTOR shall take sufficient precautions during construction to minimize the run-off of polluting substances such as silt, clay, wastes, fuels, oils and bitumens into the water supplies and surface waters of the Commonwealth. Special precautions shall be taken in the use of construction equipment to prevent operations in a manner that reduces erosion.

C. The temporary drainage ditches, silt fences, and other erosion and sediment control features shall be maintained in the locations shown on the Drawings and at other incidental locations identified by the Owner or the CQA Consultant.

D. Disposal of drainage from the site shall be at a location approved by the Owner. Drainage shall not be disposed of until silt and other sedimentary materials have been removed. Particular care shall be taken to prevent the discharge of unsuitable drainage to a water supply or surface water body.

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E. As a minimum, the following shall apply:

1. Staked bales of hay or approved silt fencing shall be provided at points where drainage from the work site leaves the site, to reduce the sediment content of the water. Sufficient bales of hay or silt fence shall be provided such that all flow will filter through the hay or silt fence. Other methods which reduce the sediment content to an equal or greater degree may be used as approved by the CQA Consultant.

2. Drainage leaving the site shall flow to water courses in a manner that minimizes erosion.

3.03 PROTECTION OF WETLANDS

A. Work in Wetlands shall be in accordance with Section 01565 - Protection of Wetlands.

END OF SECTION

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(Red)

DIVISION 3

CONCRETE

ORIGINAL (Red)

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.1 SUMMARY

A. Provide formwork in accordance with provisions of this Section for cast-in-place concrete shown on the Drawings or required by other Sections of these Specifications.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 02220: Excavating for footings.
3. Section 03200: Concrete reinforcement.
4. Section 03300: Cast-in-place concrete.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Design of formwork is Contractor's responsibility.

C. Standards: In addition to complying with pertinent regulations of governmental agencies having jurisdiction, comply with pertinent provisions of ACI 347.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Except for metal forms, use new materials. Materials may be re-used during progress of the Work, provided they are completely cleaned and reconditioned, recoated for each use, and capable of producing formwork of the required quality.

B. For footings and foundations, use Douglas Fir or similar grade boards or planks secured to wood or steel stakes, substantially constructed to shapes indicated and to support the required loads.

C. For studs, wales, and supports, use Standard grade or better Douglas Fir or similar type wood, dimensions as required to support the loads but not less than 2" by 4".

D. Wall forms:

1. Exposed concrete surfaces:
   a. Use 3/4" minimum thickness Douglas Fir or similar plywood, grade B exterior, sanded.

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b. Seal edges and coat both faces with colorless coating which will not affect application of applied finishes.

2. Unexposed concrete surfaces:

a. Use 3/4" minimum thickness Douglas Fir or similar plywood, grade C exterior, sanded and oiled.

E. Column forms, if required:

1. For square or rectangular columns, use 2" thick Douglas Fir or similar planks or joists, surfaced one side and two edges, or use metal forms.
2. For round columns, use metal forms or paper tube forms.
3. Construct column forms with tight joints and securely clamped together with steel clips.

2.2 FORM TIES

A. Hold inner and outer forms for vertical concrete together with combination steel ties and spreaders.

1. Space ties symmetrically in tiers and rows, each tier plumb from top to bottom and each row level.
2. At horizontal pour lines, locate ties not more than 6" below the pour lines. Tighten after concrete has set and before next pour is made.
3. For exposed concrete surfaces, provide form ties of removable type with she-bolts equipped with permanent plugs and a system for fixing the plugs in place.

2.3 DESIGN OF FORMWORK

A. General:

1. Design, erect, support, brace, and maintain formwork so it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure.
2. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.
3. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.
4. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on the formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of the structure during construction.
5. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
6. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
7. Support form materials by structural members spaced sufficiently close to prevent objectionable deflection.

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8. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within the allowable tolerances.
9. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints, and provide backup material at joints as required to prevent leakage and prevent fins.

2.4 EARTH FORMS

A. Side forms for footings may be omitted, and concrete may be placed directly against excavation, only when requested by the Contractor and approved by the Owner.

B. When omission of forms is accepted, provide additional concrete 1" on each side of the minimum design profiles and dimensions shown on the Drawings.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 FORM CONSTRUCTION

A. General:
1. Construct forms complying with ACI 347 to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, and level and plumb work in the finished structure.
2. Provide for openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features as required.

B. Fabrication:
1. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
2. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
3. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
4. Provide top forms for inclined surfaces where so directed.

C. Forms for exposed concrete:
1. Drill forms to suit ties being used, and to prevent leakage of cement paste around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back the joints with extra studs or girts to maintain true, square intersections.
3. Use extra studs, wales, and bracing to prevent objectionable bowing of forms between studs, and to avoid bowed appearance in the concrete. Do not use narrow strips of form material which will produce bow.

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D. Corner treatment:
   1. Unless shown otherwise, form chamfers with 3/4" by 3/4" strips, accurately formed and surfaced to produce uniformly straight lines and tight edges.
   2. Extend terminal edges to required limit, and miter the chamfer strips at changes in direction.

E. Locate control joints as indicated on the Drawings and, where required but not shown on the Drawings, as approved by the Owner.

F. Provisions for other trades:
   1. Provide openings in concrete formwork to accommodate work of other trades.
   2. Verify size and location of openings, recesses, and chases with the trade requiring such items.
   3. Accurately place and securely support items to be built into the concrete.

3.3 FORM COATINGS

A. Coat form contact surfaces with form coating compound before reinforcement is placed.
   1. Do not allow excess form coating material to accumulate in the forms or to come in contact with surfaces which will bond to fresh concrete.
   2. Apply the form coating material in strict accordance with its manufacturer's recommendations.

3.4 REMOVAL OF FORMS

A. General:
   1. Do not disturb or remove forms until the concrete has hardened sufficiently to permit form removal with complete safety.
   2. Do not remove shoring until the member has acquired sufficient strength to support its own weight, the load upon it, and the added load of construction.
   3. Do not strip floor slabs in less than 48 hours.
   4. Do not strip vertical concrete in less than 72 hours.

B. Finished surfaces:
   1. Exercise care in removing forms from finished concrete surfaces so that surfaces are nor marred or gouged, and that corners are true, sharp, and unbroken.
   2. Release sleeve nuts or clamps, and pull the form ties neatly.
   3. Do not permit steel spreaders, form ties, or other metal to project from, or be visible on, any concrete surface except where shown on the Drawings.
   4. Solidly pack form tie holes, rod holes, and similar holes in the concrete. For packing, use the cement grout specified in Section 03300 of these Specifications, flushing the holes with water before packing, screeding off flush, and grinding to match adjacent surfaces.

END OF SECTION

ORIGINAL (Red)

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Provide concrete reinforcement where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Section 03100: Concrete formwork.
   3. Section 03300: Cast-in-place concrete.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: No less than one week prior to placing any concrete reinforcement, submit the following:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
   3. Shop Drawings showing details of bars, anchors, and other items, if any, provided under this Section.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Comply with pertinent provisions of the following, except as may be modified herein:
   1. ACI 318;
   2. CRSI "Manual of Standard Practice".

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Delivery and storage:
   1. Use necessary precautions to maintain identification after bundles are broken.
   2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.

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PART 2 PRODUCTS

2.1 REINFORCEMENT MATERIALS AND ACCESSORIES

A. Bars:
   1. Provide deformed billet steel bars complying with ASTM A615, using grades shown on the Drawings.
   2. Where grades are not shown on the Drawings, use grade 60.

B. Steel wire:
   1. Comply with ASTM A82.
   2. For tie wire, provide annealed steel, black, 16 gauge minimum.

C. Welded wire fabric:
   1. Provide welded steel, complying with ASTM A185.

D. Welding electrodes:
   1. Comply with AWS A5.1, low hydrogen, E70 series.

E. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:
   1. Use wire bar type supports complying with CRSI recommendations, unless otherwise shown on the Drawings.
   2. Do not use wood, brick, or other non-complying material.
   3. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
   4. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dip galvanized or plastic-protected legs.

2.2 FABRICATION

A. General:
   1. Fabricate reinforcing bars to conform to the required shapes and dimensions, with fabrication tolerances complying with the CRSI Manual.
   2. In case of fabricating errors, do not straighten or rebend reinforcement in a manner that will injure or weaken the material.
   3. Reinforcement with any of the following defects will not be acceptable.
      a. Bar lengths, depths, and/or bends exceeding the specified fabrication tolerances;
      b. Bends or kinks not shown on the Drawings;
      c. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

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3.2 INSTALLATION

A. General:
   1. Comply with the specified standards for detail and method of placing reinforcement and supports, except as may be modified herein.
   2. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
   3. Position, support, and secure reinforcement against displacement by formwork, construction, and concrete placing operations.
   4. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
   5. Place reinforcement to obtain minimum coverages for concrete protection.
   6. Arrange, space, and securely tie bars and bar supports together with the specified tie wire.
   7. Set wire ties so twisted ends are directed away from exposed concrete surfaces.

B. Install welded wire fabric in as long lengths as practicable, lapping adjoining pieces at least one full mesh.

C. Provide sufficient numbers of supports, and of strength to carry the reinforcement.

D. Do not place reinforcing bars more than 2" beyond last leg of any continuous bar support.

E. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

3.3 SPLICES

A. Lap splices:
   1. Tie securely with the specified wire to prevent displacement of splices during placement of concrete.

B. Splice devices:
   1. Obtain the Owner's approval before using splice devices.
   2. Install in accordance with the manufacturer's written instructions.
   3. Splice in a manner developing at least 125% of the yielding strength of the bar.

C. Welding:
   1. Perform in accordance with AWS D1.4-79.

D. Do not splice bars except at locations shown on the Drawings, except as otherwise specifically approved by the Owner.

END OF SECTION

ORIGINAL (Red)

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Provide cast-in-place concrete where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Section 01410: Testing and inspecting.
   3. Section 03100: Concrete formwork.
   4. Section 03200: Concrete reinforcement.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Quality control:
   1. Do not commence placement of concrete until mix designs have been reviewed and approved by the Owner, and until copies are at the job site and the batch plant.
   2. Also see other requirements for testing stated in Part 3 of this Section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 CEMENT

A. Provide a standard brand of Portland Cement complying with ASTM C150, type I or II, low alkali.

2.2 AGGREGATES

A. General:
   1. Provide hardrock aggregate complying with ASTM C33, with additional attributes as specified herein.

B. Fine aggregate:
   1. Provide washed natural sand having strong, hard, durable particles, and containing not more than 2% by weight of deleterious matter such as clay lumps, mica, shale, or schist.

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2. Grade from coarse to fine within the following limits:

Sieve size:	Percentage by weight passing sieve:	
	Minimum:	Maximum:
3/8"	100	---
No. 4	95	100
No. 8	65	95
No. 16	45	75
No. 30	30	50
No. 50	10	22
No. 100	2	8

C. Coarse Aggregates:

1. Provide coarse aggregate consisting of clean, hard, fine grained, sound crushed rock or washed gravel, or a combination of both, containing not more than 5% by weight of flat, chip-like, thin, elongated, friable, or laminated pieces, nor more than 2% by weight of shale or cherty material.
2. Use coarse aggregate of the largest practicable size for each condition of placement, subject to the following maximum size limitations:
   a. Do not exceed 3/4 of the clear distance between reinforcing bars, 1/5 of the narrowest dimension between sides of forms, or 1/3 the depth of any slab section.
3. Grade combined aggregates within the following limits:

Sieve size or size in inches:	Percentage by weight passing sieve:					
	1-1/2" aggregate:		1" aggregate:		3/4" aggregate:	
	Min:	Max:	Min:	Max:	Min:	Max:
1-1/2"	95	100	---	---	---	---
1"	75	90	90	100	---	---
3/4"	55	77	70	90	90	100
3/8"	40	55	45	65	60	80
No. 4	30	40	31	47	40	60
No. 8	22	35	23	40	30	45
No. 16	16	30	17	35	20	35
No. 30	10	20	10	23	13	23
No. 50	2	8	2	10	5	15
No. 100	0	3	0	3	0	5

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2.3 WATER

A. Use only water which is clean and free from deleterious amounts of acid, alkali, salt, and organic materials.

2.4 ADMIXTURES

A. Use only a standard brand of admixture for concrete, meeting or exceeding the following requirements.
   1. Reduce the required mixing water at least 75% without entraining air in excess of 2% by volume.
      a. If the admixture used entrains more than 2% air, the water reduction shall be at least 10%, but in no case shall the volume of air entrained exceed 5%.
   2. A separate air-entraining agent may be used in addition to the water-reducing admixture, provided the combination of the two admixtures meets the requirements listed above.
   3. If pozzolanic materials are used, make them from an oil-impregnated diatomaceous shale, or from an opaline cherty shale, chert, or porcelaneous rock, or material of similar mineralogical composition.
   4. Use only automatic dispensers for adding admixture.
   5. If an air-entraining agent is used, run air content determinations periodically during the pour to make certain the volume of air entrained is less than 5%.

2.5 OTHER MATERIALS

A. Expansion joint filler:
   1. Provide sealants as specified in Section 07920. Provide filler complying with ASTM D1752.

B. Curing materials:
   1. Liquid curing compounds:
      a. Provide a standard brand, clear unless otherwise directed for the particular application, and complying with ASTM C309.

C. Floor hardener:
   1. Provide mineral hardener, natural gray in color. Metallic hardeners shall not be used unless specifically directed by the Owner.

D. Vapor barrier membrane:
   1. Provide polyethylene sheet of the thickness shown on the Drawings, complying with ASTM D2103.
   2. If vapor barrier is shown on the Drawings, but no thickness is indicated, provide 4 mil thickness.

2.6 CONCRETE MIXES

A. Provide a mix design based on strengths of the approved materials, and meeting the requirements stated on the Drawings.
   1. Secure the Owner's approval of each mix design, including new mix designs required to be prepared should there occur a change in the materials being used.

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B. Lightweight concrete:
   1. Design the mix in accordance with the provisions of ACI 613A, and pertinent requirements of governmental agencies having jurisdiction.
   2. Unless otherwise directed, use type II Portland Cement and achieve a weight of not more than 110 pcf and an ultimate compressive strength of 3500 psi at 28 days.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 CONCRETE MIXING

A. Concrete for minor work, when approved by the Owner, may be mixed at the site in a power mixer when the mixer has a capacity not less than one full sack batch.

B. Unless otherwise approved by the Owner, use ready mixed concrete complying with ASTM C94, except as may be modified by the following.
   1. Equip truck mixers with a mixing water tank fitted with a water gauge.
   2. Mixing:
      a. Mix each batch of concrete not less than 15 minutes, five minutes of which shall be at the site.
      b. Rotate the drum at the rate specified by the manufacturer of the mixer as "mixing speed".
      c. Whenever there is a delay in unloading, rotate the drum slowly at intervals to prevent incipient set of concrete.
   3. Addition of water:
      a. Normally, do not deliver concrete with total permissible amount of water incorporated therein.
      b. Withhold at least 2-1/2 gal. per cu.yd. and add if desired before the concrete is discharged.
      c. After water is added, at least five minutes of mixing time shall be required immediately prior to discharge.
      d. Concrete will be rejected if not placed in final position within 1-1/2 hours after water is first added to the batch.
   4. Concrete at the time of placing shall be in such condition that it can be placed properly.
   5. Discharge all wash water from the mixing drum before the truck reloads at the batching plant.

C. Concrete consistency:
   1. Use the amount of water established by the approved mix design.
      a. Do not exceed the maximum quantity specified for the grade of concrete.

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b. Use the minimum amount of water necessary to produce concrete of the workability required.
c. Do not supplement the predetermined amount of water with additional water for any reason.

2. Measure concrete consistency by ASTM C143 method.
3. Provide maximum slumps of concrete as:
   a. Footings and slabs on soil: 3";
   b. Other concrete: 4".

D. Modified concrete mix:
1. Where modified concrete mix is directed, provide the same composition as regular concrete mix; except omit 50% of the coarse aggregate.
2. Do not exceed the water/cement ratio specified for the grade of concrete.

E. Cement grout and dry-pack grout:
1. Mix at the site, in composition of one volume of portland cement to 2-1/2 volumes of fine aggregate.
2. Mix the materials dry; then add sufficient water to make the material flow under its own weight.
3. When grout is used as dry-pack concrete, add sufficient water to make a stiff mixture which can be molded into a sphere.

F. Miscellaneous provisions:
1. Provide strengths of concrete as shown on the Drawings.
2. Provide concrete dense and free from honeycomb and other defects.
3. Place and finish members to conform to the shapes and dimensions indicated, with all surfaces true to line, plumb, and level.

3.3 INSERTS, ANCHORS, AND EMBEDDED ITEMS

A. Reglets and rebates:
1. Form reglets and rebates as required to receive frames, flashing, and other equipment.
2. Verify the dimensions and positions of required reglets and rebates with trades whose work is related to or contingent upon such dimensions and positions.
3. If concrete slabs on earth join a wall or other perpendicular concrete surface, form a reglet in the wall to receive and carry the horizontal concrete work.
   a. Provide reglet full thickness of the slab and 3/4" deep, unless otherwise shown on the Drawings.
   b. Exterior walks need not be provided for in this way except where so detailed on the Drawings.

B. Embedded piping and rough hardware:
1. Coordinate the various trades who are required to fasten work to the structure, or are required to insert therein any sleeve, box, bolt, anchor, insert, or other rough hardware.
2. Provide every facility for setting all required items accurately in the forms.
3. Be responsible for changes in position of such items after they have been set.

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4. Provide in the forms for all sleeves, boxes, bolts, anchors, inserts, strap anchors for frames, and other rough hardware required for the Work, and which are shown or required to be imbedded in the Concrete.
5. Conduits and sleeves:
   a. Locate so as not to reduce the strength of construction. Do not place pipes, except conduits 1" dia. and less, in a slab 4" or less in thickness.
   b. In supported concrete slabs, do not bury conduit having an outside diameter greater than 25% of the thickness of the slab. Increase slab thickness locally to meet this requirement.
   c. Do not place conduit between the bottom of reinforcing steel and the bottom of the supported slab.
   d. In placing conduits at slabs on earth, place below the reinforcement, and encase in concrete by increasing the thickness of the slab locally to at least 3" of concrete around the conduit on all sides.

C. Where openings in floors and walls are required by the various trades, but are not detailed on the Drawings, reinforce as directed by the Owner.

3.4 CONVEYING AND PLACING CONCRETE

A. Before placing concrete, thoroughly clean forms, wash out with water, and make tight.

B. Time of placing:
1. Do not place concrete until reinforcement, conduits, outlet boxes, anchors, sleeves, hangers, bolts, and other embedded materials are securely and properly fastened in their correct positions.
2. Secure the Owner's approval of reinforcement before commencing placement of concrete.

C. Preparation:
1. Before new concrete is deposited upon or against concrete that has taken its initial set or has hardened, remove all incrustations from forms and reinforcement.
2. Remove all laitence, oil, and loose particles from concrete and concrete surfaces, and thoroughly clean the forms with water under stiff pressure.
3. Remove laitence after concrete has hardened partially (not less than 2 hours nor more than 4 hours after placing) by brushing with stiff bristles, or by directing a stream of water from a 1/4" nozzle, to expose the clean top surface of the coarse aggregate.
4. Where cleaning is not satisfactory to the Owner, sandblast the surface and then wash again.

D. Method of placing:
1. Spouts, pipes, troughs, belts, chain buckets, and other equipment may be used in conveying concrete.
2. Do not permit concrete to free drop more than 6'-0".
3. Deposit concrete directly into conveyances, and direct from conveyances to final points of repose, except where troughs, buckets, or the like are used, in which case dump concrete into hoppers and then into the conveyances.

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4. Where tremies are used, or where the free drop is 5'-0" or more, and through reinforcement, use a dumping box or board, moving the concrete therefrom by shovels or hoes.
5. Deposit concrete so that the surface is kept level throughout, a minimum being permitted to flow from one position to another, and place as rapidly as practicable after mixing.
6. Do not use in this Work any concrete not placed within 30 minutes after leaving the mixer.

E. Tamping and conveying:
1. Thoroughly work concrete around reinforcement and embedded fixtures, and into corners of forms, during placing operations.
2. Completely compact with tamping poles and by tapping forms until the concrete is thoroughly compact and without voids. Determine the number of tampers needed by the amount and method of placing concrete.
3. Exercise care to tamp concrete vigorously and thoroughly to obtain maximum density.
4. Use manual tampers as well as mechanical vibrators.
   a. Exercise care to direct the quick handling of vibrators from one position to another.
   b. Do not over-vibrate concrete.
   c. Do not move concrete by use of vibrator.

F. Stoppages:
1. Stop concrete placing only when and where approved by the Owner.
2. Maintain flow surfaces of freshly placed concrete as level whenever a pour is stopped, providing tight dams to accomplish this.
3. Make construction joints only where unavoidable, and then only at points determined by the Owner.
4. Make horizontal construction joints only where shown on the Drawings or specifically approved by the Owner.
5. Provide keys and dowels at construction joints where indicated on the Drawings, and where concrete placement is interrupted.

3.5 STEPS, SLABS, WALKS, AND PAVING ON EARTH

A. Preparation for slabs on earth:
1. Prepare the subgrade as specified in other Sections.
2. Dampen the subgrade for exterior slabs and paving prior to placing concrete, but do not dampen subgrade at interior floor slabs.
3. Provide the specified vapor barrier membrane, with the bedding and covering shown on the Drawings, beneath floor slabs on grade.
   a. Place the membrane in as large sheets as practicable, lapping 12", with the top lap placed in the direction concrete will be spread.

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b. Carefully cut, fit, and seal the membrane to all pipes and conduits projecting through the membrane, using small sheets, where necessary, and pressure-sensitive tape.
c. Make necessary repairs to the membrane, and secure to the Owner's approval before placing concrete.
d. Do not permit membrane to be punctured except at screed stakes and utility risers.

B. Placing and finishing:
1. Tamp the freshly placed concrete, except slabs to receive separate topping finish or mortar setting bed, using a heavy tamper, until at least 3/8" of mortar is brought to the surface.
2. Use tampers having a face consisting essentially of a grid of parallel metal bars.
3. Tamp with a light tamper, and screed with a heavy straightedge, until depressions and irregularities are worked out and the surface is true to finish grades and elevations.
4. Remove excess water and debris worked to the surface in compacting and screeding.
5. At slabs to receive separate topping finish or mortar setting beds, do not continue tamping to raise the mortar.
6. Remove laitence.
7. When concrete has hardened sufficiently, float to a compact and smooth finish.
8. Provide the finish surfaces shown on the Drawings or otherwise directed by the Owner.

C. Except as otherwise directed by the Owner or called for in the Contract Documents, cure and protect concrete in accordance with pertinent provisions of ACI 302.

3.6 SODA AND ACID WASH

A. At concrete surfaces to receive plaster, paint, or other finish, and which have been formed by oil coated forms, scrub with a solution of 1-1/2 lbs. caustic soda to one gal. of water.

B. On surfaces where smooth wood or waste molds have been used, scrub with a solution of 20% muriatic acid or hydrochloric acid.

C. After the surfaces have been scrubbed, wash with clean water as soon as possible.

3.7 DEFECTIVE CONCRETE

A. The following concrete will be deemed to be defective, and shall be removed promptly from the job site.
1. Concrete which is not formed as indicated, is not true to intended alignment, is not plumb or level where so intended, is not true to intended grades and levels;
2. Has voids or honeycomb that have been cut, resurfaced, or filled, unless with the approval of the Owner;
3. Has sawdust, shavings, wood, or embedded debris;
4. Or does not conform fully to provisions of the Contract Documents.

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B. Repairs and replacements:
   1. Defective concrete may be cut out and repaired with gunite, or other approved methods, when and as directed by the Owner.
   2. Where defective concrete is found after removal of the forms, cut out the defective concrete, if necessary, and make the surfaces match adjacent surfaces.
   3. Work uneven surfaces and angles of concrete to a surface matching adjacent concrete surfaces.

3.8 GROUTING AND CEMENT POINTING

A. After steel columns have been installed and leveled, dry pack the space between the bottom of the plate and concrete, using cement grout driven in to completely fill the space and forming solid bearing for the column base plate.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Walls and curbs:
   1. Construct header walls and curbs as shown on the Drawings.
   2. Trowel exposed concrete surfaces smooth.

B. Leave openings in floor slabs and future foundations for machines and equipment, where so indicated on the Drawings, and in dimensions and arrangements required for the approved machines and equipment.

END OF SECTION

ORIGINAL (Red)

SECTION 03345
CONCRETE FINISHING

PART 1 GENERAL

1.1 SUMMARY

A. Provide finishes on cast-in-place concrete as called for on the Drawings, specified herein, and needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 03300: Cast-in-place concrete.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Manufacturer's recommended installation procedures, which are the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Except as may be modified herein or otherwise directed by the Owner, comply with ACI 301, "Specifications for Structural Concrete for Buildings".

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Carefully study the Drawings and these Specifications, and determine the location, extent, and type of required concrete finishes.

B. Concrete materials: Comply with pertinent provisions of Section 03300, except as may be modified herein.

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C. Liquid bonding agent: "Weld-Crete" or equal.

D. Curing and protection paper:
   1. "Sisalkraft, Orange Label", or equal, complying with ASTM C171.
   2. Where concrete will be exposed and will be subjected to abrasion, such as floor slabs, use non-staining paper such as "Sisalkraft, Seekure 896" or equal paper faced with polyurethane film.

E. Liquid curing agents:
   1. Where application of specified finish materials will be inhibited by use of curing agents, cure the surface by water only; do not use chemical cure.
   2. For curing other areas, use "Hunt TLF" or equal.

F. Floor sealer:
   1. Acceptable products include "Superkote Special Clear Sealer", "Supershield", or equal.

G. Slip-resistant abrasive aggregate:
   1. Provide aluminum oxide, 14/36 grading.
   2. Acceptable manufacturers include Carborundum Co., Norton Co., and L. M. Scofield Co.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 FINISHING OF FORMED SURFACES

A. General:
   1. After removal of forms, give the concrete surfaces one or more of the finishes described below where so indicated on the Drawings.
   2. Revise the finishes as needed to secure the approval of the Owner.

B. As-cast finish:
   1. Rough form finish:
      a. Leave surfaces with the texture imparted by forms, except patch tie holes and defects.
      b. Remove fins exceeding 1/4" in height.
   2. Smooth form finish:
      a. Coordinate as necessary to secure form construction using smooth, hard, uniform surfaces, with number of seams kept to a practical minimum and in a uniform and orderly pattern.

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b. Patch tie holes and defects.
c. Remove fins completely.

C. Rubbed finishes:
1. Provide these finishes only where specifically called for, and then only on a "smooth form finish" base as described above.
2. Smooth rubbed finish:
a. Produce on newly hardened concrete no later than the day following form removal.
b. Wet the surfaces, and rub with carborundum brick or other abrasive until uniform color and texture are produced.
c. Do not use a cement grout other than the cement paste drawn from the concrete itself by the rubbing process.
3. Grout cleaned finish:
a. Do not start cleaning operations until all contiguous surfaces to be cleaned are completed and accessible.
b. Do not permit cleaning as the work progresses.
c. Mix one part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having the consistency of thick paint.
d. Substitute white portland cement for part of the gray portland cement as required to produce a color matching the color of surrounding concrete, as determined by a trial patch.
e. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout, and apply the grout uniformly with brushes or spray gun.
f. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes.
g. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, sack, or other means.
h. After the surface whites from drying (about 30 minutes at normal temperatures), rub vigorously with clean burlap.
i. Keep the surface damp for at least 36 hours after final rubbing.
4. Cork floated finish:
a. Remove forms at an early stage, and no later than three days after placement of concrete.
b. Remove ties.
c. Remove burrs and fins.
d. Mix one part portland cement and one part fine sand with sufficient water to produce a stiff mortar.
e. Dampen the wall surface.
f. Apply mortar with a firm rubber float or with a trowel, filling all surface voids.
g. Compress mortar into voids using a slow-speed grinder or stone.
h. If the mortar surface dries too rapidly to permit proper compacting and finishing, apply a small amount of water with a fog sprayer.

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i. Produce the final texture with a cork float using a swirling motion.

D. Unspecified finish: If the finish of formed surfaces is not specifically called out elsewhere in the Contract Documents, provide the following finishes as applicable:
1. Rough form finish:
   a. For all concrete surfaces not exposed to public view.
2. Smooth form finish:
   a. For all concrete surfaces exposed to public view.

3.3 FINISHING SLABS

A. Definition of finishing tolerances:
1. "Class A": True plane within 1/8" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.
2. "Class B": True plane within 1/4" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.
3. "Class C": True plane within 1/4" in two feet as determined by a two foot straightedge placed anywhere on the slab in any direction.

B. Scratched finish: After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, roughen the surface with stiff brushes or rakes before the final set.

C. Floated finish:
1. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further until ready for floating.
2. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
3. During or after the first floating, check the planeness of the surface with a ten foot straightedge applied at not less than two different angles.
4. Cut down high spots and fill low spots, and produce a surface with Class B tolerance throughout.
5. Refloat the slab immediately to a uniform sandy texture.

D. Troweled finish:
1. Provide a floated finish as described above, followed by a power troweling and then a hand troweling.
   a. Produce initial surface relatively free from defects, but which may still show some trowel marks.
   b. Provide hand troweling when a ringing sound is produced as the trowel is moved over the surface.
   c. Thoroughly consolidate surface by hand troweling.
2. Provide a finished surface essentially free from trowel marks, uniform in texture and appearance, and in a plane of Class A tolerance.
   a. For concrete on metal deck, Class B plane tolerance is acceptable.
   b. ON surfaces intended to support floor coverings, use grinding or other means as necessary and remove all defects of such magnitude as would show through the floor covering.

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E. Broom finish:
   1. Provide a floated finish as described above.
   2. While the surface is still plastic, provide a textured finish by drawing a fiber bristle broom uniformly over the surface.
   3. Unless otherwise directed by the Owner, provide the texturing in one direction only.
   4. Provide "light", "medium", or "coarse" texturing as directed by the Owner or otherwise called for on the Drawings.

F. Exposed aggregate finish:
   1. Provide a floated finish as described above.
   2. While the surface is still plastic, embed an approved aggregate uniformly into the surface by light tamping.
   3. Provide complete coverage to the depth of a single stone.
   4. Float the surface until the embedded stone is fully coated with mortar and the surface is brought to a true plane with Class B tolerance.
   5. After the matrix has hardened sufficiently to prevent dislodgment of aggregate, begin exposure.
      a. Allow copious quantities of water, without force, to flow over the surface of the concrete while the matrix encasing the aggregate is removed by brushing with a fine bristle brush.
      b. Continue this operation until the aggregate is uniformly exposed but not dislodged.
   6. An approved chemical retarder sprayed onto the freshly floated surface may be used to extend the working time for exposure of aggregate.

G. Unspecified finish: If the finish of slab surfaces is not specifically called for elsewhere in the Contract Documents, provide the following finishes as applicable:
   1. Scratched finish:
      a. For surfaces scheduled to receive bond-applied cementitious applications.
   2. Floated finish:
      a. For surfaces intended to receive roofing.
   3. Troweled finish:
      a. For floors intended as walking surfaces;
      b. Floors scheduled to receive floor coverings or waterproof membrane;
      c. Parking areas.
   4. Broom finish:
      a. Garage ramps.
   5. Non-slip finish:
      a. Exterior platforms, steps, and landings;
      b. Interior and exterior pedestrian ramps.

3.4 CURING AND PROTECTION

A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures, and mechanical injury.

ORIGINAL (Red)

B. Preservation of moisture:
   1. Unless otherwise directed by the Owner, apply one of the following procedures to concrete not in contact with forms, immediately after completion of placement and finishing:
      a. Ponding or continuous sprinkling;
      b. Application of absorptive mats or fabric kept continuously wet;
      c. Application of sand kept continuously wet;
      d. Continuous application of steam (not exceeding 150ø F) or mist spray;
      e. Application of waterproof sheet materials specified in Part 2 of this Section;
      f. Application of other moisture-retaining covering as approved by the Owner;
      g. Application of the curing agent specified in Part 2 of this Section or elsewhere in the Contract Documents.
   2. Where forms are exposed to the sun, minimize moisture loss by keeping the forms wet until they can be removed safely.
   3. Cure concrete by preserving moisture as specified above for at least seven days.

C. Temperature, wind, and humidity:
   1. Cold weather:
      a. When the mean daily temperature outdoors is less than 40ø F, maintain the temperature of the concrete between 50ø F and 70ø F for the required curing period.
      b. When necessary, provide proper and adequate heating system capable of maintaining the required heat without injury due to concentration of heat.
      c. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.
   2. Hot weather: When necessary, provide wind breaks, fog spraying, shading, sprinkling, ponding, or wet covering with a light colored material, applying as quickly as concrete hardening and finishing operations will allow.
   3. Rate of temperature change: Keep the temperature of the air immediately adjacent to the concrete during and immediately following the curing period as uniform as possible and not exceeding a change of 5ø F in any one hour period, or 50ø F in any 24 hour period.

D. Protection from mechanical injury:
   1. During the curing period, protect the concrete from damaging mechanical disturbances such as heavy shock, load stresses, and excessive vibration.
   2. Protect finished concrete surfaces from damage from construction equipment, materials, and methods, by application of curing procedures, and by rain and running water.
   3. Do not load self-supporting structures in such a way as to overstress the concrete.

END OF SECTION

ORIGINAL (Red)

SECTION 03375
CONCRETE SEALING

PART 1 GENERAL

1.1 SUMMARY

A. Seal concrete surfaces where indicated on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 03300: Cast-in-place concrete.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Sufficient technical data to prove compliance with the specified requirements.
2. Evidence satisfactory to the Owner that the proposed applicator is currently approved by the manufacturer of the specified product.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Use an applicator currently approved in writing by the manufacturer of the specified product.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

1.5 WARRANTY

A. Upon completion of the work of this Section, and as a condition of its acceptance, deliver to the Owner two copies of the manufacturer's standard written warranty, signed by an officer of the manufacturer's firm and co-signed by an officer of the applicator's firm, under which:

1. Surfaces to which the product was applied, under this Section are warranted to remain waterproof, dustproof, hardened, and abrasion resistant; and
2. The manufacturer agrees to provide materials required to maintain such surfaces in the warranted condition for a period of twenty years commencing on the date on which the product was applied; and

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3. The applicator agrees to provide labor and equipment required to maintain such surfaces in the warranted condition for a period of ten years commencing on the date on which the material was applied; and
4. The warranted materials, labor, and equipment will be provided at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 SEALER

A. Where concrete sealer is called for on the Drawings or is specified herein, provide "Ashford Formula" or equal subject to the approval of the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 APPLICATION

A. Preparation:
1. On freshly finished concrete surfaces, no additional preparation is required.
2. On areas where forms are recently removed, remove all form oil and breaking compound residue to assure penetration of the product into the surface.
3. On existing concrete, vertical surfaces, and masonry surfaces:
   a. Sweep all areas to be treated, using a fine bristle broom, or hose off with water and let dry to remove all surface dust and dirt.
   b. Free the surface from all contaminants which would inhibit penetration of the product into the pores of the material to be treated.
   c. Remove all curing, sealing, and coating agents by use of chemical and/or mechanical means as necessary.
   d. If acid is used to remove surface coatings, flush the surface with water sufficiently to remove all acid and acid residue.
4. When applying near windows, mask the glass.
5. Avoid contact with plant life, glass, aluminum, and other finished surfaces. Where contact occurs, immediately wipe with a clean, damp cloth or flush with water.
6. Avoid contact with asphaltic concrete.

B. Application:
1. On freshly finished surfaces, spray the product with a low pressure sprayer immediately following the finishing operation.
   a. To assure proper curing, apply the product to the entire surface as soon as the surface is firm enough to walk on, and before checking and temperature cracking begins.

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b. Keep the entire surface wet for 30 minutes by brooming excess product onto the dry spots, or by respraying the dry spots immediately.

c. As the product begins to dry into the surface and becomes slippery underfoot, lightly sprinkle the surface with water to aid penetration and to bring alkali to the surface.

d. As the product again begins to dry into the surface and become slippery underfoot, flush the surface with water and squeegee the surface totally dry, removing all excess product and alkali or other impurities brought to the surface.

2. On broom-finished surfaces, no flushing is required, but squeegee or broom the excess product from the surface after 30 to 40 minutes.

3. On cured concrete surfaces, saturate the surface with the specified product.

a. If dry spots appear, broom excess material onto the dry spots or respray them immediately.

b. Keep the entire surface wet with the product for 30 minutes.

c. If, after 30 to 40 minutes, the majority of the product has not been absorbed into the surface, broom or squeegee the excess product from low spots and puddles so it will be absorbed into the surface, or remove such excess product from the surface.

d. If, after 30 to 40 minutes, the majority of the product is still on the surface, wait until the surface becomes slippery underfoot and then flush the entire surface with clear water and squeegee completely dry. If no water is available, squeegee the excess product from the surface after 30 minutes so that the surface is completely dry.

END OF SECTION

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SECTION 03400

PRECAST CONCRETE MANHOLES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary to install a precast concrete structure, frame, covers, manhole rungs, appurtenances, and related work, as specified herein, as shown on the Drawings, and as necessary for a complete installation.

B. The CONTRACTOR shall be prepared to install precast concrete structures in conjunction with other construction activities.

C. Work shall include procurement, shipment, and installation of a precast treated effluent discharge line manhole.

1.02 RELATED SECTIONS

A. Section 02220 - Excavation and Subgrade Preparation

B. Section 02200 - Earthwork

C. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

A. CONTRACTORS shall submit for review drawings and conformance data for manhole sections, slabs, steps, frames and covers, location and size of base section and manhole step locations.

PART 2 - PRODUCTS

2.01 GENERAL

A. Products used in the work of this Section shall be produced by manufacturers regularly engaged in the production of similar items and with a history of successful production acceptable to the CQA Consultant.

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2.02 PRECAST CONCRETE SECTIONS

A. Precast concrete pipe sections and slabs shall be constructed and reinforced in accordance with ASTM C478, with a minimum wall thickness of 5 inches and with joints having an "O" ring seal. Manhole sections shall be waterproofed with bituminous material on the exterior.

B. Base section shall have reinforced flat bottoms protruding 6 inches beyond the outside face of the riser section. The flat bottom shall be 6 inches.

C. Tapered top sections shall have concentric opening as shown on the Drawings.

2.03 Manhole steps

A. Steps for manholes shall be cast iron, ASTM A48, Class 30 or others acceptable to the CQA Consultant.

B. Steps shall be installed in each manhole in vertical alignment spaced 12-inches on center and shall be placed over the largest benchwall of the manhole.

C. Steps shall have a minimum tread width of 12-inches and shall be precasted into the manhole sections or other methods of installation with prior acceptance of the CQA Consultant.

2.04 FRAMES AND COVERS

A. Manhole frames and covers shall be in accordance with ASTM A-48, Class 30 and shall be insulated and water tight. Lettering shall be "Groundwater Discharge".

B. Covers shall be provided with a minimum of two water tight pickholes and shall be solid.

2.05 MORTAR AND BRICKS

A. Masonry cement for mortar shall meet the requirements of ASTM C91, Type II and shall be mixed with a graded quality sand conforming to ASTM C144. Mix shall be one part masonry cement to three parts sand using the minimum amount of clean water required for workability.

B. Brick shall meet the requirements of ASTM C62, Grade SW of a hard-burned manufacture.

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2.06 PIPE CONNECTIONS TO MANHOLE

A. Manhole pipe connections shall be made by drilling holes in the side of the manhole approximately one to two inches larger diameter than the penetrating pipe and, after placement, sealing the annular space between pipe and manhole using flexible polyurethane grout or a rubber boot.

2.07 WATERPROOFING MANHOLES

A. The waterproofing for manholes shall be with Bitumastic Epoxy Sealant, and shall be applied in two coats to all interior and exterior surfaces of manholes. Waterproofing shall be performed by the precast concrete fabricator the CONTRACTOR shall waterproof joints of manholes in the field using same waterproofing sealant.

2.08 OTHER MATERIALS

A. All materials not specifically described herein, but required for a complete and proper installation of precast concrete sections, shall be selected by the CONTRACTOR and subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Care shall be taken in loading, transporting, and unloading to prevent damage to precast structures and components. Lifting lugs shall be provided. The CONTRACTOR shall examine all materials before installation. The CONTRACTOR shall not install any material which is defective. Defective materials shall be removed and replaced with new materials by the CONTRACTOR at no cost to the OWNER.

2. Precast concrete structures shall be constructed to the dimensions shown on the Drawings and as specified in these specifications.

B. Manhole Installation

1. Bases of manholes shall be placed on at least 12 inches of pipe bedding material as shown on the Drawings. The top of the bases shall be shaped to mate with the precast sections.

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2. Precast concrete sections shall be set so as to be vertical and with sections in true alignment with a 1/4 inch maximum tolerance to be allowed. The CONTRACTOR shall install the precast sections in a manner that will result in a watertight joint. The joints of precast barrel sections shall be sealed with either a rubber O-ring set in a recess or a preformed flexible joint sealant used in sufficient quantity to fill 75 percent of the joint cavity. The outside and inside joint shall be filled with polyurethane flexible grout and finished flush with the adjoining surfaces. Joints shall be allowed to set for a minimum of 24 hours before backfill material is placed around the manhole adjacent to the joints. Backfilling shall be preformed carefully, bringing the fill up evenly on all sides of the precast sections. If any leaks appear in the manholes, the inside joints shall be caulked using polyurethane flexible grout to the satisfaction of the CQA Consultant.

3. Holes in the concrete barrel sections required for handling or other purposes shall be plugged with a polyurethane flexible grout or polyurethane flexible grout in combination with concrete plugs, and finished flush on the inside.

4. Where holes must be cut in precast sections to accommodate pipes, cutting shall be done prior to setting manhole sections in place to prevent any subsequent jarring which may loosen the mortar joints.

C. Manhole Pipe Connections

Manhole pipe connections shall be in accordance with Part 2.06 of this Section. Pipe stubs for future extensions shall also be connected and the stub end closed by a suitable watertight plug. Shop drawings submitted by the CONTRACTOR shall illustrate that adequate room exists for any valves and fittings.

3.02 CLEANING

A. Manholes shall be thoroughly cleaned of all silt, debris, and foreign matter of any kind prior to final inspection.

END OF SECTION

ORIGINAL
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DIVISION 4

MASONRY

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SECTION 04220
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Provide concrete unit masonry and water repellent coating where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Mock-ups:

1. At an area on the site where approved by the Owner, provide mock-up concrete unit masonry panels.
   a. Make each mock-up panel approximately 4'-0" high and 6'-0" long.
   b. Provide one mock-up panel for each combination of concrete masonry unit, bond pattern, mortar color, and joint type used in the Work.
   c. The mock-up panels may be part of the Work, and may be incorporated into the finished Work, when so approved in advance by the Owner.
   d. Revise as necessary to secure the Owner's approval.
2. If the mock-up panels are not permitted to be a part of the finished Work, completely demolish and remove them from the job site upon completion and acceptance of other Work of this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Store masonry units above ground on level platforms which allow air circulation under the stacked units.

ORIGINAL (Red)

C. Cover and protect against wetting prior to use.

1.5 WARRANTY

A. Upon completion of the work of this Section, and as a condition of its acceptance, deliver to the Owner two copies of a written warranty signed by the Contractor, the water repellent coating application subcontractor, and the water repellent manufacturer, under which:
   1. The three parties mutually agree to maintain the water repellent coated surface free from the penetration of water for a period of two years following Date of Substantial Completion; and
   2. The water repellent coating manufacturer agrees to provide water repellent coating materials as required for that purpose for a period of five years following Date of Substantial Completion; and
   3. These warranty services will be provided at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Provide lightweight hollow load-bearing concrete masonry units complying with ASTM C90, grade N, type I, in color "natural gray".

B. Dimensions:
   1. Provide units of the dimensions shown on the Drawings.
   2. Where dimensions are not shown on the Drawings, provide units having nominal face dimensions of 16" long by 8" high by the depth shown or otherwise required.

C. Provide accessory shapes as indicated or otherwise required.

2.2 REINFORCEMENT AND ACCESSORIES

A. Comply with the following as minimums.
   1. Bars: ASTM A615, grade 40, unless otherwise shown on the Drawings, using deformed bars for number 3 and larger.
   2. Bending: ACI 318.
   3. Wire reinforcement: ASTM A82.

B. Fabricate reinforcement in accordance with recommendations contained in CRSI "Manual of Standard Practices".

2.3 MORTAR

A. Ingredients:
   1. Portland cement: Comply with ASTM C150, type I.
   2. Lime:
      a. Provide hydrated lime complying with ASTM C207, or quicklime complying with ASTM C5.
      b. When quicklime is used, slake and then screen through a 16 mesh sieve. After slaking and screening, but before using, store and protect for not less than ten days.

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3. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter, and complying with ASTM C144.
4. Admixtures: Do not use admixtures unless specifically approved in advance by the Owner.
5. Water: Provide water free from deleterious amounts of acids, alkalis, and organic materials.

B. Mixing:
1. Provide mortar type "M" or type "S", as designated on the Drawings or otherwise directed by the Owner, and in accordance with ASTM C270.
2. Proportions:
   a. For type "M" mortar, provide one part portland cement to 1/4 parts hydrated lime and 3-3/4 parts sand by volume.
   b. For type "S" mortar, provide one part portland cement to 1/2 part hydrated lime and 44-1/2 parts sand by volume.
3. Mechanically mix in a batch mixer for not less than three minutes, using only sufficient water to produce a mortar which is spreadable and of a workable consistency.
4. Retemper mortar with water as required to maintain high plasticity.
   a. On mortar boards, retemper only by adding water within a basin formed with mortar, and by working the water into the mortar.
   b. Discard and do not use mortar which is unused after 1-1/2 hours following initial mixing.

2.4 GROUT

A. Ingredients:
1. Portland cement: Comply with ASTM C150, type I.
2. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter.
3. Admixtures: Do not use admixtures unless specifically approved in advance by the Owner.
4. Water: Provide water free from injurious amounts of acids, alkalis, and organic materials.

B. Mixing:
1. Provide "fine grout" or "coarse grout" as designated on the Drawings of otherwise directed by the Owner, and in accordance with ASTM C476.
2. Grout compressive strength to be 2000 psi unless otherwise indicated on the Drawings.
3. Proportions:
   a. For "fine grout", provide one part portland cement to 2-1/4 parts minimum to 3 parts maximum of damp loose sand, with sufficient water to achieve fluid consistency.

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b. For "coarse grout", provide one part portland cement to three parts maximum of damp loose sand to two parts coarse aggregate, with sufficient water to achieve fluid consistency.

4. "Fluid consistency" is interpreted as meaning as fluid as possible for pouring intimately in place without segregation.

2.5 WATER REPELLENT COATING

A. At all exterior wall surfaces, provide "Rainguard HD" clear water repellent coating, or equal approved in advance by the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 ENVIRONMENTAL CONDITIONS

A. Do not place masonry units when air temperature is below 40ø F.

B. Protect masonry construction from direct exposure to wind and sun when erected in ambient air temperature greater than 90ø F in the shade, with relative humidity less than 50%.

3.3 INSTALLATION

A. General:

1. Do not commence installation of the work of this Section until horizontal and vertical alignment of the foundation is within 1" of plumb and the lines shown on the Drawings.
2. Lay only dry masonry units.
3. Use masonry saws to cut and fit masonry units.
4. Set units plumb, true to line, and with level courses accurately spaced.
5. Clean the top surface of foundation free from dirt, debris, and laitence, and expose the aggregate prior to start of installing first course.
6. Accurately fit the units to plumbing, ducts, openings, and other interfaces, neatly patching all holes.
7. Keep the walls continually clean, preventing grout and mortar stains. If grout does run over, clean immediately.

B. Unless otherwise shown on the Drawings, provide running bond with vertical joints located at center of masonry units in the alternate course below.

C. Do not use chipped or broken units. If such units are discovered in the finished wall, the Owner may require their immediate removal and replacement with new units at no additional cost.

D. Laying up:

1. Place units in mortar with full shoved bed and head joints.

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2. Align vertical cells of hollow units to maintain a clear and unobstructed system of flues.
3. Hold racking to an absolute minimum.
4. Provide cleanouts at the bottom of each cell of hollow units for removing mortar droppings. Do not close the cleanouts until they have been inspected by the Owner.

E. Reinforcement:
1. Provide reinforcement as shown on the Drawings, fully embedded in grout and not in mortar or mortar joints.
2. Provide required metal accessories to ensure adequate alignment of steel during grout filling operations.

F. Tooling:
1. Tool joints to a dense, smooth surface.
2. Unless otherwise shown on the Drawings, provide joints of "concave" pattern throughout.

3.4 GROUTING

A. Perform grouting in strict accordance with the provisions of the governing building code.
1. Solidly fill vertical cells containing reinforcement.
2. Consolidate grout at time of pour by puddling with a mechanical vibrator, filling all cells of the masonry, and then reconsolidating later by puddling before the plasticity is lost.

3.5 CLEANING

A. Inspection and adjustment:
1. Upon completion of the work of this Section, make a thorough inspection of the installed masonry and verify that units have been installed in accordance with the provisions of this Section.
2. Make necessary adjustments.

B. Clean surfaces of masonry as required for proper application of the specified finishes.

3.6 WATER REPELLENT COATING

A. Apply sufficient coats of the approved material to achieve a consistent and uniform appearance, free from runs and sags, and with a uniformly resistive surface which will prevent penetration of water through the walls for the required period of warranty.

B. Twenty days after completion of this portion of the Work, and as a condition of its acceptance, demonstrate by running water test that the work of this Section will successfully repel water.
1. Notify the Owner at least 72 hours in advance, and conduct the test in the Owner's presence.
2. By means of an outrigger or similar acceptable equipment, place the nozzle of a 3/4" garden hose at a point approximately 10'-0" away from the wall where

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approved by the Owner, aiming the nozzle so that water will strike the wall at a downward angle.

3. Run the water onto the wall at full available force for not less than two hours.
4. Upon completion of the test period, inspect the interior surfaces of the wall for evidence of moisture penetration.

C. If evidence of moisture penetration is discovered, apply an additional coat of the approved water repellent to the exterior surface in areas directed by the Owner, repeating the application and testing at no additional cost to the Owner until no evidence of moisture penetration is found.

END OF SECTION

ORIGINAL
(Red)

DIVISION 5

METALS

ORIGINAL (Red)

SECTION 05118
FURNISHING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

A. Furnish; fabricate; mark for erection identification; pack, crate, or otherwise properly prepare for shipment; and ship to the site all structural steel indicated on the Drawings, specified herein, and/or needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 05119: Erecting structural steel.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 45 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Producer's or manufacturer's specifications and installation recommendations for the following products, including laboratory test reports and other data required to prove compliance with the specified requirements.
   a. Structural steel, including certified copies of mill test reports covering chemical and physical properties;
   b. High strength bolts, including nuts and washers;
   c. Unfinished bolts and nuts;
   d. Structural steel primer paint.
2. Shop Drawings including complete details and schedules for fabrication and shop assembly of members.
   a. Include details of cuts, connections, camber, holes, and other pertinent data;
   b. Indicate welds by AWS symbols, and show size, type, and length of weld;
   c. Provide setting drawings, templates, and directions for installing anchor bolts and other required anchors;
   d. Identify details by reference to sheet and detail number of the Drawings.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedures".

ORIGINAL (Red)

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Delivery and storage:

1. Deliver materials to the job site properly marked to identify the location for which they are intended.
2. Use markings corresponding to markings shown on the approved Shop Drawings.
3. Store in a manner to maintain identification and to prevent damage.

PART 2 PRODUCTS

2.1 ALL MATERIALS TO BE OF U. S. A. MANUFACTURE.

2.2 MATERIALS

A. Rolled steel plates and bars: Comply with ASTM A36.

B. Steel pipe: Comply with ASTM A53, type E or S, grade B and, where applicable, API-5L, grade B.

C. Steel tube: Comply with ASTM A501.

D. Anchor bolts: Comply with ASTM A307, non-headed type with heavy hexagonal nuts unless otherwise indicated.

E. Unfinished threaded fasteners:

1. Comply with ASTM A307, grade A, regular low carbon steel bolts and nuts.
2. Provide either hexagonal or square heads and nuts; except use only hexagonal units for exposed connections.

F. High strength threaded fasteners: Provide heavy hexagonal structural bolts, heavy hexagonal nuts, and hardened washers, all from quenched and tempered medium carbon steel complying with ASTM A325.

G. Primer: Use "10-99 Tnemec Primer", "Rustoleum No. 5769 Primer", or equal approved in advance by the Owner.

H. Electrodes for welding: Comply with AWS Code, using AWS A5.1 or A5.5 E70XX electrodes.

2.3 FABRICATION

A. Shop fabrication and assembly:

1. Fabricate items of structural steel in accordance with AISC specifications, and as indicated on the approved Shop Drawings.
2. Properly mark and match-mark materials for field assembly and for identification as to location for which intended.
3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations.

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5. Provide finish surfaces of members exposed in the final structure free from markings, burrs, and other defects.

B. Connections:
1. Provide bolts and washers of types and sizes required for completion of field erection.
2. High strength bolted construction:
   a. Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".
   b. Use A325N bolts unless noted otherwise.
3. Welded construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welded work.
4. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

C. Holes for other work:
1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved Shop Drawings.
2. Provide threaded nuts welded to framing, and other specialty items as shown, to receive other work.
3. Cut, drill, or punch holes perpendicular to metal surfaces.
4. Do not flame cut holes or enlarge holes by burning.
5. Drill holes in bearing plates.

2.4 SHOP PAINTING

A. General:
1. Shop paint structural steel work, except those members or portions of members to be embedded in concrete or mortar.
2. Paint embedded steel which is partially exposed on the exposed portions, and the initial 2" of embedded areas only.
3. Do not paint surfaces which are to be welded or high strength bolted with friction type connections.
4. Apply two coats of paint to surfaces which are inaccessible after assembly or erection. Change color of the second coat to differentiate it from the first.

B. Surface preparation:
1. After inspection and before shipping, clean steelwork to be painted.
2. Remove loose rust, loose mill scale, and spatter, slag, and flux deposits.
3. Clean steel in accordance with Steel Structures Painting Council SP-3, "Power Tool Cleaning".

C. Painting:
1. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's recommendations and at a rate to provide a uniform dry film thickness.

ORIGINAL (Red)

2. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 EXECUTION

3.1 FABRICATION

A. Comply with AISC specifications and "Code of Standard Practice", except as may be modified herein.

B. Anchor bolts:
   1. Provide anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
   2. Provide templates and other devices necessary for presetting bolts and anchors to accurate locations.

C. Bases and bearing plates: Shop weld to columns and members attached to concrete.

D. Splicing:
   1. Splice members only where indicated unless, with the Owner's approval, splices not indicated would result in lower costs due to reduced shipping expense.
   2. For splices not indicated, submit structural calculations prepared and signed by a structural engineer licensed to practice where the fabricator is located.

E. Gas cutting:
   1. Do not use gas cutting torches for correcting fabrication errors in the structural framing.
   2. Cutting will be permitted only in secondary members as acceptable to the Owner.
   3. When gas cutting is permitted, finish the gas cut section to a sheared appearance acceptable to the Owner.

3.2 TESTING AND INSPECTING

A. Test costs:
   1. The Owner's selected testing laboratory will pick up specimens and make required tests.
   2. Cost of procuring test specimens at locations more than 50 miles from the job site will be paid by the Owner and backcharged to the Contractor.
   3. Costs of tests of identified stock will be paid by the Owner; except that if a test fails to comply with the specified requirements, the cost of testing will be paid by the Owner and backcharged to the Contractor.
   4. Costs of tests of unidentified stock will be paid by the Owner and backcharged to the Contractor.

B. Test specimens:
   1. Test specimens shall be furnished by the steel fabricator, and shall be taken under the direction of the Owner's selected testing laboratory.
   2. Each specimen shall be machined by the Owner's selected testing laboratory to dimensions required by ASTM A370.

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3. Cost of procuring, making, and machining test specimens shall be considered test costs as defined above.

C. Identification and tests:
1. If structural steel can be identified by heat or melt numbers, and if accompanied by mill analysis and test reports, not less than one tension and one bend test will be made for each ten tons or major fractional part thereof.
2. If structural steel cannot be identified, or if its source is questionable, not less than one tension test and one bend test will be made for each five tons or fractional part thereof.
3. If steel pipe can be identified by heat or melt number, or manufacturer's name, not less than one tension test and one bend test will be made for each ten tons or major fractional part thereof.
4. Additional tests may be required when deemed necessary by the Owner.

D. Inspecting:
1. A complete four sided inspection of steel will be made when required by the Owner.
2. Cost of inspecting will be paid by the Owner subject to the same provisions made above for tests.
3. If, after fabrication and inspection, the work of this Section is found to be defective and to require reinspection, cost of such reinspection will be paid by the Owner and backcharged to the Contractor.
4. Provide labor, equipment, and facilities needed to move and handle the materials to be inspected.

E. Welding inspection:
1. Unless otherwise specified, perform welding under observation of a qualified inspector from a testing laboratory approved by the Owner.
2. Inspect every layer of weld for quality, penetration, and conformity with design requirements.
3. Require the welding inspector to submit a signed report to the Owner, verifying that:
   a. The welding is adequate and was performed in conformity with the specified requirements;
   b. Adequate methods have been used to determine the quality of the welding.
4. The welding inspector may use gamma ray, magnaflux, trepanning, or any other aid to visual inspection considered necessary to assure adequacy of welding, or may use ultrasonic testing performed in accordance with pertinent requirements of governmental agencies having jurisdiction.
5. Cost of welding inspection will be paid by the Owner.

F. Access: Provide access for the testing agencies and inspectors to places where structural steel work is being fabricated or produced, so that required testing and inspecting may be accomplished.

END OF SECTION

ORIGINAL (Red)

SECTION 05119
ERECTING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

A. Erect structural steel shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Section 05118: Furnishing structural steel.

C. Definitions:
   1. "Structural steel" is that work defined as such in the AISC "Code of Standard Practice", and as otherwise shown on the Drawings or specified herein.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 45 calendar days after the Contractor has received the Owner's Notice to Proceed, submit manufacturer's data on proposed shrinkage-resistant grout.

C. Shop Drawings:
   1. Refer to Shop Drawings requirements stated in Section 05118 of these Specifications.
   2. Should the Contractor elect to change the sequence of erection, or other details of field erection, submit necessary Shop Drawings to the Owner for review.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedures".

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Protection:
   1. Store materials to permit easy access for inspection.
   2. Keep steel members off the ground, using pallets or other support.
   3. Protect steel members and packaged materials from corrosion and deterioration.

ORIGINAL (Red)

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
   1. Refer to Section 05118 of these Specifications for materials furnished thereunder for erection under this Section.
   2. Provide other materials required for completion of erected structural steel.

B. Headed stud type shear connectors: Comply with ASTM A108, grade 1015 or 1020, cold-finished carbon steel, with dimensions complying with the AISC specifications.

C. Unfinished threaded fasteners:
   1. Comply with ASTM A307, grade A, regular low carbon steel bolts and nuts.
   2. Provide hexagonal heads and nuts for all fasteners.

D. Metallic non-shrink grout:
   1. Provide high-strength non-shrink metallic grout as approved by the Owner.
   2. Acceptable products:
      a. "Embeco", manufactured by Master Builders.
      b. Equal products of other manufacturers when approved in advance by the Owner.

2.2 FABRICATION

A. High strength bolted construction:
   1. Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".
   2. Use A325N bolts unless otherwise noted.

B. Welded construction:
   1. Comply with AWS Code for procedures, appearance, and quality of welds, and for methods used in correcting welding.
   2. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

C. Holes for other work:
   1. Should holes be required in addition to those provided under Section 05118, provide such holes and strengthen the area as required to compensate, always subject to the approval of the Owner.
   2. Provide threaded nuts welded to framing, and other specialty items as required, to receive other work.
   3. Cut, drill, or punch holes perpendicular to metal surfaces.
   4. Do not flame cut holes or enlarge holes by burning.
   5. Drill holes in bearing plates as required.

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PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 ERECTION

A. Comply with AISC specifications and "Code of Standard Practice", and as specified herein.

B. Surveys:
   1. Establish permanent benchmarks necessary for accurate erection of structural steel.
   2. Check elevations of concrete surfaces, and locations of anchor bolts and similar items, before erection proceeds.

C. Temporary shoring and bracing:
   1. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads.
   2. Provide temporary guy lines to achieve proper alignment of the structure as erection proceeds.
   3. Remove temporary connections and members when permanent members are in place and the final connections have been made.

D. Anchor bolts:
   1. Install anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
   2. Provide templates and other devices needed for presetting bolts and other anchors to accurate locations.

E. Setting bases and bearing plates:
   1. Clean concrete bearing surfaces free from bond-reducing materials, and then roughen to improve bond to the surface.
   2. Clean the bottom surface of base and bearing plates.
   3. Set loose and attached base plates and bearing plates for structural members in wedges or other adjusting devices.
   4. Tighten anchor bolts after the supported members have been positioned and plumbed.
   5. Do not remove wedges or shims but, if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.
   6. Pack grout solidly between bearing surfaces and bases or plates to assure that no voids remain.
   7. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's recommendations.

F. Field assembly:
   1. Set structural frames accurately to the lines and elevations indicated.

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2. Align and adjust the members forming a part of a complete frame or structure before fastening permanently.
3. Clean the bearing surface, and other surfaces which will be in permanent contact, before assembly.
4. Adjust as required to compensate for discrepancies in elevation and alignment.
5. Level and plumb individual members of the structure within specified AISC tolerances.
6. Establish required leveling and plumbing measurements on the mean operating temperature of the structure, making allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.
7. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

G. Gas cutting:
1. Do not use gas cutting torches for correcting fabrication errors in the structural framing.
2. Cutting will be permitted only on secondary members as acceptable to the Owner.
3. When gas cutting is permitted, finish the section to a sheared appearance acceptable to the Owner.

3.3 FIELD QUALITY CONTROL

A. Inspection:
1. The Owner's testing and inspection agency will inspect high strength bolted connections, will visually inspect field welded connections, will perform such additional tests and inspections of field work as are required under Section 05118 of these Specifications or by the Owner, and will prepare test reports for the Owner's review.
2. The testing agency will conduct and interpret the tests and will state in each report whether the inspected work complies with the requirements, and will specifically state all deviations therefrom.

B. Correction:
1. Correct deficiencies in structural steel work which inspections and test reports indicate to be not in compliance with the specified requirements.
2. Perform additional tests required to reconfirm noncompliance of the original work and to show compliance of corrected work, all at no additional cost to the Owner.

C. Inspect field bolted connections in accordance with the AISC specifications.

D. Field welding: Inspect and test during erection of structural steel as follows:
1. Certify welders and conduct inspections and tests in accordance with provisions of Paragraph 3.2-E of this Section of these Specifications.
2. Record types and locations of defects found in the work of this Section.
3. Record the work required and performed to correct deficiencies.

ORIGINAL (Red)

4. Perform visual inspection of all welds.

3.4 PAINTING

A. General:
   1. Prime coat structural steel and fittings, except galvanized items, which will not be enclosed or concealed in the finished Work.
   2. Use prime coat material identical to that approved for use under Section 05118 of these Specifications.

B. Procedures:
   1. Prepare surfaces as required under Section 05118 of these Specifications.
   2. After erection, clean spots and surfaces where paint has been removed, damaged, or burned off, and clean field bolts and other field connections not concealed in the finished Work.
   3. Remove dirt, oil, and grease.
   4. Apply a spot coat of the approved primer.
   5. Do not apply paint to wet, damp, oily, or improperly prepared surfaces.
   6. Spray apply the primer, filling joints and corners, and covering surfaces with a smooth unbroken film of at least 1.5 mils dry thickness.

C. Notify the Owner when the work of this Section is ready to receive primer.

D. Secure inspection and approval by the Owner prior to application of the primer.

END OF SECTION

ORIGINAL (Red)

SECTION 05200
METAL JOISTS

PART 1 GENERAL

1.1 SUMMARY

A. Provide metal joist system, complete with accessories, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Section 05118: Furnishing structural steel.
   3. Section 05119: Erecting structural steel.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
   3. Shop Drawings showing sizes, spacing, and location of joists, connections, bridging, reinforcing, anchoring, cambers, loads, and other pertinent data, and showing welded connections and the length thereof, using AWS standard welding symbols;
   4. Manufacturer's recommended installation procedures, which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. In addition to complying with pertinent requirements of governmental agencies having jurisdiction, comply with the "Standard Load Tables" and pertinent standard specifications of the Steel Joist Institute.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

ORIGINAL (Red)

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide steel joists and accessories system in dimensions and arrangements shown on the Drawings.

2.2 FABRICATION

A. Fabricate the steel joists system in strict accordance with the approved Shop Drawings and the requirements of governmental agencies having jurisdiction, and in accordance with the following as pertinent:

1. Verify dimensions prior to fabrication.
2. Provide top and bottom joist chord extensions where indicated on the Drawings or otherwise required.
3. Where wood nailers are required:
   a. Drill holes at proper locations in top chords;
   b. Weld threaded lugs to top chords for attachment of the nailers;
   c. Make allowances in bottom chords to compensate for reduction in cross-sectional area of the top chords.
4. Camber joists to accommodate dead load deflection.

B. Except where galvanizing may be called for on the Drawings or the approved Shop Drawings, shop-prime the joist system using one coat of "10-99 Tnemec Primer", "Rustoleum No. 5769 Primer", or equal approved in advance by the Owner, to a dry film thickness between 2.0 and 3.5 mils.

2.3 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the original design, the approved Shop Drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the Owner, anchoring all components firmly into position for long life under hard use.

END OF SECTION

ORIGINAL (Red)

SECTION 05300
METAL DECKING

PART 1 GENERAL

1.1 SUMMARY

A. Provide metal decking where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 05118: Furnishing structural steel.
3. Section 05119: Erecting structural steel.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Shop Drawings showing layout of decking, with details of materials, gauges, accessories, openings, finishes, welds, and other pertinent conditions;
4. Manufacturer's recommended installation procedures, which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. When the materials of this Section are used as a part of an assembly indicated on the Drawings in which fire-resistive construction ratings are required, demonstrate approval by Underwriters' Laboratories, Inc. and the governmental agencies having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

ORIGINAL (Red)

PART 2 PRODUCTS

2.1 METAL DECK UNITS

A. Design the units in accordance with AISC "Specification for Design of Light Gauge Cold-Formed Steel Structural Members".

1. Floor deck:
   a. Provide that the maximum steel flexural stress for dead load plus construction load will be 20,000 psi; and
   b. Do not allow deflection under dead load to exceed 1" or L/180, whichever is smaller.
2. Roof deck:
   a. Provide for a maximum steel fiber stress of 20,000 psi; and
   b. Provide that the live load deflection does not exceed L/240 of the span.

B. Properties:

1. Form from galvanized steel sheets complying with ASTM A446, with a minimum yield strength of 33,000 psi, and coat in accordance with ASTM A525, designation G60.
2. Provide the pattern shown on the Drawings.

C. Acceptable products:

1. Floor deck:
   a. Inryco Floor Deck 1-1/2" B; or equal products of H. H. Robertson Co., Bethlehem Steel Co., or other members of the Steel Deck Institute.

2.2 ACCESSORIES

A. Floor deck:

1. Provide accessories specifically designed to be used with the metal deck system approved for this Work.
2. Provide other accessories normal to the uses shown on the Drawings including, but not necessarily limited to:
   a. Sheet metal ends, sides, and column closures as shown on the Drawings or otherwise required.

B. Roof deck:

1. Provide accessories specifically designed to be used with the metal deck units supplied to the Work, and as normal to the uses shown on the Drawings, including but not necessarily limited to:
   a. Ridge and valley plates, closures, cant strips, and sump pans if required.
2. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

ORIGINAL (Red)

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Prior to start of installation, verify that beams are in proper alignment and that surfaces are clean for welding.

B. Place each unit on the supporting steel framework, and adjust to final position prior to permanent welding.

1. Fasten panels to each structural support by welds not less than 3/4" diameter spaced 12" on center, with three welds for each 30" wide panel.
2. Fasten sheet metal accessories by tack welding or screwing at 3'-0" on center.
3. Button punch panels together if so indicated on the Drawings, recommended by the manufacturer, or required by governmental agencies having jurisdiction.
4. For roof decks, weld sump pans when required, directly to the deck at 6" on center around the perimeter of the pan.

C. Complete installation in accordance with the manufacturer's recommendations as approved by the Owner.

3.3 TOUCH UP

A. Upon completion of installation, and as a condition of its acceptance, visually inspect each item installed under this Section and locate surfaces where finish was damaged.

1. Touch up galvanized surfaces with zinc-rich primer or other galvanized repair paint approved for the purpose by the Owner.
2. Touch up other damaged surfaces as required to return the surfaces to condition commensurate with the services required.

END OF SECTION

ORIGINAL (Red)

SECTION 05500
METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Provide miscellaneous metal work shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades;
4. Manufacturer's recommended installation procedures, which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 MATERIALS

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Comply with the following standards, as pertinent:

ORIGINAL (Red)

1. Steel plates, shapes, and bars: ASTM A36;
2. Steel plates to be bent or cold-formed: ASTM A283, grade C;
3. Steel tubing (hot-formed, welded, or seamless): ASTM A501;
4. Steel bars and bar-size shapes: ASTM A306, grade 65, or ASTM A36;
5. Cold-finished steel bars: ASTM A108;
6. Cold-rolled carbon steel sheets: ASTM A336;
7. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525;
8. Stainless steel sheets: AISI type 302 or 304, 24 gauge, with number 4 finish;
9. Gray iron castings: ASTM A48, class 10;
10. Malleable iron castings: ASTM A47;
11. Steel pipe: ASTM A53, grade A, schedule 40, black finish unless otherwise noted;
12. Concrete inserts:
    a. Threaded or wedge type galvanized ferrous castings of malleable iron complying with ASTM A27;
    b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.

2.2 FASTENERS

A. General:
1. For exterior use and where built into exterior walls, provide zinc-coated fasteners.
2. Provide fasteners of type, grade, and class required for the particular use.

B. Comply with the following standards as pertinent:
1. Bolts and nuts: Provide hexagon-head regular type complying with ASTM A307, grade A
2. Lag bolts: Provide square-head type complying with Fed. Spec. FF-B-561;
3. Machine screws: Provide cadmium plated steel type complying with Fed. Spec. FF-S-111;
4. Washers:
    a. Plain washers: Comply with Fed. Spec. FF-W-92, round, carbon steel;
    b. Lock washers: Comply with Fed. Spec. FF-W-84, helical spring type carbon steel;
5. Toggle bolts: Provide type, class, and style needed but complying with Fed. Spec. FF-B-588;
6. Anchorage devices: Provide expansion shield complying with Fed. Spec. FF-S-325.

2.3 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

2.4 SHOP PAINT

A. Primer: Use "10-99 Tnemec Primer" or "Rustoleum Number 5769 Primer".

ORIGINAL (Red)

B. For repair of galvanizing, use a high-zinc content paint complying with MIL-P-21035.

2.5 FABRICATION

A. Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of the size, thickness, and type required to produce reasonable strength and durability in the work of this Section.

B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item.

D. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from first.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.3 INSTALLATION

A. General:

1. Set work accurately into position, plumb, level, true, and free from rack.
2. Anchor firmly into position.
3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc welding for appearance and quality of weld and for methods to be used in correcting welding work.
4. Grind exposed welds smooth, and touch up shop prime coats.
5. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or screwed field connections.

B. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with same material used for shop painting.

END OF SECTION

ORIGINAL
(Red)

DIVISION 6

WOOD AND PLASTICS

ORIGINAL (Red)

SECTION 06010
LUMBER

PART 1 GENERAL

1.1 SUMMARY

A. Provide wood, nails, bolts, screws, framing anchors and other rough hardware, and other items required for rough and finish carpentry as shown on the Drawings, specified herein, and needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Codes and standards:

1. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, unless otherwise specifically directed or permitted by the Owner comply with:

a. "Plywood Specification and Grade Guide" of the American Plywood Association.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Protection:

1. Deliver the materials to the job site and store, in a safe area, out of the way of traffic, and shored up off the ground surface.
2. Identify framing lumber as to grades, and store each grade separately from other grades.
3. Protect metals with adequate waterproof outer wrapping.
4. Use extreme care in off loading of lumber to prevent damage, splitting, and breaking of materials.

PART 2 PRODUCTS

2.1 GRADE STAMPS

A. Identify framing lumber by the grade stamp of the appropriate regional lumber inspecting and testing agency.

ORIGINAL (Red)

B. Identify plywood as to species, grade, and glue type by the stamp of the American Plywood Association.

C. Identify other materials of this Section by the appropriate stamp of the representative agency.

2.2 MATERIALS

A. Provide materials in the quantities needed for the Work shown on the Drawings, and meeting or exceeding the following standards of quality:

1. Horizontal framing members: Douglas Fir-Hemlock or similar, Table 1, Construction grade.
2. Vertical framing members: Douglas Fir-Hemlock or similar, Table 1, Standard grade.
3. Plywood:
   a. Sheathing: Structural II, C-C, exterior; or standard sheathing with exterior glue.
4. Rough hardware:
   a. Steel items:
      (1) Comply with ASTM A7 or ASTM A36.
      (2) Use galvanized at exterior locations.
   b. Machine bolts: Comply with ASTM A307.
   c. Lag bolts: Comply with Fed. Spec. FF-B-561.
   d. Nails:
      (1) Use common except as otherwise noted;
      (2) Use galvanized at exterior locations.

2.3 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.1 DELIVERIES

A. Stockpile materials sufficiently in advance of need to assure their availability in a timely manner for this Work.

B. Make as many trips to the job site as are needed to deliver materials of this Section in a timely manner to ensure orderly progress of the Work.

3.2 COMPLIANCE

A. Do not permit materials not complying with the provisions of this Section to be brought onto or to be stored at the job site.

B. Promptly remove non-complying materials from the job site and replace with materials meeting the requirements of this Section.

END OF SECTION

ORIGINAL (Red)

SECTION 06100
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Install wood framing as shown on the Drawings, specified herein, and needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 06010: Lumber

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

(No products required for this Section.)

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 WORKMANSHIP

A. Produce joints which are tight, true, and well nailed, with members assembled in accordance with the Drawings and with pertinent codes and regulations.

B. Selection of lumber pieces:

1. Carefully select the members.
2. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing, and will allow making of proper connections.
3. Cut out and discard defects which render a piece unable to serve its intended function.

ORIGINAL (Red)

4. Lumber may be rejected by the Owner, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

C. Do not shim any framing component.

3.3 GENERAL FRAMING

A. General:
1. In addition to framing operations normal to the fabrication and erection indicated on the Drawings, install wood blocking and backing required for the Work of other trades.
2. Set horizontal and sloped members with crown up.
3. Do not notch, cut, or bore members for pipes, ducts, or conduits, or for other reasons except as shown on the Drawings or as specifically approved in advance by the Owner.

B. Bearings:
1. Make bearings full unless otherwise indicated on the Drawings.
2. Finish bearing surfaces on which structural members are to rest so as to give sure and even support.
3. Where framing members slope, cut or notch the ends as required to give uniform bearing surface.

3.4 BLOCKING AND BRIDGING

A. Install blocking as required to support items of finish and to cut off concealed draft openings, both vertical and horizontal, between ceiling and floor areas.

B. Bridging:
1. Install wood cross bridging (not less than 2" by 3" nominal), metal cross bridging of equal strength, or solid blocking between joists where the span exceeds 8'-0".
2. Provide maximum distance of 8'-0" between a line of bridging and a bearing.
3. Cross bridging may be omitted for roof and ceiling joists where the omission is permitted by code, except where otherwise indicated on the Drawings.
4. Install solid blocking between joists at points of support and wherever sheathing is discontinuous. Blocking may be omitted where joists are supported on metal hangers.

3.5 ALIGNMENT

A. On framing members to receive a finished surface, align the finish subsurface to vary not more than 1/8" from the plane of surfaces of adjacent furring and framing members.

3.6 INSTALLATION OF PLYWOOD SHEATHING

A. Placement:
1. Place plywood with face grain perpendicular to supports and continuously over at least two supports, except where otherwise shown on the Drawings.
2. Center joists accurately over supports, unless otherwise shown on the Drawings.

ORIGINAL (Red)

B. Protect plywood from moisture by use of waterproof coverings until the plywood in turn has been covered with the next succeeding component or finish.

3.7 FASTENING

A. Nailing:
1. Use only common wire nails or spikes of the dimension shown on the Nailing Schedule, except where otherwise specifically noted on the Drawings.
2. For conditions not covered in the Nailing Schedule provide penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike, provided however, that 16d nails may be used to connect two pieces of 2" (nominal) thickness.
3. Nail without splitting wood.
4. Prebore as required.
5. Remove split members and replace with members complying with the specified requirements.

B. Bolting:
1. Drill holes 1/16" larger in diameter than the bolts being used.
2. Drill straight and true from one side only.
3. Do not bear bolt heads on wood, but use washers under head and nut where both bear on wood, and use washers under all nuts.

C. Screws:
1. For lag screws and wood screws, prebore holes same diameter as root of threads, enlarging holes to shank diameter for length of shank.
2. Screw, do not drive, lag screws and wood screws.

3.8 NAILING SCHEDULE

A. Unless otherwise directed by the Owner, comply with nailing requirements stipulated by the current edition of the applicable building code.

END OF SECTION

ORIGINAL (Red)

SECTION 06200
FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Install wood trim and other items not specifically described as being installed under other Sections of these Specifications.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 06010: Lumber
3. Section 06100: Rough carpentry.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

(No products required for this Section.)

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 WORKMANSHIP

A. Produce joints which are tight, true, and well nailed, with all members assembled in accordance with the Drawings.

B. Joining and fastening:

1. Make joints to conceal shrinkage; miter exterior joints; cope interior joints; miter or scarf end-to-end joints.
2. Install trim in pieces as long as possible, jointing only where solid support is obtained.
3. Install items straight, true, level, plumb, and firmly anchored in place.

ORIGINAL (Red)

4. Where blocking or backing is required, coordinate as necessary with other trades to ensure placement of required backing and blocking in a timely manner.
5. Nail trim with finish nails of proper dimension to hold the member firmly in place without splitting the wood.
6. Nail exterior trim with galvanized nails, making joints to exclude water and setting in waterproof glue or the sealant described in Section 07920 of these Specifications.
7. On exposed work, set nails for putty.
8. Screw, do not drive, wood screws; except that screws may be started by driving and then screwed home.

3.3 INSTALLATION OF OTHER ITEMS

A. Install items in strict accordance with the Drawings, and the recommended methods of the manufacturer, anchoring firmly into position at the prescribed location, straight, plumb, and level.

3.4 FINISHING

A. Sandpaper finished wood surfaces thoroughly as required to produce a uniformly smooth surface, always sanding in the direction of the grain; except do not sand wood which is designed to be left rough.

B. No coarse grained sandpaper mark, hammer mark, or other imperfection will be accepted.

3.5 CLEANING UP

A. Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the Work, free from accumulation of sawdust, cut-ends, and debris.

B. Sweeping:
1. At the end of each working day, and more often if necessary, thoroughly sweep surfaces where refuse from this portion of the Work has settled.
2. Remove this refuse to the area of the job site set aside for its storage.
3. Upon completion of this portion of the Work, thoroughly broom clean all surfaces.

END OF SECTION

ORIGINAL
(Red)

DIVISION 7

THERMAL AND MOISTURE PROTECTION

ORIGINAL (Red)

SECTION 07210
BUILDING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Provide building insulation where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide the following building insulation where shown on the Drawings or otherwise needed to achieve the degree of insulation required under pertinent regulations of governmental agencies having jurisdiction.

1. Type A: 3-1/2" thick foil-faced glass fiber batts with an insulation-only value of R-11.
2. Type B: 6" thick foil-faced glass fiber batts with an insulation-only value of R-19.
3. Type C: 3-12/" thick unfaced glass fiber sound isolating batts.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

ORIGINAL (Red)

B. Remove, or protect against, projections in construction framing which may damage or prevent proper insulation.

3.2 INSTALLATION

A. Install the work of this Section in strict accordance with the original design, requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the owner, anchoring all components firmly into position.

END OF SECTION

ORIGINAL
(Red)

DIVISION 8

DOORS AND WINDOWS

ORIGINAL (Red)

SECTION 08100
METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Provide metal doors, and metal door and window frames, which are not specifically described in other Sections of these Specifications, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Shop Drawings showing details of each frame type, elevations of door designs, details of openings, and details of construction, installation, and anchorage.
4. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Unless specifically otherwise approved by the Architect, provide all products of this Section from a single manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 METAL DOORS

A. Acceptable products:

1. As manufactured by _____;
2. Equal products of other manufacturers approved in advance by the Architect.

ORIGINAL (Red)

B. Type and design:
   1. Provide full-flush design, fabricated from metal complying with ASTM A40, hot dip galvanized and prime painted, with a tightly hemmed vertical seam on lock and hinge edges, with top flush channel and beveled lock edge, in the dimensions and types shown on the Drawings, reinforced for the finish hardware being provided under Section 08710 of these Specifications, and in the following model numbers and gauges:
      a. _____ non-labeled, 20, gauge honeycomb core;
      b. _____ non-labeled, 20, gauge foamed core;
      c. _____ labeled, 20 gauge, honeycomb core;
      d. _____ labeled, 18 gauge, mineral core.

C. Where indicated on the Drawings, provide louvers of clear anodized aluminum fabricated in a sightproof arrangement, complete with aluminum screen.

D. Pre-clean and shop prime each door for finish painting which will be performed at the job site under Section 09900 of these Specifications.

2.2 METAL FRAMES

A. Acceptable products: See Paragraph 1.3.B above.

B. Type and design:
   1. Provide frames in the dimensions and types shown on the Drawings, non-labelled or labeled as indicated on the Drawings, in 18 gauge for interior frames and 16 gauge for exterior frames, properly reinforced for the finish hardware being provided under Section 08710 of these Specifications.
   2. The Contractor may, at his option, provide either all welded or knock-down construction.

C. Pre-clean and shop prime each frame for finish painting which will be performed at the job site under Section 09900 of these Specifications.

2.3 FINISH HARDWARE

A. Secure templates from the finish hardware supplier, and accurately install, or make provision for, all finish hardware at the factory.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Placing frames:
   1. Where practicable, place frames prior to construction of enclosing walls and ceilings.

ORIGINAL (Red)

2. Set frames accurately into position, plumbed, aligned, and braced securely until permanent anchors are set.
3. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
4. At in-place construction, set frames and secure to adjacent construction with machine screws and suitable anchoring devices. Provide "Z" fillers at each screw location.
5. When installed in prepared openings in concrete construction, provide sealant between frame and concrete in accordance with provisions of Section 07920 of these Specifications.

3.3 ADJUST AND CLEAN

A. Final adjustments:
1. Check and readjust operating finish hardware items in hollow metal work just prior to final inspection.
2. Leave work in complete and proper operating condition.
3. Remove defective work and replace with work complying with the specified requirements.

B. Immediately after erection, sand smooth all rusted and damaged areas of prime coat, and apply touchup of compatible air-drying primer.

END OF SECTION

ORIGINAL (Red)

SECTION 08710
FINISH HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Provide finish hardware throughout the Work as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.
2. Installation of finish hardware is described in other Sections of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 45 calendar days after the Contractor has received Owner's Notice to Proceed, submit:

1. A "Door Schedule" listing all doors in the Work, and all other locations requiring finish hardware (a copy of the Door Schedule included in the Drawings may be used for this purpose), and assigning a "Hardware Group" to each door and other location.
2. A "Finish Hardware Schedule" listing each of the proposed "Hardware Groups," and defining in detail the proposed contents of each Hardware Group.
   a. Show the quantity of each type of item proposed to be supplied within each Hardware Group;
   b. Show the dimensions, when pertinent, and the manufacturer's catalog number;
   c. Show the finish of each item;
   d. Show the manufacturer's name by a suitable legend.

C. Samples:

1. Within 15 days after being so requested by the Owner, deliver to the Owner Samples of each finish hardware item.
2. All Samples will be returned to the Contractor, provided those Samples which are approved by the Owner are positively identified and are installed in the Work at locations agreed to by the Owner.

D. In a timely manner to assure the orderly progress of the Work, deliver templates or physical samples of the approved finish hardware items to pertinent manufacturers of interfacing items such as doors and frames.

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1.3 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Individually package each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on the outside to indicate contents and specific locations in the Work.

PART 2 PRODUCTS

2.1 GENERAL

A. Fasteners:

1. Furnish necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.
2. Where necessary, furnish fasteners with expansion shields, toggle bolts, sex bolts, and other anchors approved by the Owner, according to the material to which the hardware is to be applied and according to the recommendations of the hardware manufacturer.

B. Where butts are required to swing 180 degrees, furnish butts of sufficient throw to clear the trim.

C. Furnish silencers for door frames at the rate of three for each single door and two for each door of pairs of doors; except weather-stripped doors and doors with light seals or sound seals.

2.2 KEYING

A. Factory key, masterkey, and grand-masterkey locks and cylinders as directed by the Owner.

B. Furnish three keys for each lock, twelve masterkeys for each set, and three grand-masterkeys.

C. Construction keying:

1. Furnish a construction masterkey system with 15 keys for locks and cylinders.
2. Use only the construction keys during construction.
3. At the time of final acceptance of the Work, void the construction key system and, in the presence of the Owner, demonstrate that the specified keying system is operating properly.

D. Identification and delivery:

1. Factory stamp permanent keys, "DO NOT DUPLICATE."
2. Identify permanent keys with tags, and send direct to the Owner by registered mail.

2.3 TOOLS AND MANUALS

A. With the delivery of the permanent keys, deliver to the Owner one complete set of adjustment tools and one set of maintenance manuals for locksets, latchsets, closers, and panic devices.

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2.4 ACCEPTABLE PRODUCTS

A. Single source for items:
   1. Except as specifically otherwise approved by the Owner, furnish for each item (such as "door butt type 1") only the product of a single manufacturer.
   2. To the maximum extent practicable, furnish similar items (such as "door butts") only as the products of a single manufacturer.

B. For each of the required items of finish hardware, provide from the following list of acceptable products, or equals approved in advance by the Owner.
   1. Door butts: Hager; Lawrence; or McKinney.
   2. Locksets: Schlage.
   3. Latchsets: Schlage.
   4. Door closers: Norton; Yale.
   5. Panic devices: Von Duprin.
   6. Door stops: Builders Brass Works; Quality.

C. Finishes: Provide finish hardware with finish selected by the Owner from standard finishes of the approved manufacturers in the actual items selected.

2.5 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.1 DELIVERIES

A. Stockpile items sufficiently in advance to assure their availability, and make necessary deliveries to the jobsite in a timely manner to assure orderly progress of the total Work.

3.2 COORDINATION

A. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interference with the work of this Section.

END OF SECTION

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SECTION 08800
GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Provide glazing and glazing accessories where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 60 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturers' specifications and other data needed to prove compliance with the specified requirements;
3. Manufacturers' recommended installation procedures which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. During storage and handling of glass, provide cushions at edges to prevent impact damage.

PART 2 PRODUCTS

2.1 GLASS

A. General:

1. For all glass, provide the type and thickness shown on the Drawings or specified herein.
2. Where type or thickness, or both, are not shown on the Drawings or specified herein, provide type and thickness directed by the Owner.

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B. Plate or float glass:
   1. Comply with Fed Spec DD-G-451, type I, class 1, quality q3.2.
   2. Where plate glass is called for, plate glass or float glass may be used.

C. Sheet glass:
   1. Provide type II, class 1, quality q5.

D. Clear wire glass:
   1. Provide type III, class 1, kind A, form 1, with pattern M3 wire mesh where shown or required.

E. Tempered glass:
   1. Provide tempered or heat-strengthened glass where indicated on the Drawings, and elsewhere as required by governmental agencies having jurisdiction.
   2. Glass for tempering:
      a. For plate glass or float glass, use type I, class 1, quality q3.
   3. Sizes and cutting.
      a. Prior to tempering or heat treating, cut glass to required sizes as determined by accurate measurements of the openings to be glazed, making allowances for required edge clearances.
      b. Cut and process edges in accordance with the glass manufacturer's recommendations.
      c. Do not cut or treat edges in the field.

F. Laminated glass:
   1. Provide laminated safety glass, clear and/or tinted as shown on the Drawings, consisting of an inner face and an outer face of float glass laminated under heat and pressure to a clear plastic core.
   2. Use 1/4" thickness for maximum sizes of 60" x 120".
   3. For larger sizes, use 3/8" thickness.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Clean glazing channels, stops, and rabbets to receive the glazing materials, making free from obstructions and deleterious substances which might impair the work.
   1. Remove protective coatings which might fail in adhesion or interfere with bond of sealants.
   2. Comply with manufacturers' instructions for final wiping of surfaces immediately prior to application of primer and glazing compounds of tapes.

3. Prime surfaces to receive glazing compounds in accordance with manufacturers' recommendations.

3.2 INSTALLATION

A. Inspect each piece of glass immediately prior to start of installation.
   1. Do not install items which are improperly sized, have damaged edges, or are scratched, abraded, or damaged in any other manner.
   2. Do not remove labels from glass until so directed by the Owner.

B. Mask, or otherwise protect, surfaces adjacent to installation or sealants.

C. Miter-cut and seal the joints of glazing gaskets in accordance with the manufacturer's recommendations, to provide watertight and airtight seal at corners and other locations where joints are required.

3.3 PROTECTION

A. Protect glass from breakage after installation by promptly installing streamers or ribbons, suitably attached to the framing and held free from glass. Do not apply warning markings, streamers, ribbons, or other items directly to the glass except as specifically directed by the Owner.

END OF SECTION

ORIGINAL
(Red)

DIVISION 9

FINISHES

ORIGINAL (Red)

SECTION 09260
GYPSUM WALLBOARD SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Provide gypsum drywall and accessories where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 35 calendar days after the Contractor has received Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Manufacturer's recommended installation procedures which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 GYPSUM WALLBOARD

A. General

1. Provide gypsum wallboard complying with Fed Spec SS-L-30D, in 48" widths and in such lengths as will result in a minimum of joints.
2. Regular wallboard: Provide type III, grade R, class 1, 5/8" thick expect as may be shown otherwise on the Drawings.
3. Fire-retardant wallboard: Provide type VII, grade W or X as required, class 2, 5/8" thick except as may be shown otherwise on the Drawings.

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2.2 METAL TRIM

A. Form from zinc-coated steel not lighter than 26 gage, complying with Fed Spec QQ-S-775, type I, class d or e.

B. Casing beads:
   1. Provide channel-shapes with an exposed wing, and with a concealed wing not less than 7/8" wide.
   2. The exposed wing may be covered with paper cemented to the metal, but shall be suitable for joint treatment.

C. Corner beds: Provide angle shapes with wings not less than 7/8" wide and perforated for mailing and joint treatment, or with combination metal and paper wings bonded together, not less than 1-1/4" wide and suitable for joint treatment.

D. Edge beads for use at perimeter of ceilings:
   1. Provide angle shapes with wings not less than 3/4" wide.
   2. Provide concealed wing perforated for nailing, and exposed wing edge folded flat.
   3. Exposed wing may be factory finished in white color.

2.3 JOINTING SYSTEM

A. Provide a jointing system, including reinforcing tape and compound, designed as a system to be used together and as recommended for this use by the manufacturer of the gypsum wallboard approved for use on this Work.

B. Jointing compound may be used for finishing if so recommended by its manufacturer.

2.4 FASTENING DEVICES

A. For fastening gypsum wallboard in place on metal studs and metal channels, use flat-head screws, shouldered, specially designed for use with power-driven tools, not less than 1" long, with self-tapping threads and self-drilling points.

B. For fastening gypsum wallboard in place on wood, use 1-1/4" type W bugle-head screws, or use annular ring type nails complying with ASTM C514 and of the length required by governmental agencies having jurisdiction.

2.5 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:

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1. Install the gypsum wallboard in accordance with the Drawings and with the separate boards in moderate contact but not forced into place.
2. At internal and external corners, conceal the cut edges of the boards by the overlapping covered edges of the abutting boards.
3. Stagger the boards so that corners of any four boards will not meet at a common point except in vertical corners.

B. Ceilings:
1. Install the gypsum wallboard to ceilings with the long dimension of the wallboard at right angles to the supporting members.
2. Wallboard may be installed with the long dimension parallel to supporting members that are spaced 16" on centers when attachment members are provided at end joints.

C. Walls:
1. Install the gypsum wallboard to studs at right angles to the furring or framing members.
2. Make end joints, where required, over framing or furring members.

D. Attaching:
1. Drive the specified screws with clutch-controlled power screwdrivers, spacing the screws 12" on centers at ceilings and 16" on centers at walls.
2. Where framing members are spaced 24" apart on walls, space screws 12" on centers.

3.3 JOINT TREATMENT

A. General:
1. Inspect areas to be joint treated, verifying that the gypsum wallboard fits snugly against supporting framework.
2. In areas where joint treatment and compound finishing will be performed, maintain a temperature of not less than 55 degrees for 24 hours prior to commencing the treatment, and until joint and finishing compounds have dried.
3. Apply the joint treatment and finishing compound by machine or hand tool.
4. Provide a minimum drying time of 24 hours between coats, with additional drying time in poorly ventilated areas.

B. Embedding compounds:
1. Apply to gypsum wallboard joints and fastener heads in a thin uniform layer.
2. Spread the compound not less than 3" wide at joints, center the reinforcing tape in the joint, and embed the tape in the compound. Then spread a thin layer of compound over the tape.
3. After this treatment has dried, apply a second coat of embedding compound to joints and fastener heads, spreading in a thin uniform coat to not less than 6" wide at joints, and feather edged.
4. Sandpaper between coats as required.
5. When thoroughly dry, sandpaper to eliminate ridges and high points.

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C. Finishing compounds:
   1. After embedding compound is thoroughly dry and has been completely sanded, apply a coat of finishing compound to joints and fastener heads.
   2. Feather the finishing compound to not less than 12" wide.
   3. When thoroughly dry, sandpaper to obtain a uniformly smooth surface, taking care to not scuff the paper surface of the wallboard.

3.4 CORNER TREATMENT

A. Internal corners: Treat as specified for joints, except fold the reinforcing tape lengthwise through the middle and fit neatly into the corner.

B. External corners:
   1. Install the specified corner bead, fitting neatly over the corner and securing with the same type fasteners used for installing the wallboard.
   2. Space the fasteners approximately 6" on centers, and drive through the wallboard into the framing or furring member.
   3. After the corner bead has been secured into position, treat the corner with joint compound and reinforcing tape as specified for joints, feathering the joint compound out from 8" to 10" on each side of the corner.

3.5 OTHER METAL TRIM

A. General:
   1. The Drawings do not purport to show all locations and requirements for metal trim.
   2. Carefully study the Drawings and the installation, and provide all metal trim normally recommended by the manufacturer of the gypsum wallboard approved for use in this work.

3.6 CLEANING UP

A. In addition to other requirements for cleaning, use necessary care to prevent scattering gypsum wallboard scraps and dust, and to prevent tracking gypsum and joint finishing compound onto floor surfaces.

B. At completion of each segment of installation in a room or space, promptly pick up and remove from the working area all scrap, debris, and surplus material of this Section.

END OF SECTION

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DIVISION 11

EQUIPMENT

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SECTION 11220

TANK MIXERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section includes all labor, materials, tools, equipment, supervision, transportation, and training necessary to install fixed mount tank agitators and appurtenances as specified herein, as shown on the Drawings, and as necessary to provide a complete installation.

B. Included under this section are the mixers for the equalization tank and potassium permanganate tank.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

C. Section 13200 - Vertical Atmospheric Aboveground Tanks and Vents

1.03 QUALITY ASSURANCE

A. Applicable standards and references

1. American National Standards Institute (ANSI)

2. American Welding Society (ASW)

3. Anti-Friction Bearing Manufacturers Association (AFBMA),

4. American Gear Manufacturers Association (AGMA)

5. American Society for Testing and Materials (ASTM)

B. Agitators shall be functionally tested to check for excessive noise, vibration, heat build up, and proper motor operation.

1.04 SUBMITTALS

A. The CONTRACTOR shall submit the manufacturer's name, agitator type, model, and protective coating system.

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B. CONTRACTOR shall submit detailed shop drawings of each mixer and appurtenances in accordance with Section 01340. Shop drawings shall include general arrangements, dimensions, and mounting details.

C. CONTRACTOR shall submit agitator specifications including primary pumping capacity, horsepower, shaft length and diameter, material of wetted parts, impeller RPM, performance curves, and electrical requirements.

D. CONTRACTOR to provide installation, start-up, and operating instructions, maintenance instructions and specifications, and a complete list of spare parts including original equipment manufacturer part numbers, as well as three complete bound copies of the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Brawn Mixer Inc., Holland, MI.

B. Approved Equal

2.02 MATERIALS

A. Drive Assembly

1. The agitator gear drive shall consist of a single reduction helical gearing. Motor pinion and driven gear shall be flexibly coupled to prevent unbalanced load on the motor shaft. Gearing shall be AGMA quality (10 per AGMA 2000-A88) to provide smooth and quiet operation. Gear drive thermal rating shall exceed the mechanical rating to eliminate the need for external cooling. The gear drive shall be designed in accordance with applicable AGMA standards for continuous duty with a minimum service factor of 1.5. The gear drive shall be a permanently lubricated splash type system. Oil pumps will not be acceptable. Operating noise level shall not exceed 82 dBA at a distance of three feet from the gear drive.

2. The ball mount assembly shall be provided with two handles for lifting the assembled unit at it's balance point.

B. Motors

1. Motors shall be standard C-face motors, TEFC, energy efficient, 1.15S.F., class F insulated with

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anti-fungus protection. Motors shall be provided with thermal overload protection using normally closed thermostats for three phase motors.

C. Agitator Shaft and Impellers

1. Shafts and impellers shall be fabricated from 316 stainless steel.

2. Agitator shafts shall be of sufficient size to avoid dynamic instability of assembly.

3. Impellers shall be axial flow type and precision machined to insure smooth and vibration free operation. Lower impellers shall include a stabilizing device for shafts which exceed 48 inches.

D. Agitator Mounting Hardware

1. Fixed mount agitators shall be provided with stock mounts to isolate the agitator from the mounting structure.

2. Vertical on center agitator mounts shall include tank baffles per agitator manufacturer's recommendations.

E. Equalization Tank Mixer

1. The CONTRACTOR shall furnish and install one Brawn BGM 100 mixer (or equal) complete with low pressure stuffing box, motor mounting brackets, motor couplings, and coupling guard.

2. Mixer shall have a 1.0 HP, 3 phase motor operating at 233 RPM. Impeller shall be mounted on a 120 inches long, 1-1/2 inch diameter shaft.

F. Potassium Permanganate Tank Mixer

1. The CONTRACTOR shall furnish and install one Brawn SD 33 mixer (or equal) complete with motor mounting brackets, motor couplings, and coupling guard.

2. Mixer shall have a 1/3 hp, 3 phase motor operating at 1,750 rpm. Propeller shall be mounted on a 42 inches long, 5/8 inch diameter shaft.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions and shall be coordinated with tank installation.

B. Installation shall not damage or interfere with the structural integrity of the tanks.

3.03 FIELD QUALITY CONTROL

A. A manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Engineer or Owner upon completion of work along with the Operation and Maintenance Manual.

END OF SECTION

ORIGINAL (Red)

SECTION 11230

AIR STRIPPING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, engineering, drawings, field services, and incidental services necessary to install a complete air stripping system and appurtenances as specified herein as shown on the Drawings, and as necessary to provide a complete installation.

B. The CONTRACTOR shall install the air stripping system in accordance with the manufacturer's instructions and recommendations.

C. The manufacturer shall provide technical assistance for installation, start-up, training, and performance testing as outlined below.

1.02 RELATED SECTIONS

A. Section 01340 - Shop drawings, Product Data, and Samples

B. Section 01620- Storage and Protection

1.03 SYSTEM DESCRIPTION

A. The air stripping system shall include a complete packed tower including all nozzles, internals, sump, influent piping, and fluid handling equipment; duplex blowers including variable frequency controllers, motors, and accessories; control and instrumentation package including control panel, and all controls as specified below.

B. The air stripping system shall successfully treat groundwater which is contaminated with volatile organic compounds (VOC's), and to produce an effluent that will meet the requirements for discharge specified in the NPDES permit and discussed below.

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Contaminants	Maximum Influent Concentration (ug/L)	Required Effluent Concentration (ug/L)
Benzene	11.0	5.8
Trichloroethylene	25.0	18.0
Vinyl Chloride	2,100.0	<1.0

C. The air stripping system shall provide satisfactory service for continuous or intermittent operation under specified operating conditions.

D. All components of the air stripping system shall be installed in the treatment building in accordance with the Contract Drawings. The part of the influent piping and tower which penetrates the building's roof (which will be 18 feet high) shall be exposed to the atmosphere and seasonal weather conditions. Exposed portions of the air stripping system shall be designed for outdoor service.

E. The blower shall be designed with duct work to draw air from outside of the building as shown on the Contract Drawings.

F. All materials of construction including miscellaneous hardware shall be resistant to attack by any compounds likely to be found in the system, including any cleaning solutions and as follows:

Constituent	Maximum Influent Concentration (μg/L)
VOCs and SVOCs	
Acetone	2,265
Benzene	11
Trans-1,2-DCE	125
MEK	252
MIBK	2,673
TCE	25
Vinyl Chloride	2,100
Conventional Parameters	
pH (s.u.)	6-10
Oil and Grease (mg/L)	3.81

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1.04 DESIGN CRITERIA

A. The air stripping system design criteria are as follows:

Water Design Temperature	**55°F**
Air Stripping Tower	
-Minimum Tower Diameter, ft	1.5
-Minimum Packing Height, ft	25
-Packing Material	1 in. Tri-Packs®
-Air to Water Ratio, Average	50:1
-Air to Water Ratio, Maximum	100:1
Blowers	
-Type	Centrifugal
-Air to Water Ratio, Average @ 47 gpm	50:1
-Air to Water Ratio, Range @ 47 gpm	25:1 to 100:1

B. Alternate packing materials and sizes may be submitted to CQA Consultant and Owner for consideration if process objectives specified above are guaranteed to be achieved.

C. Equipment shall be designed for operation at temperatures up to 120°F, with a wind load of 100 mph, and in seismic zone 1. A load safety factor of three (3) shall be applied to the design.

D. Equipment shall be designed in accordance with the latest editions of the following codes and standards: Uniform Building Code (UBC), National Electrical Code (NEC), International Electrotechnical Commission (IEC), National Electrical Manufacturers Association (NEMA), and American Society for Testing and Materials (ASTM).

1.05 QUALIFICATIONS

A. Equipment for the air stripping system shall be supplied by a single manufacturer with single-source responsibility. The manufacturer shall be qualified and experienced in the design, construction, installation, and operation of equipment for the purpose required and shall regularly produce such systems.

B. The manufacturer shall submit a list of at least three (3) installations similar to the one being proposed.

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1.06 SUBMITTALS

A. CONTRACTOR shall submit detailed shop drawings, design calculations, and literature describing the air stripping system and appurtenances in accordance with Section 01340. Fabrication of equipment and ordering of the units shall not begin until approval of shop drawings.

B. The CONTRACTOR shall furnish all important details of construction including dimensions, performance curves, process and instrumentation diagrams, sequence of operation, and installation details.

C. The CONTRACTOR shall submit the following: a complete description of the process, design and performance data including mass loading, mass transfer coefficients, pressure drop across the packing, and removal efficiencies for each compound of interest as presented in Section 1.03.

D. The CONTRACTOR shall submit to the owner three (3) bound copies of the Operation and Maintenance instructions for the air stripping system. The information shall be sufficient to instruct personnel who are unfamiliar with such equipment in the operation and maintenance of the system. Diagnostic procedures shall be provided for use in the event of system shutdown or malfunction. The manuals shall also include cleaning instructions, a full spare and replacement parts list, and general and electrical drawings of the system including original equipment manufacturer part numbers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Environmental Restoration Systems Inc., Middletown, PA.

B. MET PRO Corporation Duall Division, Owosso, MI.

C. ReSource Technologies Corporation, Pennington, NJ.

D. Hydrogroup, New Jersey.

E. Approved Equal.

2.02 MATERIALS

A. Air Stripping Tower

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1. The stripping tower shall be a vertical, cylindrical packed column with integral sump and flat bottom. Air shall enter the column at the bottom of the packing and be discharged from the top of the tower. Water shall be applied to the top of the pack and flow by gravity toward the bottom of the column.

2. The tower shall be complete, including all internals, packing, packing supports, mist eliminator, access doors(s), lifting lugs, anchoring lugs, couplings and flanges for instrumentation and plumbing connections, differential pressure gauge, air inlet and outlet, liquid distributors, and other appurtenances necessary for safe and efficient operation of the system.

3. The tower shall be fabricated from fiberglass reinforced plastic (FRP) chemical resistant isophthalic resin with U/V protection (or equal). The material must resist wicking should hairline cracks form in the structure. The material shall also have a class I flame spread rating or better to reduce hazard in the event of a fire.

4. The tower shall be fabricated in such a way as to facilitate shipping, erection, and repair. Sections should be sized considering building and overhead door dimensions. The clear building height is 18 feet and the overhead door is 12 feet wide by 14 feet high. Sections shall be flanged and have adequately sized and located lifting lugs. The bottom section shall have appropriate hold-downs.

5. Packing material shall consist of random-dumped, high efficiency type sized to have a nominal diameter that is commensurate with the tower diameter. Packing height shall be designed to provide adequate performance and efficiency to meet required discharge limits. Packing material shall be supported on FRP grating and FRP I-beams.

6. The tower shall have an integral mist eliminator located above the liquid distributor. It shall consist of random-dumped packing material fabricated from polypropylene, and supported on FRP grating and FRP I-beams. The mist eliminator shall be designed to remove 99 percent of droplets 10 microns or larger.

7. A tower stack shall extend to 35 feet above the finish floor elevation. The tower and stack shall

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penetrate the roof at a height of 24 feet above the floor elevation.

8. Access doors shall be provided at the top and bottom of the packing section to facilitate removal and replacement. Other access doors shall be provided in order to facilitate observation and maintenance of the spray header and to access the sump. The openings shall be flanged and the manufacturer shall provide all clear flange covers, gaskets, and hardware.

9. Spray nozzles, located at the top of the packing, shall be designed to uniformly distribute liquid over the packing. The liquid distributor shall be fabricated from FRP. Spray nozzles shall be a non-clogging, open-orifice type.

10. Redistributors shall be provided within the packing section to ensure proper operation.

11. The tower shall be manufactured with pipe supports to facilitate the influent line. The manufacturer shall design and install all pipe supports.

B. Blowers

1. The manufacturer shall provide a duplex blower system consisting of two (2) centrifugal type fans installed to operate one on line and the other as a spare.

2. Each centrifugal fan shall be designed and furnished to provide air at a volume range capable of delivering the air to water ratio range specified in the design criteria and shall be designed with noise suppression. Blower noise level shall not exceed 75 dBA.

3. The fan's impeller shall be fabricated from steel and shall be coated with FRP or plastisol in order to make it corrosion-resistant.

4. The wheel(s) shall be keyed to the shaft and shall be statically and dynamically balanced prior to delivery.

5. The fan(s) shall have heavy-duty, grease-lubricated, self-aligning, precision, anti-friction pillow-block bearings that have a minimum average life (AFBMA L50) of 100,000 hours.

6. The pedestal base for each fan shall be fabricated of steel with an epoxy coating.

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7. Each fan shall be complete with a TEFC motor, adjustable-speed, V-belt drive, belt and shaft guards, inlet screen, and drain. Drives shall have a 1.5 service factor. Belts shall be minimum size "B", high-capacity type and shall be furnished in matched sets.

8. The fan shall be connected to the stripping tower through adequately sized rigid duct. A flexible coupling shall be included in between the motor and the tower in order to reduce transmission of vibration.

9. Outlet velocity of the fan shall not exceed 2,800 fpm.

10. Fan motors shall be sized to operate at least 125 percent of the maximum operating brake horsepower, being approximately 2 hp.

11. Fans shall be tested and rated according to AMCA Standard 210 and ASHRAE Standard 51 prior to delivery. Fans shall also be certified by the Air Movement and Control Association (AMCA) and shall be licensed to bear the AMCA seal.

12. Fans shall be designed to provide manual set controls for adjusting the air to water ratio to operate between 50:1 to 100:1. A variable frequency controller, manually adjusted, shall be designed and provided to operate the blower at the desired speed and cfm output.

13. An inlet duct shall be provided to allow the fan(s) to take in air from outside the treatment building. The inlet duct shall be fabricated of the same duct materials and specified above including a flexible connection. A screen shall be installed over the exterior portion of the inlet duct sized to provide protection from the intake of animals and debris while not hindering performance of the fan(s).

C. Control Package

1. The manufacturer shall provide a single motor control center/control panel for operation of the air stripping system. All internal components shall be completely factory assembled, tested, and wired for a 3/60/230 volt power supply in a NEMA 4 enclosure.

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2. The electrical package shall be designed to control and operate an air blower, a manually adjusted variable frequency controller, and an effluent pump.

3. The manufacturer shall provide a lockable, fused disconnect switch of adequate current rating and a transformer to deliver 120 volt control power.

4. A motor starter and start/stop switches shall be provided for each fan and pump. The starters shall include IEC-type motor overload protection. Start switches shall be illuminated.

5. A low air flow alarm shall be provided. A timer will provide a 10-second delay to allow the fan to start before the sensor begins operating. Pressure in the tower will be measured by a pressure switch mounted on or near the stripping tower. The pressure switch shall be connected to an alarm which will indicate an exceedance of high and low pressure set points. The pressure switch shall be a Dwyer Photohelic switch/gauge, or approved equal.

6. An interlock shall be provided to shut down the tower feed pump in the event of low air flow.

7. Liquid level in the sump shall be controlled by conductivity probes mounted at specific elevations in the stripping tower sump. High and low water level alarms shall also be provided. A redundant liquid level control system shall be provided that will activate in the event that the primary level controls fail. The redundant level control system shall be designed to shut down the entire extraction and treatment system and alarm.

8. Alarm lights and an audible alarm shall be provided to indicate low air flow, high pressure drop across the packing, and high and low water levels in the sump. Alarm signals shall be locked in and require manual reset.

9. An adjustable alarm horn and a dry contact for remote alarm indication shall be provided. Acknowledge/silence and alarm reset buttons shall also be provided.

10. All pilot and alarm signals shall be transformer-type and shall be grouped on the front of the main control panel in order to easily distinguish between components.

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11. Labels shall be fixed to the face of the main control panel in such a manner that the function of each component shall be easily ascertained.

12. Terminal strips shall be provided to facilitate wiring of external devices such as switches, probes, meters, and controllers.

D. Motors

1. Motors shall be NEMA design B (normal torque) standard foot-mounted type with rigid base design.

2. Motors shall be designed for continuous operation. Motors shall be housed in TEFC enclosures with class F insulation, class B temperature rise, and a 1.15 service factor.

3. Maximum anticipated connected loads shall not exceed nameplate horsepower rating of the motor exclusive of service factor.

E. Aerator Skid

1. The entire air stripping system including tower, fans, motors, pumps, and local controls shall be mounted on a pre-fabricated skid to the extent possible furnished by the manufacturer. The aerator skid shall be constructed of structural grade carbon steel and coated with enamel paint.

F. Special Tools and Spare Parts

1. The manufacturer shall provide all special tools required for normal operation and maintenance of the equipment. The operation and maintenance manual shall identify each such tool and where it is used.

2. The following spare parts for each motor shall be furnished by the manufacturer: one (1) set of fan belts and one (1) set of fan bearings.

3. Spare parts shall be properly packaged and labeled with the name and part number contained within the package.

PART 3 EXECUTION

3.01 PREPARATION

A. Anchor bolt locations shall be field determined based on the template provided by the vendor.

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B. Anchor bolts and tower foundation to be provided by the CONTRACTOR in accordance with manufacturer's recommendations.

3.02 INSTALLATION

A. Installation shall be in strict accordance with manufacturer's instructions and recommendations.

B. Guy wires, anchor bolts, and other hardware required for installation shall be provided by the CONTRACTOR.

C. The CONTRACTOR shall provide all materials and labor for plumbing, electrical wiring, heat tracing for the outdoor portion of the system, and similar incidentals that may be necessary to complete installation of the equipment specified in this section.

3.03 START UP AND TESTING

A. The manufacturer shall provide a factory representative, knowledgeable of the system and it's components, to inspect the final installation, supervise initial operation, and train necessary personnel in the proper operation and maintenance of the system. Services shall be provided during a single site visit of no more than three (3) days.

B. Testing of the system shall be performed by the Owner or the CQA Consultant. The manufacturer shall be available to provide technical assistance concurrent with and as part of the services described above.

END OF SECTION

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SECTION 11360

FILTER PRESS SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, and training necessary to furnish and install a complete filter press system as specified herein, as shown on the Drawings and as necessary for a complete installation.

B. The filter press shall efficiently dewater iron hydroxide sludge for handling as a dry cake and shall include all components necessary for a complete operating unit as specified herein. All components shall be new, free of defects or mechanical damage, and in operating condition. The filter press system shall be supplied complete in all respects and shall be supplied with the following components, features, appurtenances, and accessories.

1. Polypropylene, gasketed recessed chamber plates.
2. Fabricated steel skeleton.
3. Hydraulic Control Center with switches and gauges.
4. Filter press controls.
5. Sidebar plate suspension system.
6. Semi-automatic, pneumatic plate shifting system.
7. PVC feed and discharge line pipes.
8. PVC air blow down manifold
9. Integral cabinet to house all hydraulic components.
10. Closing force of 25 tons maximum.
11. Self-dumping filter cake dumpster.
12. Air compressor and controls

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13. Air Diaphragm pump and automatic pump control system

14. All additional interconnecting piping, valves, and controls between the air compressor and the pump and press necessary to provide a complete packaged system.

C. The filter press shall be manufactured to meet the following design parameters:

Design Operating Pressure	100 psi
Total Volume	5 ft^3
Total Filtration Area	6 ft^2
Plate Size	630 mm
Number of Chambers	18
Cake Thickness	1.25 inches
Volume per chamber	0.28 ft^3
Filtration area per chamber	6.35 ft^2

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

1.03 SUBMITTALS

A. CONTRACTOR shall provide submittals in accordance with Section 01340.

B. Submit detailed shop drawings and product data including dimensions, performance curves, piping and instrumentation diagrams, sequence of operation, and installation details for all components of the complete package system including but not limited to the filter press, press components, controls, valving, interconnecting piping and manifold, air-diaphragm pump and controls, hopper, air compressor, and proposed layout including skid mounted components.

C. Three complete bound Operation and Maintenance manuals. The information contained shall be sufficient to instruct personnel who are unfamiliar with such equipment in the operation and maintenance of the system. The manuals shall also include cleaning instructions, a full spare and replacement parts list including original equipment manufacturer part numbers, and general and electrical drawings of the system.

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D. The manufacturer of the complete system shall submit a list of at least 3 installations similar to the one being proposed.

1.04 QUALIFICATIONS

A. Equipment for the filter press system described in Section 1.01 shall be supplied by one single manufacturer with single-source responsibility. The manufacturer shall be qualified and experienced in the design, construction, installation, and operation of equipment for the purpose required and shall regularly produce such systems.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Filter Press

1. JWI Inc., Holland, Michigan
2. Netzsch Inc., Exton, PA
3. Approved Equal

B. Packaged System

1. Southern Water Technologies, Inc., Marietta, Georgia
2. Great Lakes Environmental, Inc., South Carolina
3. Approved equal.

2.02 EQUIPMENT DESIGN REQUIREMENTS

A. Filter Plates

1. Filter plates shall be of the center feed, alternating corner discharge type for operation at ambient temperature. Plates shall be of the gasketed design. Gasketing shall be on the perimeter sealing surface and around each of the corner eyes. Plates shall come complete with filter cloths installed.

2. Recessed plates shall be molded from virgin, gray polypropylene and shall contain no fillers. Plates shall have a drainage surface design that shall provide adequate support for filter cloths.

3. Filter cloths shall be made of polypropylene fabric.

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4. Cloths shall be held in place on the filter plates by a woven, high density polypropylene cord sewn into the perimeter of the cloth. It shall be pressed or caulked into place on the filter plate and held there by an interference fit.

5. The filter press shall be supplied with a back up plate to allow for the processing of less than a full capacity press load. The blank back-up plate shall be capable of being inserted, along with the tail filter plate, at any point in the press plate stack to reduce the operating capacity of the filter press.

B. Filter Press Skeleton

1. The filter press skeleton and related sub-components shall be designed to maintain the filter pack in a closed position against an internal operating pressure of 100 psi plus a minimum clamping factor of 25% greater than the maximum internal operating pressure multiplied times the filter area of the tail filter plate. Maximum closure force shall be 25 tons.

2. The filter press frame shall be fabricated of ASTM-A36 carbon steel plate and structures. Weldments shall be totally enclosed box construction. All weldments shall be designed to evenly distribute the operational forces developed during filtration over the entire component. All components shall be continuously welded with a fillet weld for maximum strength. Intermittent welding of joints shall not be acceptable. Enclosed compartments within the head end weldment shall have drain holes. All components shall be designed with a minimum safety factor of 1.5 times the maximum closure force. Critical assembly points such as sidebar/end weldment shall be machined to close tolerances to ensure uniform load distribution at all stress bearing areas.

3. All edges and welds shall be deburred and ground smooth. All weld splatter, weld slag, and mill scale shall be removed before painting.

4. The head end weldment and the cylinder bracket shall be connected at two points each. Two side bars of hot rolled steel shall connect the head and cylinder bracket at the horizontal centerline of the plate pack so as not to interfere with cake discharge. Each connection point shall be

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designed with a minimum safety factor of 1.5 times the maximum closure force.

5. Each connection point shall have the intersecting components machined to tolerances that shall ensure proper fit.

6. The side bars shall be of sufficient size and weight to support the full operational weight of the filter plate pack including the follower head, plate pack plate shifter, and filter cake with a maximum deflection of 1/900 of the length of the filter press assembly.

7. To prevent corrosion of the sidebars due to surface finish erosion, the side bars shall come complete with 304 SS wear strips on the contract surface with plate suspension handles and follower head rollers.

8. The follower head sub-assembly shall be suspended from the side bars. The follower shall ride on Delrin rollers on stainless steel axles. Grease nipples shall be provided on the axles for periodic interspacial flushing of the roller/axle assembly.

9. All non-stainless steel metallic surfaces shall be finished for maximum corrosion resistance in accordance with the following.

   a. Surface preparation: Blast to SPCC-10, near white metal blast cleaned surface.

   b. Primer: One coat, two component, chrome free, low VOC polyurethane primer @ 1.5 to 2.0 MDFT Mils Dry Film Thickness (MDFT).

   c. Finish: Two coats, single stage, two component acrylic urethane @ 1.5 MDFT each coat.

10. The support legs shall be the height specified on the drawing to ensure that the filtrate discharge manifold is at a sufficient height to provide gravity drainage into an adjacent filtrate tank as shown on the Drawings.

C. Pneumatic/Hydraulic Closure:

1. The pneumatic/hydraulic opening and closing system shall include one (1) double acting hydraulic cylinder an one (1) hydraulic power pack. The system shall be designed to automatically compensate for any thermal expansion or

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contraction of the plate stack as well as maintain the proper clamping force throughout the process cycle.

2. The hydraulic cylinder shall be capable of producing the appropriate clamping pressure.

3. The pneumatic/hydraulic power pack shall contain an air driven hydraulic pumping module that shall clamp the press by pressurizing the hydraulic system after the plate pack is fully closed. The hydraulic pumping module shall be designed to only operate after the hydraulic cylinder has been fully extended through the use of a pressurized oil reservoir. To minimize the use of the hydraulic pumping module, the press shall be opened by means of pressurizing the reiteration stroke of the cylinder with compressed air. Hydraulic tubing subject to system pressure within the power pack and to and from the cylinder shall be of 304 SS and shall have a minimum burst pressure rating of 3.5 times the maximum operating pressure of the power pack. The power pack shall be fully enclosed in a fabricated steel cabinet. All components shall be modular.

D. Controls

1. The filter press control panel shall be mounted to the hydraulic cylinder bracket and shall be NEMA 4. The control panel shall contain all necessary motor starters, relays, wiring and/or transformers. The panel shall come complete with a panel mounted PLC control and a four line LED readout and a touch-sensitive membrane switch pad. An emergency stop mushroom button shall also be included. The following functions shall be controlled from the panel:

   a. Air supply, on/off

   b. Filter press, open/close

   c. Hydraulic pump, on/off

   d. Automatic feed pump system, on/off/auto

   e. Air blow down valve sequence, on/off/auto

2. An automatic feed pump control system shall be included in the control panel as specified above. The automatic feed pump control system shall be designed to sequence the start-up of the air-operated diaphragm feed pump by 5 min/25 psi

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increments. Time and pressure increments shall be field adjustable (0-30 minutes; 0-100 psi). The control shall visually signal when the press cycle is complete by sensing the duration between pump strokes and illuminating a "cycle over" lamp. The control system shall also include a low hydraulic pressure safety shut down circuit designed to interrupt the air supply to the feed pump in the event of loss of hydraulic closure pressure.

E. Plate Shifter

1. The filter press shall be supplied with a semi-automatic plate shifter system that shall be designed to assure each plate is straightened and is perpendicular to the side bars prior to shifting. The plate shifter shall operate in a semi-automatic mode, requiring operator initiation of each plate shifting sequence. The plate shifting shall be accomplished with pneumatic operators. The plate shifter shall have the capability to shift individual or multiple plates per shifting sequence.

2. Shifter control shall be fully-automatic with "deadman" type, maintain contact button, hand-held lanyard.

F. Feed And Discharge Piping; System Piping

1. Feed and discharge line piping shall be supplied. Piping shall be fabricated schedule 80, PVC providing the connections through the head from the center feed slurry port and the corner filtrate discharge ports in the filter pack through the stationary head. All threads shall be NPT standard.

2. The feed and discharge manifolding shall be of the air blow type. Material of construction shall be schedule 40 PVC. Valving shall be the Tru-union ball type.

G. Air Diaphragm Pump

1. The air diaphragm pump and interconnecting piping shall be designed to accommodate the press and the pump control system.

H. Air Compressor

1. The air compressor shall have the capacity required to operate the filter press and pump system. It shall be equipped with low oil shut

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down, V-belt drive, automatic start and stop control, and constant speed control and all components shall be pre-piped and pre-wired.

I. Self Dumping Dumpster

1. Low profile self dumping dumpster shall be included that can be placed beneath the press. It shall have ball-bearing casters and be equipped with a spring-loaded pin to allow the unit to self dump when pulled.

PART 3 EXECUTION

3.01 GENERAL

A. The system shall be installed in accordance with manufacturer's instructions and shall be skid mounted to the extent possible.

B. The system layout must be integrated into the existing equipment floor plan.

C. The filter press system manufacturer's representative shall be present and provide assistance during start-up of the system. The representative shall be qualified to train personnel not familiar with such a system and troubleshoot the system. The representative shall be present at the site for three full working days.

END OF SECTION

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SECTION 11395

AUTOMATIC SAMPLING DEVICE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, and training necessary to furnish and install the permanent completely electric automatic sampler and appurtenances, as specified herein and as shown on the Drawings, and as necessary for a complete installation.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

C. Section 11001 - Controls and Instrumentation

1.03 SUBMITTALS

A. CONTRACTOR shall submit detailed shop drawings and literature of the automatic sampler and appurtenances in accordance with Section 01340. Shop drawings shall include detailed layout of the equipment, pump performance data, materials of construction, and electrical drawings and requirements.

B. The CONTRACTOR shall submit three complete bound Operation and Maintenance manuals. The information contained shall be sufficient to instruct personnel who are unfamiliar with such equipment in the operation and maintenance of the system. The manuals shall also include cleaning instructions, a full spare and replacement parts list including original equipment manufacturer part numbers, and general and electrical drawings of the sampler.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Isco Environmental Division, Lincoln, NE.

B. Approved Equal

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2.02 MATERIALS

A. Automatic Sampler

1. The CONTRACTOR shall furnish and install one flow controlled 8-hour composite type automatic sampler (or equivalent). The sampler shall be capable of collecting and preserving, by refrigeration, representative liquid samples from the effluent holding tank as specified under Part 3 Execution.

2. The sampler shall be equipped with a high speed peristaltic pump capable of providing 1.1 fps at 26 feet of vertical lift in a 3/8 inch I.D. line. Sample liquid shall not come in contact with any part of the pump, metering chambers, valves, etc.

3. Pump tubing shall be 3/8 inch I.D. fabricated from medical grade silicone. The unit shall also be provided with 25 feet of 3/8 inch I.D. vinyl intake tubing and strainer constructed of 316 stainless steel.

4. The sampler shall be capable of collecting a composite sample up to 6 gallon capacity, although analysis will require only 1-liter. The sampler shall be provided with a 2-1/2 gallon glass sample container with lid and Teflon lined polypropylene screw cap.

5. The sampler shall have a hermetically sealed control unit with liquid crystal display. The control unit shall have the capability of retaining up to five complete sampling programs in memory and have a program lock for security. The control unit shall have a clock providing time and date.

6. The controls, indicators, and display shall be readily accessible to the user through a totally sealed touch-pad controller label.

7. The sampler shall be capable of collecting individual samples at regular intervals over a time period. The volume of each individual sample shall be collected proportional to discharge flow rates. The sampler shall be capable of repeating sample collection attempts in the event sample liquid is not obtained on the initial attempt. The unit shall be capable of providing up to three automatic purge and sample attempts. If unsuccessful, the unit will record the missed sample event and turn off until the next sample interval.

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8. The refrigerator shall be provided with an adjustable, weight activated mechanism to automatically terminate sampling at a predetermined level; no contact with the same liquid shall be acceptable in determining the shut-off level. An exterior indicator light shall be provided to indicate when the container is full.

9. The sampler shall be capable of rinsing the sample intake line before and after each sample collection. The sampler shall be capable of providing up to three rinses automatically and also have a manual override.

10. All of the sampler's electronic and mechanical components shall be contained within a totally sealed controller. The controller shall be made of 1/4 inch thick structural form Noryl™ plastic. It shall conform to NEMA 4X standards for watertight, dust-tight and corrosion resistant operation.

11. The controller shall internally contain four ounces of desiccant to control case humidity. The controller will be provided with an internal case humidity indicator to indicate the presence of moisture inside the controller.

12. All of the sampler's logic circuitry shall be contained in a single, easily replaceable circuit board assembly.

13. The sampler shall be equipped with a refrigerated compartment for sample storage. The refrigerator shall have rigid foam insulation, 120 CFM condenser fan, and shall be controlled by an air sensing thermostat maintaining samples at 39°F in ambient air up to 120°F. The interior of the refrigerator shall be plastic and the exterior of the unit shall be constructed of steel overlaid with a protective vinyl laminate. Refrigerator components and copper plumbing shall also be protected with a phenolic resin coating.

14. ISCO, Model 3760 series or approved equal.

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PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.

B. All electromechanical components shall be enclosed in a sealed ABS housing conforming to NEMA 4X and 6 standards for submersible, watertight, dust tight, corrosion resistant, and ice resistant operation.

C. The sampler shall be installed with the pump located above the highest water level of the effluent holding tank. This is to ensure that all purge water is removed from the suction line prior to sample collection. The sampler shall be installed on a platform supplied by the CONTRACTOR.

3.02 OPERATING SCHEDULE

A. The unit shall operate from 120 VAC power. A battery backup shall be provided as part of the system which will automatically take over operation in the event of a loss of power. A lithium battery shall also be provided to maintain control memory in the event of AC power disruption.

B. The sampler shall be programmed to collect one portion of the composite sample per hour for eight hours, which is proportional to the discharge flow rate. The sampler shall be programmed to collect a minimum of one-liter. The program shall repeat this sampling event once every 30 days. The program shall also have the capability of manual override.

END OF SECTION

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DIVISION 13

SPECIAL CONSTRUCTION

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SECTION 13120
PRE-ENGINEERED STRUCTURES

Note: Contractor is provided with the option to provide either a: (1) structural steel installation as shown on the Drawings and Sections in Division Five of these Specifications, or: (2) a pre-engineered structural steel system similar to the configuration shown on the Drawings, and subject to the approval of the Owner and Architect. The following Specification Section contains additional requirements applicable only to the use of a pre-engineered structural steel system.

PART 1 GENERAL

1.1 SUMMARY

A. Provide complete pre-engineered structural steel frame, system where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:
   1. Structural design, drawings, calculations, and detailing.
   2. Professional Engineer certification.
   3. Permit applications.
   4. Material procurement and installation.
   5. Warranty.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 30 calendar days after the Contractor has received Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
   3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

C. Samples:
   1. When so requested by the Architect, promptly provide Samples of items scheduled to be exposed in the final structure.
   2. When specifically so requested by the Contractor and approved by the Architect, approved Samples will be returned to the Contractor for installation on the Work.

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D. Manual: Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Architect two copies of a manual compiled in accordance with the provisions of Section 01730 of these Specifications. Include within each manual:
   1. Copy of the approved Record Documents for this portion of the Work;
   2. Copies of all warranties and guarantees.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

1.5 WARRANTY

A. Provide standard one year warranty on all labor and materials.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide only materials that are new, of the type and quantity specified.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the Architect.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Coordinate:
   1. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interference with the work of this Section.

B. Data indicated on the Drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances,

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levels, and other conditions will be governed by actual construction and the Drawings and Specifications should be used only for guidance in such regard.

C. Verify all measurements at the building. No extra compensation will be allowed because of difference between work shown on the Drawings and actual measurements at the site of construction.

3.3 INSPECTION

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. Make written notice to the Architect adequately in advance of each of the following stages of construction:

1. At completion of the Work of this Section.

C. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

3.4 PROJECT COMPLETION

A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

END OF SECTION

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SECTION 13200

VERTICAL ATMOSPHERIC ABOVEGROUND TANKS, BAFFLES AND VENTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, and training necessary to furnish and install the permanent vertical storage tanks and appurtenances including access ladders, vents, platforms, openings, baffles, and supports as specified herein as shown on the Drawings, and as necessary for a complete installation.

B. Tanks included under this section are the equalization tank, potassium permanganate tank, effluent holding tank, sludge holding tank, and filtrate tank.

C. Tanks described herein are intended for use as vented, atmospheric pressure vessels only. Tanks shall be for aboveground indoor service.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

C. Section 11220 - Tank Mixers

1.03 SUBMITTALS

A. CONTRACTOR shall submit detailed shop drawings of the tanks, access ladders and platforms, and appurtenances in accordance with Section 01340. Shop drawings shall include detailed layout drawings of the equipment.

B. The CONTRACTOR shall submit the following:

1. Certification that tank construction is in compliance with this specification including results of factory tests, physical property tests, quality control check lists, and inspection forms for all tanks.

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2. Detailed layout drawings of tanks, all openings, supports, access platforms, baffles, and appurtenances.

3. Design loads for the tank platforms and supports.

C. Details of tank vents and design calculations shall be submitted.

1.04 WARRANTY

A. Each tank shall carry a 20 year warranty covering materials and workmanship. Tank warranty shall cover structural failure (i.e., cracking, rupture, or collapse) for the life of the installation and cover leakage due to corrosion or deterioration when the tank is installed and maintained in accordance with the manufacturer's instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Tanks

1. Viatec Process/Storage Systems, Belding, MI.

2. Approved Equal

B. Vents

1. Protectoseal, Bensenville, IL

2. Approved Equal

2.02 MATERIALS

A. General

1. Tanks shall contain recovered groundwater with the following constituents and maximum concentrations and shall be constructed of materials that will not deteriorate as a result of these conditions.

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Constituent	Maximum Influent Concentration (μg/L)
VOCs and SVOCs	
Acetone	2,265
Benzene	11
Trans-1,2-DCE	125
MEK	252
MIBK	2,673
TCE	25
Vinyl Chloride	2,100
Conventional Parameters	
pH (s.u.)	6-10
Oil and Grease (mg/L)	3.81

B. Tanks

1. Tanks to be constructed of filament wound glass reinforced polyester material. The tanks shall be fabricated using a vinyl ester resin on the inner corrosion barrier and a polyester resin on the exterior surfaces.

2. Tanks shall be a composite of three layers consisting of an inner surface, an interior layer, and an exterior layer or laminate body. The corrosion barrier, consisting of the inner surface and interior layer, shall be a 10 to 20 mils thick resin-rich layer reinforced with a chemical surfacing mat (inner surface) followed by a minimum of 100 mils of laminate (interior layer). The exterior layer for the sidewall portion of the tanks shall be composed of filament wound glass fibers and resin. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections.

3. For heads, bottoms, and other non filament wound items, the exterior layer shall be a continuation of the interior layer using the same glass and resin until the desired thickness has be achieved. Minimum head and bottom thicknesses shall be in accordance with the NBS Voluntary Product Standard PS 15-69 unless otherwise specified.

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4. Standard tanks and thicknesses will be designed for a minimum specific gravity service of 1.2 with an allowable design factor minimum of 10:1. Minimum wall thicknesses are to be based on the ASTM D3299 standards. The thickness of the filament wound portion of the tank shell may be varied with tank height (tapered-wall construction) as long as the ASTM requirements are met at any height level.

5. Tanks shall have nominal inside diameters, heights, and operating capacities as specified in the Tank Schedule herein.

6. All joint fabrication shall be in accordance with the manufacturer's specification and recommendations.

7. The manufacturer shall design and furnish the tank skirt and legs for the sludge holding tank. Leg supports shall be constructed of mild steel pipe and have welded floor flanges. Legs shall be screwed into sockets welded to a heavy steel support skirt attached to the bottom of the tank. Legs and support skirt shall be adequately designed to support the weight of the tank and to resist overturning due to sloshing under seismic zone 1 conditions. Legs and skirt shall be epoxy coated.

C. Equipment

1. All fittings, flanged nozzles, manways, and other miscellaneous tank openings shall be factory-installed in accordance with Drawings and manufacturer's specifications.

2. The equalization tank shall be equipped with a plate gusseted type flange (see Drawings) to provide a mounting platform for the vertical mixer.

3. The equalization tank shall be provided with four (4) factory installed side wall baffles as shown on the drawings. Baffles shall be mounted 1 inch away from the tank wall at 90 degrees apart and extend the full length of the tank wall. Baffles shall have a width of 10 inches or as recommended by the manufacturer.

4. The potassium permanganate tank shall be equipped with a clamp or cup plate support to provide mounting for the mixer.

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5. Prior to tank fabrication, the CONTRACTOR shall supply the tank manufacturer with pertinent details required for the design of the agitator mounts. Details shall include: mixer type, weight, torque, required mounting, bolt hole configuration, etc.

6. Tank manways shall be factory-installed in accordance with the Drawings. Standard top and side manway assemblies shall be of the flanged type. Manways shall include a gasket and bolted cover plate. Plated bolts and full face neoprene gaskets shall be provided by the manufacturer. Manways shall be 30 inches in diameter.

7. Side entry manways shall be provided with a reinforcing pad around the opening. The pad shall be of the same thickness as the shell wall thickness and have a cross sectional area equal to the cross sectional area of the cut-out.

8. All tanks shall have factory-installed lifting and hold-down lugs. Hold-down lugs shall be designed to offset buoyant force on empty installed tanks when 12 inches of water surrounds them and sloshing in the event of an earthquake. Lugs shall be constructed of mild steel finished with an epoxy coating.

9. Anchor bolts, washers, and nuts shall be provided by the CONTRACTOR and shall be designed to offset buoyant force on empty tanks surrounded by 1 foot of water and resist sloshing forces generated from an earthquake under seismic zone 1 conditions.

10. The manufacturer shall design and furnish normal and emergency vents for all closed tanks. Installation shall be in accordance with manufacturer's instructions.

11. Ladders, safety cages, platforms, catwalks, and handrails anchored to the tank shall be designed and provided by the tank manufacturer in accordance with all safety (OSHA) standards and building codes. Ladders and platforms shall be constructed of steel with slip proof expanded metal steps and walkways and finished with an epoxy coating.

12. Tanks to be graduated in gallons on side.

13. Tanks to have sight glass from low liquid level to high liquid level marks.

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14. Nameplates shall be provided on all tanks including manufacturer's name, serial number, tank capacity, and tank function as specified in the tank schedule.

D. Tank Vents

1. Tank vents shall be Conservation Breather vents with pipe-away fittings and shall provide pressure and vacuum relief.

2. Vents shall be constructed of cast iron with 346 stainless steel internals and shall be a one piece construction.

3. Tank vents shall be Protectoseal Series No. P18540 or equal.

4. Tank vents shall be mounted to a 125 pound ANSI flat flange installed in the top of the tank by the tank manufacturer in the location shown on the Drawings.

2.04 SOURCE QUALITY CONTROL

A. Standard tank and nozzle dimension tolerances are in accordance with the ASTM D3299 specifications.

B. Laminates made with gun chopped glass or chopped strand mat shall have physical properties as follows. These values also apply to the chopped portion of a composite chopped/filament wound laminate.

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LAMINATED PHYSICAL PROPERTIES

Property @ 73°, PSI	ASTM Test	1/8, 3/16	1/4	5/16	3/8 & Up
Ult. Tensile Min.	D638	9,000	12,0000	13,500	15,000
Ult. Edge Compressive, min.	D695	18,000	20,000	22,000	24,000
Flexural Strength, Min.	D790	16,000	19,000	20,000	22,000
Flexural Modulus of Elasticity	D790	700,000	800,000	900,000	1,000,000
Glass Content	By Ignition	25 to 30%	25 to 30%	25 to 30%	25 to 30%

C. The filament wound portion of the laminate will have a tensile strength of 44,750 PSI in the direction of the winding. At standard winding angles a minimum hoop tensile strength of 44,000 PSI and minimum axial tensile strength of 1400 PSI will result.

D. The manufacturer shall provide certification results in writing to the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

A. The manufacturer shall provide the CONTRACTOR with fabrication drawings for review and approval. The manufacturer shall not begin fabrication of any tank until fabrication drawings have been approved by the Engineer.

B. Flat-bottomed tanks shall be supported on concrete pads overlayed by 3/4-inch plywood to be provided by others.

C. Coned-bottom tank shall be supported on legs. The heights of the tanks are shown on the Drawings.

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D. Anchor bolt locations shall be field determined based on the template provided by the tank vendor.

E. Anchor bolts to be provided by the CONTRACTOR.

3.02 INSTALLATION

A. Handling, rigging, and installation of tanks, supports, ladders, and platforms shall be in accordance with manufacturer's instructions for handling and installing resin tanks.

1. A guide line must be used to prevent tank from swinging without control and striking other objects.

2. Tanks with only one lifting lug shall not be lifted or handled.

3. Tanks shall not be dropped or allowed to strike other objects.

4. Tanks shall not be rolled. If the tank must be stored outdoors temporarily, ensure that it is tied down to prevent movement.

5. Do not position tank during unloading or handling on any uneven surface which may concentrate the weight on a localized area.

6. In working around tank, care shall be exercised to prevent tools from striking, or being dropped inside the tank. Soft soled shoes shall be worn by workers entering the tank. Ladders used inside or outside of tank must be wooden or have rubber protection on both ends, and not be permitted to scratch the surface.

7. Under no conditions shall chains or cables be put around tank. Ropes and slings may be used in lieu of lifting lugs. Handling and installation procedures must still be observed.

8. Tank shall remain in crate or skids if it is to be stored prior to installation. Unskidded tanks shall be set in a bed of soft sand and tied down.

B. Tank anchor bolts are to be self-drilling type and will be installed into the concrete pad by the CONTRACTOR after the tank is located in accordance with the Drawings.

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3.03 FIELD QUALITY CONTROL

A. The CQA Consultant shall inspect each tank after installation for observation of alignment, elevation, and condition of the tank.

B. A manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the CQA Consultant or OWNER upon completion of work.

C. All tanks shall be hydrostatically tested in the field and inspected by the CQA Consultant prior to service.

3.04 TANK SCHEDULE

Tank	Working Capacity Excluding Cover (gallon)	Covered Or Open	Diameter (feet)	Maximum Overall Height (feet)	Remarks
Equalization Tank	6000	Covered	10' 0"	12' 8"	Flat bottom with mixer, access ladder and platform, and baffles
Potassium Permanganate	150	Open	2' 6"	4' 0"	Flat bottom with side mount mixer
Effluent Holding Tank	1700	Covered	6' 0"	10' 0"	Flat bottom
Sludge Holding Tank	2560	Covered	7' 10"	11' 11"	Cone bottom elevated as per drawing
Filtrate Tank	1500	Covered	7' 10"	5' 10"	Flat bottom

END OF SECTION

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SECTION 13220

DUPLEX PRESSURE FILTER SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, and supporting services necessary to furnish and install a vertical duplex pressure filter system as a complete package as specified herein as shown on the Drawings, and as necessary for a complete installation.

B. The filter system shall be furnished as a complete factory-built unit with both filters mounted on a steel skid complete and pre-wired with interconnecting piping, fittings, valves, controls and any other accessories required for controlling filtering and backwash operations.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

1.03 SYSTEM DESCRIPTION

A. Filtering and backwash operations shall be controlled by automatically operated electric valves and backwash shall be initiated by pressure differential with automatic timer and manual overrides. The system shall operate with one filter operating and the other filter in the backwash or standby mode so continuous treatment occurs. Backwash shall also be followed by a down flow rinse to prepare the filter for service.

B. System operation shall be capable of performing in the following modes:

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Operating Mode	Pressure Filters Valve Position			
	Raw Water Influent	Dirty Water Effluent	Backwash Water Influent	Filtered Water Effluent
1. Filter No. 1 - Operating	Open	Closed	Closed	Open
Filter No. 2 - Standby	Closed	Closed	Closed	Closed
2. Filter No. 1 - Backwash	Closed	Open	Open	Closed
Filter No. 2 - Operating	Open	Closed	Closed	Open
3. Filter No. 1 - Standby	Closed	Closed	Closed	Closed
Filter No. 2 - Operating	Open	Closed	Closed	Open
4. Filter No. 1 - Operating	Open	Closed	Closed	Open
Filter No. 2 - Backwash	Closed	Open	Open	Closed

C. Each filter shall be furnished with a header and underdrain system designed to provide for uniform distribution of the backwash water and collection of the filtered wastewater. Gravel subfill shall be provided to prevent passage of the media into the underdrain system.

1.04 SUBMITTALS

A. CONTRACTOR shall submit detailed shop drawings of the pressure filter system, electrical schematics, and appurtenances in accordance with Section 01340. Shop drawings shall include detailed layout of the equipment.

B. A copy of the ASME code certification shall be submitted and also certification by the manufacturer that the entire system is a product of his own engineering.

C. Product data on all valves, piping, control system components, filters, and supports shall be provided.

D. Three complete Operations and Maintenance Manuals for the system including spare parts listing with original equipment manufacturer part numbers, troubleshooting, offsite contacts, and basic O&M activities shall be provided.

E. The names and locations of at least three similar system installations shall be submitted.

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PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Met Pro Duall Division, Pennsylvania

B. Permutit, New Jersey

C. U.S. Filter

D. Approved Equal

2.02 MATERIALS

A. Pressure Filter System

1. Each filter shall be designed for a flow rate 4 gpm/sf with a total flow of 47 gpm. The filter shell shall consist of a welded steel or fiberglass construction throughout. Filter shells shall be pressured tested to 50 percent in excess of the maximum design working pressure of 100 psig and shall be ASME code stamped.

   a. The following constituents and maximum concentrations in the influent shall be considered in the selection of materials of construction. Metals are also anticipated.

Constituent	Maximum Influent Concentration (μg/L)
VOCs and SVOCs	
Acetone	2,265
Benzene	11
Trans-1,2-DCE	125
MEK	252
MIBK	2,673
TCE	25
Vinyl Chloride	2,100
Conventional Parameters	
pH (s.u.)	6-10
Oil and Grease (mg/L)	3.81

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2. Filters shall be equipped with sight glasses, backwash flow rate indicators, and loss of head indicators.

3. Support legs shall be constructed of structural steel angles and shall be sized to provide adequate support to the operating weight of the pressure filter.

4. The skid shall be constructed from beams and steel plates.

5. Piping shall be Schedule 80 PVC. Pipe supports shall be designed and furnished by the manufacturer where necessary to produce a rigid structure.

6. Valves shall be provided by the manufacturer and be a product of a reputable wastewater valve manufacturer. Electric operated valves shall be ball type (unless otherwise noted below) and provide complete range from open full to full closed position in a 90° rotation of the operator.

7. Unions or flanges shall be provided to allow removal of valves or piping.

8. Filter media shall be furnished with a dual media system consisting of silica sand and anthracite and shall be sized to meet the specific application of the filter. Relative sizes of the two media shall be matched so that particle size becomes smaller as the depth of the filter bed increases.

9. Sand shall have an effective size of 1.5 mm and consist of hard, round granules which have a specific gravity of 2.5 (minimum). Anthracite shall have an effective size of 1.0 mm and be hard, durable Pennsylvania anthracite coal particles with a specific gravity of 1.4 (minimum). Uniformity coefficient for the sand and anthracite shall be 1.6 and 1.7 respectively. All filter media shall conform to AWWA Standard No. B 100-72, for filtering material.

10. All electrically operated controls and motor starters shall be prewired, completely assembled in a weather resistant enclosure of NEMA 12 construction, and ready for operation once power is supplied to the control panel. The PLC shall be a microprocessor based system and the system shall be suitable for all mounting. All

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electrical equipment shall be wired in accordance with the National Electrical Code.

11. Each filter vessel shall contain inlet and outlet piping connections, gauge connections, access openings, air and pressure relief valve fittings, and manholes. Manholes shall be at least 14" x 18" to permit entry for inspection, repair, and placement of sand. Handholes shall be at least 4" x 6".

12. The filters, skid, and all equipment shall be reinforced in such a way that the entire system can be transported as a unit. Lifting eyes shall be furnished at appropriate locations to provide for handling during shipping and installation.

13. Filter feed piping shall be sized to provide a maximum velocity of 6 fps at a rate of 50 gpm.

14. Backwash piping shall be sized to provide a maximum velocity of 10 fps at a rate of 15 gpm/sf.

15. Electrically actuated operators shall be provided for automatic control of the filtering and backwash operations. The operators are to be compatible with the valve style incorporated on the filter system. The operators shall be automatically initiated by pressure differential and a time clock (to initiate backwash in the event that pressure differential fails) and also be capable of manual override for initiation.

16. A separate drain and plug shall be provided on each filter for maintenance purposes.

17. Air vents shall be provided on each filter.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.

B. Installation shall be coordinated with piping work for the treatment system. The control system shall be fully programmed prior to shipment but must be capable of being appropriately altered during installation and start up.

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3.03 FIELD QUALITY CONTROL

A. A manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the CQA Consultant or OWNER upon completion of work.

B. The services of a technically qualified manufacturer's representative at the project site during start-up is mandatory. The representative must be qualified to troubleshoot and train operators on routine operation and maintenance and shall be present for three full working days.

END OF SECTION

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DIVISION 15

MECHANICAL

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SECTION 15060

GROUNDWATER TREATMENT SYSTEM PIPES, FITTINGS, VALVES, DUCTS, PIPE SLEEVES, AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary for the installation of groundwater treatment system piping, fittings, valves, pressure gauges, ducts, pipe sleeves, and appurtenances as specified herein, as shown on the Drawings, and as necessary for a complete installation.

B. The work shall include procurement, installation, connection, and testing of piping, valves, and appurtenances.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

C. Section 15160 - Centrifugal Pumps

1.03 QUALITY ASSURANCE

A. All valves of like size and type shall be manufactured by a single manufacturer.

1.04 SUBMITTALS

A. Shop Drawings

1. Prior to obtaining any equipment in connection with this section, the CONTRACTOR shall submit detailed shop drawings and descriptions of all piping, valves, fittings, joints, gauges, duct, pipe sleeves, and appurtenances in accordance with Section 01340.

2. The submittal shall include complete information and instructions relating to the storage,

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handling, installation, and inspection of the valves, piping, etc.

3. Submit five (5) copies of manufacturer's affidavit that all delivered materials comply with the requirements of the specified standards.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pipe, Fittings, and Valves

1. Chemtrol, Indianapolis, IN
2. Harvel Plastics, Easton, PA
3. Potter-Roemer, Inc., Cerritos, CA
4. Baumann Assoc., LTD., Portsmouth, NH
5. Stockholm, Birmingham, AL

B. Pressure Gauges

1. Ashcroft
2. Ametek/U.S. Gauge
3. Approved Equal

C. Wall Castings and Sleeves

1. Clow
2. Approved Equal

2.02 PIPING AND FITTINGS

A. Pipe and fittings shall be Schedule 80 polyvinyl chloride which meets or exceeds the requirements of Cell Classification 12454-B polyvinyl chloride as outlined in ASTM D1784. Materials from which pipe and fittings are manufactured shall have been tested and listed for conveying potable water by the National Sanitation Foundation (NSF).

B. Fittings components that utilize socket-type solvent cemented connections shall have socket diameters, lengths, and wall thicknesses as required by ASTM D2466.

C. Fittings shall be industrial, heavy duty hub style.

D. Flanges shall be one piece solid design or two-part van stone type which utilize tapered, serrated face and full face gasket techniques for joining and are compatible with ANSI B16.5 Class 150 metal flanges.

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E. Unions shall be O-Ring seal type having interchangeable components with true union valves for maximum system versatility.

F. Unions intended for joining dissimilar materials shall be transitional type, which utilize components of two dissimilar materials, joined with an O-Ring to absorb the thermal expansion coefficient differential.

G. Pipe shall be as prescribed by ASTM D1785 and ASTM D2466 for pressure rated piping systems.

H. Socket fittings shall be pressure rated the same as the corresponding size pipe described by ASTM D1785.

I. Valves, unions, and flanges shall be pressure rated at 150 psi for water service at 73°F, non-shock and have a minimum burst requirement of 3.3 times the rated pressure.

J. Pipes shall be pressure rated as prescribed by ASTM D1785.

K. Fittings and pipe shall be clearly marked with manufacturer's name or trademark, material, ASTM number, NSF seal of approval, nominal pipe size, schedule size with pressure rating in psi for water at 73°F, and manufacturing date code.

L. All pipes and fittings shall be of the nominal diameters shown on the Contract Drawings. Fittings shall be solvent cemented throughout except at valves and at connections to pumps and other equipment. Connections at valves, pumps, and major equipment or packaged units shall be flanged or true union.

2.03 VALVES

A. Valves installed in pipelines shall be supported independently from the pipeline on supports approved by the CQA Consultant or as shown on the Contract Drawings.

B. Ball valves shall be PVC, Cell Class 12454-B per ASTM D-1784. Valve style shall be full port Tru-Bloc. SU seat/seal material shall be TFE/FPM.

C. Check valves shall be constructed of PVC, Cell Class 12454-B per ASTM D1784. Seat and seal materials shall be FPM.

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D. Flow control valve shall be a bronze globe valve, in-line, with a maximum body pressure of 150 psi and a temperature rating of 400°F. Valve shall have a standard threaded bonnet and shall have NPT threaded connections. Valve shall have a flow coefficient (C_V) rating of 50 and shall meet or exceed ASME/ANSI BI6.24 requirements. Valve shall have an electric actuator.

E. Globe valves to be used for manual flow throttling on the groundwater treatment system shall be made of bronze, in-line, maximum pressure rating of W.O.G. 200 psi and temperature rating of 450°F maximum, rising stem, screw-in bonnet.

F. Automatic Flow Control Valve

1. Flow control valve shall automatically control flow rate on the discharge side of the backwash pumps within a 5 percent accuracy. Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil/helical spring. The minimum operating range shall require less than 2 psid to actuate the mechanism. Manufacturer shall provide independent laboratory tests verifying accuracy of performance.

2. Flow control valve shall be PVC, threaded high capacity with a pressure range of 8 to 129 psi and a flow rate of 180 gpm.

G. PVC socket connections shall conform to the requirements of ASTM D2467 and F-439 for Schedule 80 fittings.

H. Valves shall be pressure rated for 150 psi service at 73°F water, non-shock and have a minimum bursting rating of 3.3 times the rated working pressure.

I. Valves shall be clearly marked with manufacturer's name, size, materials of construction, and bear the NSF-PW SE seal.

J. Electric Actuators for Valves

1. Materials: All materials of construction shall have maximum resistance to chemical attack from environmental conditions such as solvent fumes, acid and caustic fumes, sea water atmosphere, etc. All exposed materials of construction shall have maximum resistance to splashes and spills of acids, caustics, solvents, salts, etc. Exposed

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materials of construction should be a chemically resistant material such as thermoplastic, glass reinforced thermosetting plastic, or equivalent, which will not crack, chip, or peel (under normal usage).

2. Weights: Those actuators with output torques up to 50 lb per inch shall not weigh more than 4 lb. Those actuators with output torques in the 50 to 700 lb per inch range shall not weight more than 15 lb. Those actuators with output torques in the 700 to 5,000 lb per inch range shall not weigh more than 35 lb.

3. Mounting Hole Patterns: Those actuators with output torques up to 50 lb per inch shall have square mounting hole patterns, 1-1/2 inch between centers. Those actuators with output torques in the 50 to 700 lb per inch range shall have square mounting hole patterns, 3 inches between centers.

4. Voltages: All electric actuators shall be available in 120 VAC 60/50 Hz, single phase as standard.

5. Actuators shall be capable of receiving a 4-20 MA DC input signal from the flow controller or other control device. Actuators shall have the ability to fit to the size of the valve.

6. General

   a. All electric actuators shall be available with NEMA 4 covers and have sufficient space, under cover, for additional switches, heavy duty capacitators, thermostatically controlled heaters, motor brakes, etc.

   b. All electric actuator covers shall have a minimum of 1/2 inch drilled and tapped hole for electrical conduit as standard and have sufficient material for a 3/4 inch drilled and tapped hole for electric conduit as an option.

   c. All electric actuators shall have an externally-mounted, readily accessible means of manually overriding the motor as an option. They shall be available with optional rotational speeds over a range of from 2 seconds to 60 seconds for 90° of rotation on the output shaft, and have an externally visible output shaft position indicator.

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d. All electric actuators shall have a built-in motor overload protector, a 25 percent duty cycle minimum with optional 50 percent duty cycle and be capable of operation at ambient temperatures of from -40° to 150°F.

e. Overall dimensions of all electric actuators shall be minimal to permit installation in areas where space is at a premium.

2.04 PRESSURE GAUGES

A. Pressure gauges shall be direct reading, bourdon tube, pressure gauges for liquid, service with accessories as shown or specified.

B. Gauges of like type shall be the product of one manufacturer.

C. All gauges 4-1/2 inches unless otherwise shown.

D. Cases

1. Aluminum, stainless steel or phenalic

a. Finish to be black except for stainless steel

2. Heavy acrylic dial covers

E. Bourdon Tubes

1. Bronze unless otherwise specified

F. Accuracy

1. Gauges smaller than 4-1/2 inch, 2% of full scale

G. Movements

1. Brass or stainless steel

2. Adjustable for recalibration

H. Stop Cocks

1. Brass with lever or tee handles

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I. Pulsation Dampener

1. Brass construction

2. Adjustable by pin size or pin location

J. Diaphragm Seals

1. Stainless steel housing

2. 316 stainless steel diaphragm

3. Glycerine or silicone filled gauges shall be factory assembled

2.05 PIPE SLEEVES

A. Pipe sleeves shall be provided for each pipe which penetrates a foundation, wall, or slab unless noted otherwise on the Drawings. Sleeve shall mean a casting or fabricated special inserted in the foundation, wall, or slab through which a pipeline passes.

B. Sleeves shall be solid cast or ductile iron castings or fabricated from Schedule 40 steel pipe.

C. Pipe sleeves shall be provided with waterstops when installed in poured concrete foundations, walls, slabs, and elsewhere as shown.

D. Waterstops for fabricated sleeves shall be at least the same thickness as the sleeve and a minimum of two inches in width.

2.06 WALL HYDRANT

A. Wall hydrant shall be a cast brass back outlet body with caps and chains. Hydrant shall have two 4 inch outlets with NST threads. A cast brass round wall plate letered HYDRANT shall also be provided

2.07 PVC DUCT

A. Duct work for tank vents shall be Schedule 40 PVC and shall be fabricated in accordance with manufacturer's instructions.

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2.08 MISCELLANEOUS

A. All other materials, not specifically described, but required for a complete and operating installation of the work of this section shall be new and first quality of their respective kinds.

PART 3 EXECUTION

3.01 INITIATION OF INSTALLATION

A. Inspection

1. Prior to all work of this Section, the CONTRACTOR shall inspect the installation area to see that the installed work of other trades has progressed to the point where this installation may properly commence.

3.02 INSTALLATION

A. General

1. The installation of piping, valves, pressure gauges, and pipe sleeves shall be in accordance with the configuration shown on the Drawings and Shop Drawings.

2. Components shall be installed in accordance with the manufacturer's recommendations.

3. Pipelines shall be carefully erected and neatly arranged and run where shown on Drawings.

4. Supports and anchors shall be adequate to support the pipe filled with water with a minimum factor of safety of 5 and for the test pressure specified.

5. Field cuts of pipe shall be in accordance with manufacturer's instructions.

B. Testing

1. The CONTRACTOR shall furnish all labor, equipment, test connections, vents, water, and materials necessary for carrying out the pressure and leakage tests.

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2. All testing shall be witnessed by the CQA Consultant.

3. Equipment in or attached to the pipes being tested shall be protected. Any damage to such equipment during the test shall be repaired by the CONTRACTOR at his expense.

4. Pipes, fittings, etc. must be properly braced and harnessed before the pressure is applied. Thrust restraining devices which will become a part of the system must also be tested at the test pressure.

5. If the line fails the test, the CONTRACTOR shall explore for the cause of the excessive leakage and after repairs have been made, the line shall be retested. This procedure shall be repeated until the pipe complies.

6. Test pressure shall be 150 psi.

7. Test pressure shall be held on the piping for a period of at least two hours unless a longer period is requested by the engineer.

8. The leakage test shall be conducted concurrently with the pressure test. Rate of leakage shall be determined at 15 minute intervals by means of volumetric measurement of makeup water added to maintain test pressure. The test shall proceed until the rate of leakage has stabilized or decreases to 0 during three consecutive 15 minute intervals. After this, the test pressure shall be maintained for at least another 15 minutes.

9. At the completion of the test, the pressure shall be released at the furthermost point from the point of application.

10. All exposed pipe shall be examined during the test and all leaks, defective materials, or joints shall be repaired or replaced before repeating the tests.

11. The allowable leakage shall not exceed 0 (zero).

12. Upon completion of the installation, the CONTRACTOR shall operate all valves to show that they operate without binding or strain.

13. The pipelines in which valves are installed shall be filled with water and pressurized to the design

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pressure to demonstrate that the installed valves do not leak.

14. The CONTRACTOR shall correct any valve deficiencies as indicated by failure of the above tests.

3.03 DUCT INSTALLATION

1. PVC Duct shall be connected to tank vents and routed along the roof joist to the air stripping tower.

2. Duct work shall be manifolded such that one duct section penetrates the roof directly adjacent to the air stripping tower. Stack height shall be 35 feet above finish floor elevation.

END OF SECTION

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SECTION 15100

ISVS MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the provision and installation of a skid-mounted package vapor extraction/emission control unit consisting of blower, controls, demister, condensate removal tank and pump, and thermal oxidation system, and any other related materials as specified herein and as shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 02600 - ISVS Extraction Wells

B. Section 02700 - Pipe, Fittings, and Related Materials

C. Section 15971 - Control Systems - Barber Colman Network 8000

D. Section 15971A - Appendices to Section 15971

E. Section 16400 - Electrical

1.03 SUBMITTALS

A. Prior to fabrication, the Contractor shall provide the following information for the Owner's review and acceptance. Acceptance shall in no way be regarded as certification of the validity of the design or equipment.

1. Manufacturer(s) name, address, and model number(s).

2. A complete description of any similar installations including, at a minimum, Owner's name, contact person, and phone number; length of service; and measured performance data.

3. Descriptive catalog sheet(s), brochure(s), and photographs(s).

4. A complete material and energy balance.

5. Piping and instrumentation diagram(s).

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6. A complete list of equipment and instrumentation, including Manufacturer, sizes, model numbers, and materials of construction.

7. Equipment drawings, including plan, elevation, and section views in sufficient detail.

8. A description of any manufacturer standard features which are not required by this Specification and which are provided at no additional cost to the Owner.

9. At least four weeks prior to startup and personnel training required by Part 3 of this Specification, the Contractor shall provide to the Owner at least six (6) copies of the complete operation and maintenance procedures manuals.

B. Shop Test Results:

1. Submit copies of equipment performance test results.

2. Submit results of routine factory tests.

C. Field Test Results:

1. Submit a written report giving the results of the required field tests.

D. Operation and Maintenance Manuals:

1. Submit complete installation, operation, and maintenance manuals including copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation, and a complete spare and replacement parts list, including original equipment Manufacturer's parts numbers.

2. Furnish operation and maintenance manuals.

E. Lubricant Specifications: Furnish a lubricant specification for each type and grade necessary to meet the requirements for each type of equipment.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work.

B. Store materials to permit easy access for inspection and identification.

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C. Store in covered storage area and prevent condensation.

1.05 GUARANTEE AND WARRANTY

A. Guarantee: In addition to the manufacturer's standard guarantee, the Contractor shall include the services of a factory-trained serviceman to provide repair service for the period of one year commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.

B. Warranty: Equipment shall also be warranted by the manufacturer for a five-year period. The warranty shall be acceptable to the Owner. Wear items such as seals, bearings, impellers, rotors, and starter may be prorated during the five-year period.

PART 2 - MATERIALS

2.01 PACKAGED SYSTEM

A. Supply a skid-mounted package system, manufactured by Therm Tech, Inc. Model No. VAC 25 CL, or HMT Thermal Systems, Inc. Model 250ST, or Design Engineer approved equal, and designed for maximum ISVS feed gas flow rate of 160 scfm. The anticipated composition of landfill gas is presented in Table 1. The following items shall be contained within the package system:

1. Noise Abatement

2. Automatic Modulating Dilution Air

3. LEL Monitor (installed prior to automatic modulating dilution air) equipped to signal telemetry system.

4. CO Monitor (installed prior to automatic modulating dilution air) equipped to signal telemetry system.

5. Opacity Alarm (installed prior to automatic modulating dilution air) equipped to signal telemetry system.

6. Total Hydrocarbon Analyzer (flame ionizing detector) installed prior to automatic modulating dilution air equipped to signal telemetry system.

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TABLE 1

DESIGN FEED PARAMETERS FOR THE THERMAL OXIDIZER

Constituent	Concentration Range[1]		Emission Rate	
	low (ppm)	high (ppm)	low (lb/day)	high (lb/day)
Vinyl Chloride	170	7,700	3.83	71.74
Acetone	ND	5.4	0.00	0.05
2-Propanol	ND	2.3	0.00	0.05
1,2-Dichloroethene (total)	40	4,300	17.14	62.14
1,1-Dichloroethane	0.3	6.7	0.01	0.10
2-Butanone	4.7	13	0.12	0.14
2-Butanol	ND	5.9	0.00	0.02
Chloroform	ND	77	0.00	0.83
Tetrahydrofuran	ND	77	0.00	0.83
Benzene	0.7	7.4	0.02	0.09
Trichloroethene	14	420	0.66	8.23
4-Methyl-2-pentanone	20	630	0.72	9.41
Toluene	15	240	2.83	3.30
Tetrachlorethene	0.85	17	0.05	0.42
1,3-Dimethylbenzene	ND	42	0.00	0.66
1,2-Dimethylbenzene	3.9	41	0.15	0.65
Total non-methane VOCs	789.45	13,508.65	25.54	157.84
Methane	70,000	470,000	405.18	1,123.77
Total VOCs	70,789	483,509	430.72	1,281.61

[1] Concentration range is to be used as a guideline for the system operation range.

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7. Oxygen Monitor (installed prior to automatic modulating dilution air) equipped to signal telemetry system.

B. The supplied system shall be capable of converting to the catalytic oxidation system at a later date, if required.

C. The material of construction for a 150-gallon condensate tank shall be compatible with the waste constituents anticipated to be stored and as presented in Table 2. The condensate tank shall be capable of automatically conveying condensate water to the treatment plant. The Contractor shall propose the automated system for acceptance by the Design Engineer.

D. The pump to be used for pumping collected condensate to the treatment plant shall be manufactured by Grundfos Pump Corporation, Model # CR-2-40N, 1/4 HP at 1,750 rpm, 10 GPM estimated flow rate, total discharge head of 20 feet, and total suction head of 15 feet, a centrifugal pump with 316 ss impellers.

E. Flowmeter/totalizer to be used shall be horizontal, non-resettable registering six digits, compatible with the anticipated waste constituents, positive displacement, cast bronze split case with NPT couplings, capable of operating between 32°-100°F, and 150 psi maximum pressure.

F. Thermal Oxidizer:

1. Destruction Removal Efficiency (DRE): of 99.9 percent or greater shall be attained by the thermal oxidizer for all organic compounds in the quantities specified in Table 1.

2. Design Specifications of Thermal Oxidizer:

Volume Rating (feed)	160 scfm
Process Stream Temperature	120°F
Process Stream Content	See Table 1
Operating Temperature	82,200°C
Residence Time	at least one second

3. Combustion Chamber: shall be horizontal fired, with a minimum combustion temperature of 2,200°F and a minimum residence time of 1.0 second before exhausting heated gases into the atmosphere. Another temperature residence time combination may be proposed that meets the required DRE.

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TABLE 2

CHEMICAL SPECIFIC DATA FOR CONDENSATE FROM EXTRACTION PIPE

Constituent	Concentrations ug/l[1]
Vinyl Chloride	13,000
Methylene Chloride	7,600
Acetone	9,700
1,1-Dichloroethylene	150
1,1-Dichloroethane	74
1,2-Dichloroethylene (Total)	97,000
2-Butanone	3,600
Trichloroethylene	10,000
4-Methyl-2-Pentanone	410,000
Benzene	13
2-Hexanone	200
Tetrachloroethylene	95
Toluene	13,000
Chlorobenzene	1.9
Ethyl Benzene	540
Total Xylenes	2,100
	Concentrations mg/l
Chloride	219
Fluoride	0.16
Nitrate and Nitrite Nitrogen	1.5
Sulfate	78
	Concentration units
pH	7.1

1 Concentration range is to be used as a guideline for the extraction pipe material compatibility.

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4. Materials of Construction: of the oxidizer, associated ductwork, heat exchanger, etc. shall be corrosion resistant to withstand the combined impact of high temperature, the ISVS gas, and all products of combustion.

5. Supplementary Fuel Requirements: Natural gas shall be used as supplementary fuel. The Contractor shall determine the maximum fuel requirements and shall provide a complete natural gas feed system.

6. Burner: Included in the oxidizer package should be a gas fired burner, installed capacity 1 million BTU/hour, and piped per FM requirements. The burner will operate on natural gas without any modifications. The burner should include an ultraviolet scanner and spark igniter.

7. Flame Arrestors: Flame arrestors shall be provided in the piping leading to the thermal oxidizer to prevent backfiring of ISVS gas before it reaches the thermal oxidizer.

8. Insulation: All external surfaces of the oxidizer at a very high temperature shall be properly insulated so as to minimize injury to operators.

9. Sample Port: A minimum of one sample port shall be provided at the exit duct of the thermal oxidizer to provide for sampling. The thermal oxidizer shall also be provided with a viewport and an access door for maintenance.

10. Silencer: An in-line silencer shall be provided before the gas enters the thermal oxidizer.

11. Flowmeters: Flowmeters shall be provided on each gas line leading to the thermal oxidizer.

12. Pressure Indicators: Pressure indicators shall be provided on all gas lines leading to the thermal oxidizer. Pressure indicators shall be provided on the fuel supply system including the main fuel supply line as well as the pilot fuel supply line.

13. Control Valves: Modulating motorized valves shall be provided at all points where automatic control is required. Such valves include motorized valves on the main fuel line, on the main header line, and on the dilution air line. On/off motorized valves shall be provided on the main fuel line. Additionally, hand-operated valves shall also be

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provided on the main header line and on the main fuel line. All valves shall be explosion-proof.

14. Piping/Ducts: All piping shall be made of a material compatible with the gas composition. Insulation shall be provided on all piping containing a high temperature gas.

15. Temperature Controls/Safety Features: The oxidizer shall be equipped with a temperature control and continuous temperature recording device. The temperature control device shall be able to control fuel gas usage. If the temperature falls below the allowable range necessary to maintain a high DRE, an automatic control shall turn off the extraction blower to prevent uncontrolled emissions of hydrocarbons. Conversely, if the blower shuts down the thermal oxidizer shall also shut down to prevent unnecessary fuel usage. Audible alarms shall be provided in case of any abnormal operational conditions including very high temperatures in the combustion chamber.

    A complete control panel with a burner management system shall be provided with appropriate indicating and recording instrumentation.

16. Oxygen Probe: An oxygen probe or any other equivalent device capable of monitoring the excess air requirement shall be provided. This device shall be able to control the rate of excess air bleed-in and the ISVS gas flow rate.

17. Burner Shut-off: A burner safety control valve shall be provided which can turn off the burner if the exhaust temperature is too high, if the gas pressure is too high or too low inside the natural gas feed line, if the excess air pressure is too low, if there is a power failure, and if there is a flame failure.

18. Stack: The flanged stack shall be provided at the top of the oxidizer such that it extends at least 36 feet above the ground surface on which the oxidizer is placed. There shall be a provision for a sample port in the stack as well as a temperature indicator/recorder. Structural support, if any, shall be provided. Submit shop drawings for stacks, signed and sealed by a Registered Professional Engineer in the Commonwealth of Pennsylvania, for approval by the Design Engineer. Stacks shall be refractory-lined with a material capable of withstanding at least 2,200°F or more.

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19. Blowers: Shall be regenerative and as manufactured by E. G. Rotron. Two blowers shall be supplied to be operated either in series, parallel, or independently at 160 scfm at 4.5 inches of mercury (suction), or 70 scfm at 2.0 inches of mercury.

PART 3 - EXECUTION

3.01 INSTALLATION INSTRUCTIONS

A. The Contractor shall provide for and perform all installation procedures associated with the safe operation of the thermal oxidizer and in accordance with the written instructions by the manufacturer.

B. The DRE of the thermal oxidizer must be demonstrated by a source test when the thermal oxidizer is first fired.

C. Complete operational procedures and manuals must be provided for the correct operation of all materials included in Section 2. In addition, two days of on-site personnel training in the operation as well as start up and shut down procedures must be provided. Complete maintenance procedures must be provided including routine as well as emergency repairs.

D. The Contractor shall successfully startup, shutdown, and then startup the system during personnel training. This shall include the successful demonstration of all safety interlocks.

3.02 OPERATION AND MAINTENANCE INSTRUCTIONS

A. The equipment manufacturer shall be responsible for supplying written instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the equipment. Said instructions shall assume that the operator is familiar with similar equipment, but that he has not previously operated and/or maintained the exact equipment supplied.

B. The instructions shall be prepared as a systems manual applicable solely to the equipment supplied by the manufacturer to these specifications, and shall include those devices and equipment supplied by him.

3.03 MANUFACTURER'S SERVICES

A. Furnish the services of a qualified factory-trained serviceman to assist in the installation of the equipment, check the installation before it is placed into operation, assist in the performance of field

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tests, supervise initial operations, and instruct operators in the care, operation, and maintenance of appropriate ISVS mechanical equipment, as needed.

B. Serviceman shall check the complete installation and perform the field tests and supervise initial operations, as needed.

C. Reports: The Contractor shall submit to the Owner a report by the manufacturer of each visit to the site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information and facts.

END OF SECTION

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SECTION 15160

CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary for the installation of pumps, motors, and controls as specified herein, as shown on the Drawings, and as necessary for complete installation.

B. Centrifugal pumps shall include motor driven, end suction, top discharge, frame mounted centrifugal design all purpose pumps for the groundwater treatment and discharge system.

C. The CONTRACTOR shall furnish all equipment, supplies, materials, labor, and properly calibrated meters and instruments to perform the field running tests. A field running test shall be performed on each pump assembly installed.

C. Pump motors and controls are included under this section.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data and Samples

B. Section 01620 - Protection and Storage

C. Section 15162 - Groundwater Treatment System Instrumentation and Controls

D. Section 15971 - Control System - Barber Colman Network 8000

E. Section 15971A - Appendices to Section 15971

F. Section 16400 - Electrical

1.03 DESIGN CRITERIA

A. 1. Centrifugal Pump (Pumps No. 1 and No. 2)

Type	horizontal end-suction centrifugal
Rated Speed	1800 RPM
Worthington Series	814

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Size	2 x 1 x 10
Motor	3 HP, TEFC
Operation	Continuous Duty Alternated by a Timer
Control	Level Switches and Electrically Actuated Flow Control Design

2. Performance: 47 gpm at 77 ft T.D.H.

B. 1. Centrifugal Pump (Pumps No. 5 and No. 6)

Type	horizontal end-suction
Rated Speed	1800 RPM
Worthington Series	814
Size	2 1/2 x 1 1/2 x 5
Motor	1 HP TEFC
Operation	Continuous Duty Alternated by a Timer
Control	Level Switches and Throttling Valve

2. Performance: 45 gpm at 18 ft T.D.H.

C. 1. Centrifugal Pump (Pumps No. 7 and No. 8)

Type	horizontal end suction
Rated Speed	1800 RPM
Worthington Series	814
Size	2 x 1 x 10
Motor	3 HP TEFC
Operation	Continuous Duty Alternated by Backwash Water Storage Re-supply
Control	Level Switches,Backwash Water Storage Requirements, and Throttling Valve

2. Performance: 47 gpm at 68 ft T.D.H.

D. 1. Centrifugal Pump (Pumps No. 9 and No. 10)

Type	horizontal end suction
Rated Speed	3600 RPM
Worthington Series	814
Size	3 x 1-1/2 x 8
Motor	20 HP TEFC
Operation	Intermittent Duty, Alternated Each Backwash Cycle
Control	Backwash Cycle, Level Switches and Mechanical Flow Control

2. Performance: 180 gpm at 240 T.D.H.

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E. 1. Centrifugal Pump (Pumps 12 and 13)

Type	horizontal end suction
Rated Speed	1800 RPM
Worthington Series 814	
Size	2 x 1 x 6
Motor	1 HP TEFC
Operation	Intermittent Duty, Alternated Each Cycle
Control	Sludge Holding Tank Decant and Level Switches

2. Performance: 25 gpm at 25 T.D.H.

F. Pumps shall be capable of performing over the entire expected operating range.

1.04 SUBMITTALS

A. Submit shop drawings, product data, design criteria, etc. in accordance with Section 01340.

B. Submit detailed shop drawings, performance curves, materials of construction, and other product literature for all pumps.

C. Submittals shall contain suitable motor outline drawings together with motor performance data, including guaranteed values of full load and locked rotor currents, rated horsepower, service factor, rated speed, phase, voltage, frequency, type, frame, insulation class, time rating, design letter and code letter for locked KVA/HP.

D. Submit electrical diagrams and suitable technical information on pump control panels, timers, alternators, circuit breakers, and enclosures.

E. Submit three bound copies of the Operation and Maintenance Manual for all pumps, motors, and controls. Submit a complete and detailed list of spare and replacement parts including original equipment manufacturer part numbers.

PART 2 PRODUCT

2.01 ACCEPTED PUMP MANUFACTURERS

A. Dresser Pump, Dreser Industries, Chesapeake, VA.

B. Approved Equal.

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2.02 PUMP

A. Materials

1. Pumps shall be cast iron construction.

2. Impellers shall be bronze closed design with Buna/carbon/ceramic/stainless steel mechanical seals.

B. Pump Construction

1. General

a. Pumps shall fit into the space provided on the Contract Drawings without undue adjustment of the piping.

b. Pumps shall be frame-mounted and flexible-coupled (with an OSHA coupling guard) to the drive motors.

c. Motors and pumps shall be mounted on steel baseplates, arranged for bolting to the foundation.

d. Each casing shall be designed to permit back or top pullout to remove pump intervals without disturbing system piping. Drain connections are to be provided.

2. Impellers

a. Impellers shall be enclosed design statically and hydrostatically balanced and positioned on the shaft with an impeller key. Balance shall be provided through the impeller hub.

3. Pump Shafts

a. Shaft shall be high-strength carbon steel sized for minimum deflection. The shaft shall be designed to accommodate a replaceable shaft sleeve.

b. Pump impellers, shafts, sleeves, and coupling shall be balanced for the operating speeds.

c. Shaft shall be steel and shaft sleeve shall be bronze.

d. The shaft shall be supported by two anti-friction ball bearings located in the pump bearing frame designed and sized to two-year

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minimum life. Both bearings shall be sealed-for-life pre-lubricated type and shielded from entrance of foreign material while operating.

4. Baseplace and coupling.

   a. The baseplate shall be channel steel sufficiently designed to support the pump and driving motor.

   b. Coupling shall be flexible spacer type.

2.03 MOTORS

A. All motors shall conform to standards outlined above. Unless otherwise specified, all motors shall be of a design suitable for full voltage starting. All motors shall operate without undue noise or vibration and shall show no signs of phase unbalance.

B. To the extent possible, all motors furnished for similar equipment shall be of one manufacturer.

C. Three Phase Motors

   1. NEMA Design Designation shall be as noted below, unless other classification is required by the equipment manufacturer and approved by the Engineer.

      a. Three Phase Motors

         1. Unless otherwise shown or specified, all motors shall be three phase, 480 VAC, 60 Hertz induction motors.

         2. Unless otherwise shown, specified or as required by the dynamic characteristics of the load, all polyphase motors shall have torque characteristics as required for NEMA Design B motors.

D. Ratings

   1. All motors shall be of the continuous rated type with adequate ratings to accelerate and drive their connected equipment under all normal operating conditions without exceeding 1.0 times the rated horsepower.

   2. All motors shall be provided with a service factor of 1.15, unless otherwise specified.

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3. Unless otherwise specified, motor synchronous speeds shall not exceed 1,800 RPM.

4. Nameplates shall be furnished with all motors with markings in accordance with NEMA standards.

2.04 SPARE PARTS AND TOOLS

A. One set of the replaceable seal elements for each pump shall be furnished.

B. The CONTRACTOR shall also furnish one set of special tools for maintenance.

2.05 PAINTING

A. The manufacturer shall provide the equipment with the manufacturer's standard shop primer and finish coats.

2.06 CONTROLS

A. Pump and motor shall be provided with two-pump control panels, including magnetic across-the-line starters, circuit breakers, bi-metal overload relays, and quick-trip heater elements for overload protection, electric alternators, on and off-auto switch, NEMA 1 enclosure and timers as required.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pumping units shall be installed in accordance with manufacturer's template, installation instructions, and approved shop drawings.

B. Pump baseplates shall be furnished and shall be grouted and anchored to the foundation as required.

C. The CONTRACTOR shall furnish the services of the competent representative of the manufacturer for a minimum of the two man days, who shall inspect, startup the pumping units, and demonstrate that the equipment operates in accordance with the specifications.

3.02 FIELD RUNNING TESTS

A. Each pump assembly with its drive unit and auxiliary equipment shall be field tested after installation.

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B. The field running tests shall not be started on any pump assembly until the manufacturer's representative is present and has completed the inspection for proper assembly, erection, and alignment. The manufacturer shall supply certification of installation according to his specifications.

C. The field running tests shall be conducted by the CONTRACTOR and the manufacturer's representative and witnessed by the CQA Consultant, and shall demonstrate compliance with the following over the full range of operating conditions:

1. That the unit has been properly installed and has no mechanical defects.

2. That the unit is in proper alignment and has been properly connected.

3. That the unit is free from undue vibration.

4. That the unit is free from overloading or overheating.

END OF SECTION

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SECTION 15161

ELECTRONIC METERING PUMPS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section includes all labor, materials, tools, equipment, supervision, transportation, engineering, drawings, and training necessary to furnish and install the electronic metering pumps, interconnecting valving, piping, tubing, mounting hardware, support brackets, and appurtenances as specified herein, as shown on the Drawings, and as necessary for a complete installation.

B. The electronic metering pumps are to be installed as part of the potassium permanganate feed system and shall be sized to operate feeding a 2 percent potassium permanganate solution with an operating range of 0 to 2.5 gph

C. One pump will operate with the other on standby and sequencing of pumps will be manually controlled.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

C. Section 16400 - Electrical

1.03 SUBMITTALS

A. CONTRACTOR shall submit detailed shop drawings of the pumps, pump support brackets, mountings, and appurtenances in accordance with Section 01340. Shop drawings shall include detailed layout drawings of the equipment.

B. CONTRACTOR shall submit details including pump curves, electrical wiring diagrams, and installation instructions.

C. CONTRACTOR shall submit three bound copies of the operation and maintenance manual for the pumps. The manuals shall contain information sufficient to

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instruct persons not familiar with this type of operation. CONTRACTOR shall submit a complete and detailed list of spare and replacement parts including original equipment manufacturer part numbers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pulsafeeder (IDEX Corporation), Punta Gorda, FL.

B. Approved Equal

2.02 MATERIALS

A. Electronic Metering Pumps

1. The CONTRACTOR shall furnish and install two (2) Pulsatron® Series E Plus electronic metering pumps or approved equal.

2. Chemical metering pumps shall be positive displacement, non-hydraulic, solenoid driven, diaphragm type pumps. Positive flow shall be ensured by a minimum of four ball type check valves per pump. A bleed valve shall also be provided for manual evacuation of entrapped air or vapor and safe relief of pressure in the discharge line.

3. All materials of construction shall be compatible with compounds found in the liquid. Pump heads shall be constructed of glass-filled polypropylene. The pump diaphragm shall be Teflon faced with a hypalon backing. Check valves shall have Teflon seats/o-rings, Teflon balls, and a glass-filled polypropylene housing. The bleed valve shall be constructed of glass-filled polypropylene. Suction tubing shall be constructed of PVC and discharge tubing shall be constructed of polyethylene.

4. The pump control panel shall be located opposite the liquid handling end of the pump. Output volume adjustments shall be made using independent dial knobs for stroke length and frequency. Stroke length adjustment shall have a locking lever.

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5. Control functions shall be automatic with stop. Pump control shall be selectable between manual and automatic by means of a 3 position center off switch. In the automatic mode, the pump shall accept a direct 4-20 mADC signal (without a signal interface or external conversion device). Internal resistance shall be 124 ohms.

6. The control panel shall be equipped with a green indicator which, for all operating modes, shall illuminate when the pump is in operation and strobe once for each pump stroke.

7. Pump shutoff shall be controlled by a dry contact closure switch. The stop function shall operate in either the manual or automatic mode. The contact switch shall illuminate a red indicator light on the control panel of the pump when operation has stopped. The pump shall resume normal operation when the contact opens.

8. The electronic drive shall be equipped with a solenoid for automatic reset for thermal overload protection. The pump shall also be equipped with an automatic shutoff for over pressure protection when the pressure in the discharge line exceeds 35 percent of the pump pressure rating at maximum stroke.

9. The pump shall be provided with a circuit breaker accessible from the outside of the pump and capable of providing protection from circuit overload.

10. Internal wiring between electronic circuit board, solenoid, and power shall be a quick disconnect terminal at least 3/16" wide.

11. Pump drive shall be enclosed in a water resistant housing constructed of a chemically resistant glass filled polyester. The control panel shall be enclosed by a hinged dust cover constructed of polycarbonate plastic. Electronic circuitry shall be mounted at the rear of the pump for maximum protection against chemical intrusion.

12. The pump mounting brackets and supports shall be designed to anchor to the top of the permanganate feed tank. Pumps shall be mounted using less than half of the tank area. Supports shall be PVC construction.

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PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.

B. Installation of pumps shall be on top of the potassium permanganate tanks in accordance with approved pump mounting details.

END OF SECTION

ORIGINAL (Red)

SECTION 15162

GROUNDWATER TREATMENT SYSTEM INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section includes all labor, materials, tools, equipment, supervision, transportation, engineering, and drawings necessary to furnish and install controls and instrumentation required for the groundwater treatment system including flow controls, level indicators/controls, pump controls, alarms, etc. as specified herein and as shown on the Drawings.

B. The manufacturer shall provide technical assistance for installation, start-up, and training as outlined below.

1.02 RELATED SECTIONS

A. Section 01340 - Shop Drawings, Product Data, and Samples

B. Section 01620 - Storage and Protection

C. Section 11395 - Automatic Sampling Device

D. Section 15971 - Control System - Barber Colman Network 8000

E. Section 15971A - Appendices to Section 15971

F. Section 16400 - Electrical

1.03 SUBMITTALS

A. CONTRACTOR shall submit detailed shop drawings including system drawings, wiring diagrams, operating data, detailed description of operating sequence, and description and engineering data on each control system component in accordance with Section 01340.

B. The CONTRACTOR shall submit to the OWNER three (3) bound copies of the Operation and Maintenance instructions for all instruments and controls specified in this section. The information shall be sufficient to instruct personnel who are unfamiliar with such equipment in the operation and maintenance

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of the equipment. Diagnostic procedures shall be provided for use in the event of equipment shutdown or malfunction.

C. The CONTRACTOR shall submit a complete and detailed list of spare and replacement parts including original equipment manufacturer part numbers.

D. Instrumentation symbols shall be consistent with Instrument Society of American Instrumentation Symbols and Identification.

1.04 INSTRUMENTATION FUNCTION AND DESCRIPTION

A. Provide instrumentation and controls to perform the functions described hereafter. Instrumentation and control requirements are discussed below in conjunction with the P & I Diagram in the Contract Drawings.

B. Equalization Tank

1. Provide two (2) dual level float control switches to control pump operation. One switch shall be set for Level Switch High (LSH) and Level Switch Low Low (LSLL) which will turn P-1/P-2 on and off, respectively. The other level switch shall be set for Level Switch High High (LSHH) and Level Switch Low (LSL). Level Switch High High (LSHH) shall turn off submersible well pumps and activate the operator alarm system. Level Switch Low (LSL) shall activate the operator alarm system to provide early warning of the low water level in the tank.

2. Provide one (1) in-line flow sensor in the recovery well header. Flow sensor shall send a signal to a flow indicator/totalizer and flow recorder. Continuous flow and flow total shall be recorded.

C. Permanganate Feed Tank

1. Provide one (1) dual level float control switch. Level Switch Low (LSL) shall turn off P-3/P-4 and activate operator alarm system. Level Switch High (LSH) shall activate operator alarm system.

D. Effluent Holding Tank

1. Provide one (1), three level float control switch. Level Switch High High (LSHH) shall turn off P-5/P-6 and activate operator alarm system. Level

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Switch High (LSH) shall turn P-7/P-8 on and Level Switch Low (LSL) shall turn P-7/P-8 off.

2. Provide one (1) level float control switch. Level Switch Low Low shall turn off P-9/P-10 (stop backwash) and activate operator alarm system.

E. Sludge Holding Tank

1. A sludge depth meter shall be installed in the sludge holding tank to measure the sludge level in the tank. The meter probe shall scan a vertical distance, locate the sludge/liquid interface, and relay this information to the controller. When sludge depth reaches a set depth, the controller shall alert the operator to activate the filter press system and remove the sludge from the tank.

2. The sludge depth meter shall provide satisfactory service for continuous operation under specified operating conditions.

3. Provide one (1), dual level float control switch. LSH shall turn off pump P-9/P-10 and activate operator alarm system. LSL shall close the electrically actuated decant valve. Decant valve opens by a timer.

F. Filtrate Tank

1. Provide one (1), three level float control switch. Level Switch High High (LSHH) shall close the decant valve on the sludge holding tank and activate operator alarm system. Level Switch High (LSH) shall turn P-12/P-13 on and Level Switch Low (LSL) shall turn P-12/P-13 off.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Markland Specialty Engineering Ltd., Ontario, Canada
B. Great Lakes Instruments, Milwaukee, WI.
C. SOR, Lenexa, KS
D. Chessel Corporation, Newtown, PA
E. Approved Equal.

2.02 MATERIAL

A. pH Sensor

1. The CONTRACTOR shall furnish and install one (1) submersion mounted epoxy encapsulated pH sensor in the effluent storage tank.

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2. The pH sensor shall be a differential electrode type utilizing two electrodes to compare the process signal to a stable reference standard buffer solution. The standard shall have non-flowing and fouling resistant characteristics.

3. The convertible mount sensor shall be 5-wire model with integral preamplifier and shall have a hex-shaped body to facilitate mounting.

4. The sensor shall have a leak proof epoxy coated body which completely encapsulates all the sensor's components.

5. The sensor signal shall be automatically temperature compensated by an integral temperature sensor. The sensor shall not polarize when removed from the process while energized.

6. The sensor shall include a ground electrode to cause ground loop currents to by-pass the measurement system without causing disturbance. The electrode material shall be glass material for pH measurement.

7. The sensor shall include close-coupled electronics for low impedance, long distance transmission over standard cable. The standard sensor cable length shall be 10 feet.

8. The sensor shall be provided with submersion mounting hardware including a 1 inch x 4 feet PVC pipe and coupling with PVC pipe-mount junction box and protector. The sensor shall be mounted below the low water line in the effluent holding tank. Additional 1 inch PVC pipe for mounting the probe at the proper elevation shall be included.

9. Great Lakes Instruments, Model 6001-series or approved equal

B. pH Analyzer

1. The CONTRACTOR shall furnish and install one (1) microprocessor-based pH analyzer.

2. The analyzer shall accept an input directly from a GLI differential electrode type sensor or conventional combination electrode.

3. The analyzer shall have a 4-1/2 digit LCD display with 7/8 inch high digits. The analyzer shall

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alternately display pH, °C or °F, the sensor's mV signal, and the 4-20 mA analog output.

4. The analyzer shall be capable of performing single or two-point automatic calibration using pH and temperature response monitoring circuits, automatically recognizing pre-selected buffer values, and displaying preprogrammed diagnostic messages that indicate operating malfunctions.

5. The analyzer shall have two configurable relays for control, dual alarm or system alarm and fail safe operating modes, a security lockout feature, and a 4-20 mA output hold function to prevent upsets during calibration or instrument setup.

6. The analyzer enclosure shall be NEMA 4X and capable of being panel, surface, or pipe mounted. Operating key pad shall also be watertight.

7. Great Lakes Instruments, Model 672P-series or approved equal

C. Flow Sensors

1. The CONTRACTOR shall furnish and install two (2) lock pin-mount impeller type flow sensors suitable to measure flow velocity from 1 to 30 fps in piping. Flow measuring sensors shall be located in accordance with the Contract Drawings.

2. The flow sensor shall have a six-bladed, forward swept-shaped impeller and a non-magnetic sensing mechanism.

3. The sensor shall have a noise-free pulse signal to allow the sensor and transmitter to be separated up to 2000 feet over standard two-wire cable.

4. The sensor components shall be fully encapsulated.

5. The sensor shall be constructed of polypropylene and shall have a locking pin/retaining ring fastening system to secure the sensor in the mounting tee.

6. The mounting tee shall be PVC with socket-weld type process connections for pipe sizes from 1 to 4 inches. Operating limits shall be 60 °C at 40 psi or 25°F at 100 psi.

7. Great Lakes Instruments, Model 1361F1 Sensor

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D. Digital Flow Monitor/Totalizer

1. The CONTRACTOR shall furnish and install two (2) microprocessor-based flow monitors/totalizers.

2. The monitor/totalizer shall be designed to receive and interpret the sensor output directly. The monitor/totalizer shall accept a 0 to 2,000 Hz signal from an inductive pickup (includes turbine flow meters), 0 to 200 Hz signal from impeller flow sensors, TTL-compatible signal of less than 200 Hz, and a transmitted linear 4 to 20 mA isolated flow signal. Input selector switches shall be provided to configure the monitor/totalizer for use with one of these input signals.

3. The monitor/totalizer shall have a minimum two-line LCD display with 3/8" high digits per line. Electronics shall enable the display to indicate flow rate and flow total simultaneously.

4. The monitor/totalizer shall have two integral SPDT relays. Each relay shall have adjustable set point and deadband and a selectable operating mode.

5. The monitor/totalizer shall have 4 to 20 mA, 0 to 100 Hz, LSTTL, and scaleable output signals which shall be connected to a recorder.

6. The monitor/totalizer shall be housed in a NEMA 4X enclosure which conforms to 1/2 DIN standards for panel, surface, or horizontal pipe mounting.

7. Great Lakes Instruments, Model 675F - series or approved equal

E. Digital Flow Controller

1. The CONTRACTOR shall furnish and install one (1) microprocessor-based flow controller.

2. The controller shall be designed to receive and interpret the sensor output directly. The controller shall accept a 0 to 2,000 Hz signal from an inductive pickup (includes turbine flow meters), 0 to 200 Hz signal from impeller flow sensors, TTL-compatible signal of less than 200 Hz, and a transmitted linear 4 to 20 mA isolated flow signal. Input selector switches shall be provided to configure the controller for use with one of these input signals.

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3. The controller shall have a two-line LCD display with 3/8 inch high digits per line. Electronics shall enable the display to indicate flow rate and flow total simultaneously.

4. The controller shall have two integral SPDT relays. Each relay shall have adjustable set point and deadband and a selectable operating mode for control of the flow control valve.

5. The controller shall have 4 to 20 mA, 0 to 100 Hz, LSTTL, and scaleable output signals which shall be connected to the flow control valve.

6. The controller shall be housed in a NEMA 4X enclosure which conforms to 1/2 DIN standards for panel, surface, or horizontal pipe mounting.

7. Great Lakes Instruments, Model 675F - series or approved equal.

F. Conductivity Electrode

1. The CONTRACTOR shall furnish and install one (1) electrodeless conductivity sensor which shall have a measuring range from 0 to 200 microSiemens/cm to 0 to 1,000,000 microSiemens/cm.

2. The sensor shall be constructed such that only one material is wetted by the process. The wetted material shall be polypropylene. This non-conductive material shall isolate the sensor from the process fluid and eliminate this potential cause of ground loop errors.

3. The sensor style shall be convertible for submersion mounting.

4. The sensor shall have an integral temperature compensator to allow adjustment of the conductivity reading to a 25°C reference.

5. The sensor shall be provided with submersion mounting hardware to include a 1/2 inch x 4 feet PVC pipe, PVC coupling, and PVC pipe-mount junction box.

6. Great Lakes Instruments, Inc., Model 3600E series or approved equal

G. Conductivity Analyzer

1. The CONTRACTOR shall furnish and install one (1) electrodeless conductivity and percent

ORIGINAL (Red)

concentration analyzer. The analyzer shall have two operating modes - conductivity and concentration. In the conductivity mode, solution conductivity shall be monitored and solution temperature and 4 to 20 mA instrument output shall be displayed. In the concentration mode, solution percent concentration shall be displayed in addition to conductivity, temperature and mA output.

2. The analyzer shall have a 4 1/2 digit LCD display with 7/8 inch high digits and be capable of indicating measured conductivity in µS/cm, mS/cm or S/cm and solution concentration from 0.0 to 100.0 percent.

3. The analyzer shall automatically flash preprogrammed diagnostic messages, without operator interaction, whenever system operating problems are detected.

4. The analyzer shall be microprocessor-based and have a watertight keypad on the enclosure door for ease of use.

5. The analyzer shall have a non-volatile memory to store all user-entered values indefinitely, even if power is lost or turned off.

6. The analyzer shall have a security lock feature to prevent unauthorized tampering with stored values.

7. For solution concentration, the analyzer shall have nine built-in conversion tables to convert conductivity to percent concentration. For other solutions, the user shall be able to create a user-defined table to convert conductivity to percent concentration. The user shall be able to enter up to 10 data points via the keypad to define the solution curve.

8. The analyzer shall provide four temperature compensation methods: none, linear, built-in solution table, and user-defined temperature table.

9. The analyzer shall have two calibration methods: the convention method where the operator enters reference solution values into memory; and the "two-key" method where two reference solution values are entered and calibration is accomplished with two keys.

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10. The analyzer shall provide three analog output signals; 0-5 VDC, 0-1 mA, and 4-20 mA. The analyzer shall have a range expand feature to allow these outputs to represent the entire measuring scale or a small portion of it.

11. The analyzer shall have an output hold feature to maintain the latest output during calibration or while configuring the instrument. The user shall be able to activate this feature via the keypad or from a remote location using an LSTTL-compatible or switch closure input signal connected to dedicated 672E terminals.

12. Great Lakes Instruments, Model 672E-series or approved equal

H. Flow, pH, and Conductivity Recorders

1. The CONTRACTOR shall furnish and install two (2) microprocessor-based strip chart type recorders in accordance with the Contract Drawings.

2. The recorder shall have three channel continuous trace capability, isolated universal inputs to accept TCs, RTDs, mA, mV, and Volts, capability of running rolls or Z-fold chart cassettes, and front mounted operator controls.

3. The recorder shall have a fluorescent display of measured, calculated, and totalized values.

4. The recorder shall have an adjustable chart speed configurable from 1 to 3,600 cm/hr with either roll or Z-fold chart cassette.

5. The plot performance shall have a minimum digital accuracy of 0.1 percent of span.

6. Chessel Corporation Model 345 or approved equal

I. Sludge Level Indicators

1. The CONTRACTOR shall furnish and install one (1) Markland Model 600 sludge depth meter including all necessary hardware and controls.

2. The Sludge Depth Meter and its probe shall be solid-state and have no moving parts. A Liquid Crystal Display (L.C.D.) shall indicate the depth of sludge from 0.0 to 48.0 inches (122 cm), and a 4-20 mA output signal shall be proportional to sludge depth.

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3. There shall be a BOTTOM OFFSET adjustment from 0 to 99 for setting if the probe is not resting on the bottom of the tank. This bottom offset will automatically be added to the sludge depth indicated on the L.C.D.

4. Two DPDT 5 Amp. output Relays shall be provided. Relay set-points shall be individually adjustable by pushbutton over the Meter's entire range, and shall include an OFF setting. Relay set-points shall be displayed on the L.C.D. for easy checking by the Operator. Set-points shall be indefinitely retained in the Meter, even during extended power failure, without using any backup batteries.

5. Sludge depth shall be displayed in either inches or centimeters, selectable by a slide switch.

6. Printed circuit boards shall be epoxy-glass plug-in type for easy replacement.

7. The Meter shall have automatic intensity control for operation in either thick or thin sludges, and it shall increase its own power to overcome probe scumming.

8. If the sludge depth cannot be determined because of some fault, such as a broken cable or bad connection, the L.C.D. shall display "SIGNAL LOST" and the 4-20 mA output shall go to zero mA, signifying a fault condition, and both Relays shall be de-energized. Upon correction of the fault condition, normal operation shall automatically resume.

9. All materials of construction including miscellaneous hardware shall be resistant to attack by any compounds likely to be found in the system.

10. The probe shall be supplied with 12 feet of 1 inch, Schedule 80 PVC pipe mast, c/w two stainless steel/polypropylene mounting clamps, and shall have a 33 foot cable pigtail. The active element of the probe shall be 48 inches long, and shall contain 64 pairs of high intensity infrared L.E.D./Phototransistors spaced vertically on 3/4 inch centers.

11. The micro-processor operating system shall contain error traps to detect and reject bad scan data. Only correct scans shall be included in the Meter's memory which provides damping by averaging

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the result of several scans, and it is this average that is displayed on the L.C.D.

12. The Meter shall have a self-diagnostic capability, and when a button on the panel is pushed, the contents of the Meter's memory shall scroll on the L.C.D., including an indication of any errors which were detected/corrected by the Meter, plus the light intensity received at each of the 64 element pairs within the probe's 48 inch active length shall be displayed.

13. The CONTRACTOR shall supply three (3) copies of the Operating Manual, which shall contain installation and operating instructions, circuit diagrams, troubleshooting, and a recommended list of spare parts.

J. Level Switches

1. The CONTRACTOR shall furnish and install six (6) multi-stage displacer operated level switches to be mounted in the process tanks as described herein.

2. Switches shall have a 2 1/2 NPT nipple type mount for installation as shown on the Drawings.

3. All materials of construction shall be compatible with materials found in the process solution including cleaning solutions. Materials shall comply with all applicable ASTM standards.

4. Displacers shall be fabricated from porcelain with the displacer spring constructed of Iconel and the cable made from 316 stainless steel.

5. Switch mechanisms shall be constructed of 316 stainless steel.

6. All flanges and fittings shall meet or exceed applicable ANSI requirements.

7. The level switch shall carry a 5 year warranty for defective material or workmanship provided the switch is installed in accordance with manufacturer's instruction and operation guidelines.

8. SOR, Model 700- series or approved equal.

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K. Level Alarms

1. Level alarms shall receive a signal from level switches and shall activate light on alarm panels and shall be audible in the building. Provide a 4-20 mA signal to close valve, turn on/off pumps, etc. as shown on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with manufacturer's instructions and recommendations

B. The CONTRACTOR shall provide all materials and labor for electrical wiring and incidentals that may be necessary to complete installation of the equipment specified in this section.

C. The CONTRACTOR shall <u>not</u> install instrumentation wiring and electrical wiring in the same conduit.

3.02 START UP AND TESTING

A. Testing of the system shall be performed by the OWNER or the Engineer. The manufacturer shall be available to provide technical assistance concurrent with and as part of the services described above.

END OF SECTION

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SECTION 15400
PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Provide plumbing where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:
   1. Domestic hot and cold water piping systems;
   2. Drain, waste, and vent systems;
   3. Gas piping system;
   4. Storm drainage system within the structures;
   5. Plumbing fixtures and trim.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 60 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications, catalog cuts, and other data needed to prove compliance with the specified requirements;
   3. Shop Drawings and other data as required to indicate method of installing and attaching equipment, except where such details are fully shown on the Drawings.

C. Sterilization Certificate:
   1. Upon completion of water line sterilization, deliver to the Architect two copies of an acceptable "Certificate of Performance" for that activity.

D. Cathodic protection:
   1. Upon completion of the work of this Section, deliver to the Architect sufficient data to prove that wrapping of steel piping has been tested and meets the specified requirements.
   2. Show date of inspection, voltages used, and name and address of the inspector.

E. Manuals:
   1. Upon completion of the work of this Section, deliver to the Architect two copies of an operation and maintenance manual.
   2. Include within each manual a copy of the Project Record Documents showing all work of this Section.

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1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Codes and regulations:

1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern when so directed by the Architect.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENT

A. All materials to be manufactured in the U. S. A.

2.2 PIPE SCHEDULE

A. Drain, waste, and vent system:

1. For sanitary work below the floor and outside underground:
   a. Provide service weight cast iron pipe and fittings.
   b. Soil lines 5'-0" or more away from the structures may be vitrified clay pipe with first grade markings, unless otherwise restricted by governmental agencies having jurisdiction.
2. Above ground:
   a. Sizes 4" and larger: Provide service weight cast iron pipe and fittings;
   b. Waste and vent piping 3" and smaller installed above ground: Provide standard weight galvanized steel pipe with Durham fittings for waste lines and standard black cast iron fittings for vent lines, or provide service weight cast iron pipe and fittings.

B. Water system (domestic piping):

1. Above ground, provide Type "L" copper with sweated connections;
2. Below ground, provide Type "K" copper with sweated connections;
3. Sizes 4" and larger below ground, and where noted on the Drawings:
   a. Provide Class 200 "Transite" with step-machined ends and rubber gasket rings.
   b. Also provide cement-lined cast iron fittings modified for use with rubber rings.
   c. Provide thrust blocks.
   d. Where used below grade, provide tracing wire as recommended by the pipe manufacturer.

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C. Gas piping:
   1. Provide Schedule 40 black steel pipe with malleable iron screwed fittings; except provide galvanized where pipe or fittings are exposed to the weather.

D. Indirect drains:
   1. Provide galvanized Schedule 40 steel pipe with galvanized malleable iron fittings; or
   2. Provide Type "L" copper with sweated connections;
   3. Provide lines full sizes of the equipment connections.

E. Roof drainage piping:
   1. Above grade, provide service weight cast iron pipe and fittings; or provide galvanized steel pipe and fittings.
   2. Below grade, provide service weight cast iron pipe and fittings.
   3. Where necessary because of space limitations, leaders may be of rectangular cast iron of equivalent area.

2.3 MATERIALS

A. Cast iron soil pipe and fittings:
   1. Provide service weight cast iron conforming to ASTM A72, or provide hubless type.

B. Lead:
   1. Provide new pig lead complying with ASTM B29.

C. Hemp packing:
   1. Provide impregnated jute, manufacturing for caulking soil pipe and fittings.

D. Galvanized or black steel pipe:
   1. Provide standard weight complying with ASTM A12.

E. Fittings:
   1. For copper lines, provide copper fittings.
   2. For steel lines, provide service weight cast iron type fittings.

F. Unions:
   1. For copper lines, provide copper fittings.
   2. For connections in iron pipe lines 2-1/2" and smaller, provide ground joint brass-to-iron fittings.

G. Victualic fittings may be used where permitted by code.

2.4 VALVES

A. Gate valves: Provide solid wedge disc, rising stem, 200# WOG; non-rising stem valves may be used only where there is insufficient clearance.
   1. 3" and smaller, rising stem: Provide Zurn, bronze, screwed.
   2. 3" and smaller, non-rising stem: Provide Zurn, bronze, screwed.
   3. 4" and larger: Provide Zurn, flanged, non-rising stem.

B. Globe valves: Provide replaceable composition disc suitable for 200° F water.

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1. 2" and smaller: Provide Zurn, bronze, screwed.
2. 2-1/2" and larger: Provide Zurn, iron body, flanged, 200# WOG.

C. Gas cocks:
1. 2" and smaller: Provide 250#, bronze, screwed, square head, 125#.

D. Check valves:
1. 3" and smaller: Provide Zurn, bronze, screwed, Y-pattern, 200# WOG, swing check type.
2. 4" and larger: Provide Zurn, IBBM, flanged, 200# WOG.

E. Strainers: Provide Y-pattern, 200# WOG, 20 mesh monel screen:
1. 3" and smaller: Provide Zurn, screwed.
2. 4" and larger: Provide Zurn, flanged.

F. Pressure regulators:
1. Provide Zurn, all bronze.
2. Install with brass strainer upstream of regulator.

G. Partition stop valves: Provide Zurn, loose key type.

2.5 FLASHING

A. Where pipes of this Section pass through the roof, flash with Semco #1100-4 seamless 4 lb flashing, with steel reinforced "Vari-Pitch" boot and cast iron counterflashing sleeve.

2.6 PIPE HANGERS

A. Water piping:
1. Provide split ring hanger type with supporting rods.

B. Soil and waste piping:
1. Provide adjustable ring hanger type with supporting rods.
2. Use riser clamps at each floor and as required.

C. Gas piping:
1. Provide split ring hanger type with supporting rods.

2.7 CLEANOUTS

A. Exterior:
1. Provide Zurn, with cast iron top in concrete areas.

B. Floors:
1. Provide Zurn, with round nickel-bronze top in finished room floors.
2. Provide Zurn, with round cast-iron top in unfinished room floors.
3. Provide "flush-with-floor" type cleanouts, with adjustable watertight covers and integral anchoring flange with clamping collar where waterproofing membrane is used.

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C. Finished walls:
   1. Provide Zurn, with round chrome plated or stainless steel access plate and screw.

D. Provide cleanout plugs of extra heavy bronze.

2.8 ACCESS BOXES

A. Walls:
   1. Provide polished chrome plate face in tile walls.
   2. Provide with bonderized prime-coated steel face and with Allen lock in walls of other finished rooms.

B. Ceilings:
   1. Provide with bonderized prime-coated steel face with Allen lock.

C. Floors:
   1. Provide Zurn, with plain aluminum or nickel-bronze non-skid top.

D. Yard boxes:
   1. Provide cast concrete boxes with cast iron rim and hinged self-closing cast iron lid marked GAS SHUTOFF or WATER, size 12" x 18" x 12".
   2. Set flush with finished grades with 4" thick concrete pad under perimeter (but not under interior) of box.

2.9 PRESSURE GAUGES AND THERMOMETERS

A. Provide gauges with 4-1/2" dial, gauge cock, in type required. For pump suction, provide compound type.

B. Provide thermometers, straight, angle, or oblique as required, equipped with separable sockets and well. Provide extension necks as required on insulated line.

C. Arrange thermometers for easy reading from the floor.

2.10 TRAPS

A. For lavatories and sinks, except service sinks, provide cast brass traps with brass nuts.

2.11 WATER HAMMER ARRESTORS

A. Provide Zurn, stainless steel.

2.12 HANDICAPPED INSULATION

A. Where shown on the Drawings or required by governmental agencies having jurisdiction, at lavatories for handicapped persons provide insulation with paint coating, on hot water supply, tailpiece, and trap.

2.13 FIXTURES AND EQUIPMENT

A. Water closets (flush valve): Provide:

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1. White vitreous china, siphon jet action, American Standard, complete with Sloan flush valve with vacuum breaker and stop.
2. White open-front seat with self-sustaining check hingeless cover, china cap seat bumpers.
3. Zurn cast bronze flanges assembly.

B. Urinal (wall hung):
1. Provide vitreous white china, American Standard, with Sloan flush valve with vacuum breaker.

C. Lavatory (counter type):
1. Provide enameled cast iron American Standard, size 19" x 16", complete with faucet and drain fitting with aerator, P-trap, and stops.

D. Electric drinking fountain:
1. Provide with stainless steel finish, designed for handicapped use.

E. Service sink:
1. Provide white, acid resisting cast iron American Standard, size 20" x 28", complete with hose and faucet with vacuum breaker, strainer, and rim guard.

F. Floor drains:
1. Provide in sizes shown on the Drawings, and connect to cast iron P-traps.
2. In toilet rooms and other finished rooms, provide Zurn, with 6" round nickel-bronze heel-proof strainer.
3. In unfinished areas, provide Zurn with extra heavy top grate and sediment bucket.

G. Floor sinks:
1. Provide receptors in sizes shown on the Drawings.
2. Provide complete with cast iron acid resisting enameled free-flow style top grate, aluminum dome bottom strainer, cast iron P-trap, and integral anchoring flange.
3. For units located on the roof, provide Zurn with water dam and cast iron dome bottom strainer.

H. Roof drains:
1. Provide Zurn cast iron roof drains complete with roof clamping collar and removable dome strainers, in sizes shown on the Drawings.
2. Provide underdeck clamp, sump receivers, and extensions where required.
3. For overflow drains, provide Zurn, with 2" water dam and complete as described for roof drains.

I. Hose bibbs:
1. Provide sill cocks on building walls, loose key style.
2. Provide vacuum breaker.

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3. In finished spaces, provide chromium plated bibbs, and provide rough cast bronze finish elsewhere.
4. Provide loose-key stop ahead of each bibb.

J. Water hydrants:
1. Provide with integral loosekey stop and vacuum breaker.

K. Water heating system:
1. Provide the complete system as shown on the Drawings including heater, pumps, controls, and supplementary accessories recommended by the manufacturer.

L. Hot water pump:
1. Provide Bell and Gossett, all bronze construction, inline type, of the size and capacity indicated on the Drawings.

2.14 BACKFLOW PREVENTERS

A. General:
1. Where installed in finished spaces, provide chromium plated finish.
2. For flush valves, provide diaphragm type, complete with approved vacuum breaker provided by the manufacturer of the valve.

2.15 GAS VENT LINES

A. For combustion vent flues for gas-fired equipment, provide size required by the manufacturer of the equipment and as required by governmental agencies having jurisdiction.

B. Do not use single-wall metal vent line.

2.16 INSULATION

A. Insulate hot water lines with 1" thick Owens/Corning Fiberglass "25 ASJ/SSL."

B. Also see requirements specified for "handicapped insulation."

2.17 PIPE WRAPPING

A. Steel piping in concrete or underground:
1. Wrap with "Hunt's Process HP-9."
2. Fittings and other joints: Wrap in the field with "Polyken" tape and primer.
3. Provide 50% overlap on tape weld rubber coating.

B. Testing:
1. Secure inspection and testing by an independent agency approved in advance by the Architect.
2. Note test report submission requirement specified elsewhere.
3. Demonstrate protection by passing 6000 V holiday test after wrapping.

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2.18 SLEEVES

A. Where pipes pass through concrete, masonry, or stud walls, or pass through ceilings, provide sleeves of the size required.

2.19 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PLUMBING SYSTEM LAYOUT

A. Lay out the plumbing system in careful coordination with the Drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a satisfactorily functioning system.

B. Follow the general layout shown on the Drawings in all cases except where other work may interfere.

C. Lay out pipes to fall within partition, wall, or roof cavities, and to not require furring other than as shown on the Drawings.

3.3 TRENCHING AND BACKFILLING

A. Perform trenching and backfilling associated with the work of this Section in strict accordance with the provisions of Section 02220 of these Specifications.

B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the pipe.

C. Bedding and backfilling:

1. Install piping promptly after trenching. Keep trenches open as short a time as practicable.
2. Under the building, install pipes on a 6" bed of damp sand. Backfill to bottom of slab with damp sand.
3. Outside the building, install underground piping on a 6" bed of damp sand. Backfill to within 12" of finished grade with damp sand. Backfill remainder with native soil.
4. Do not backfill until installation has been approved and until Project Record Documents have been properly annotated.

3.4 INSTALLATION OF PIPING AND EQUIPMENT, GENERAL

A. General:

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1. Proceed as rapidly as the building construction will permit.
2. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
3. Cut pipe accurately, and work into place without springing or forcing, properly clearing windows, doors, and other openings. Excessive cutting or other weakening of the building will not be permitted.
4. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
5. Make changes in direction with fittings; make changes in main sizes with eccentric reducing fittings. Unless otherwise noted, install water supply and return piping with straight side of eccentric fittings at top of the pipe.
6. Run horizontal sanitary and storm drainage piping at a uniform grade of 1/4" per foot, unless otherwise noted. Run horizontal water piping with an adequate pitch upwards in direction of flow to allow complete drainage.
7. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the Drawings.
8. Support piping independently at pumps, coils, tanks, and similar locations, so that weight of pipe will not be supported by the equipment.
9. Pipe the drains from pump glands, drip pans, relief valves, air vents, and similar locations, to spill over an open sight drain, floor drain, or other acceptable discharge point, and terminate with a plain end unthreaded pipe 6" above the drain.
10. Securely bolt all equipment, isolators, hangers, and similar items in place.
11. Support each item independently from other pipes. Do not use wire for hanging or strapping pipes.
12. Provide complete dielectric isolation between ferrous and non-ferrous metals.
13. Provide union and shut-off valves suitably located to facilitate maintenance and removal of equipment and apparatus.

B. Equipment access:
1. Install piping, equipment, and accessories to permit access for maintenance. Relocate items as necessary to provide such access, and without additional cost to the Owner.
2. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in walls or chases above ceilings. Coordinate location of access doors with other trades as required.

3.5 PIPE JOINTS

A. Copper tubing:
1. Cut square, remove burrs, and clean inside of female fitting to a bright finish.
   a. Apply solder flux with brush to tubing.
   b. Remove internal parts of solder-end valves prior to soldering.

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2. Provide dielectric unions at points of connection of copper tubing to ferrous piping and equipment.
3. For joining copper tubing, use:
   a. Water piping 3" and smaller: 95-5 solder;
   b. Water piping larger than 3": "Sil-fos" brazing;
   c. Underground: "Sil-fos" brazing.

B. Screwed piping:
1. Deburr cuts.
   a. Do not ream exceeding internal diameter of the pipe.
   b. Thread to requirements of ANSI B2.1.
2. Use litharge and glycerin on joint prior to cleaning for air and oil piping.
3. Use Teflon tape on male thread prior to joining other services.

C. Leaky joints:
1. Remake with new material.
2. Remove leaking section and/or fitting as directed.
3. Do not use thread cement or sealant to tighten joint.

3.6 PIPE SUPPORTS

A. Support suspended piping with clevis or trapeze hangers and rods.

B. Space hangers and support for horizontal steel pipes according to the following schedule:

Pipe size:	Maximum spacing on centers:
1-1/4" and smaller:	8'-0"
1-1/2" to 3":	10'-0"
4" to 5":	14'-0"

C. Space hangers and supports for horizontal copper tubing according to the following schedule:

Tube size:	Maximum spacing on centers:
1" and smaller:	6'-0"
1-1/2":	7'-0"
2":	8'-0"
2-1/2":	9'-0"
3" and larger:	10'-0"

D. Provide sway bracing on hangers longer than 18".

E. Support vertical piping with riser clamps secured to the piping and resting on the building structure. Provide at each floor unless otherwise noted.

F. Provide insulation continuous through hangers and rollers. Protect insulation by galvanized steel shields.

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G. Arrange pipe supports to prevent excessive deflection, and to avoid excessive bending stress.

H. Support piping from inserts or anchors in concrete slabs. Provide the inserts under this Section and arrange for the placing under Section 03300 of these Specifications.

I. Hubless piping:
   1. Provide hangers on the piping at each side of, and within 6" of, hubless pipe coupling so the coupling will bear no weight.
   2. Do not provide hangers on couplings.
   3. Provide hangers adequate to maintain alignment and to prevent sagging of the pipe.
   4. Make adequate provision to prevent shearing and twisting of the pipe and the joint.

3.7 SLEEVES AND OPENINGS

A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, and ceilings.
   1. Set pipe sleeves in place before concrete is placed.
   2. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of 1/2" clearance between the inside and outside of the pipe.
   3. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance for packing and caulking.

B. Caulk the space between sleeve and pipe or pipe covering, using a noncombustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack with noncombustible asbestos cotton, rope, or fiberglass to within 1/2" of both wall faces, and provide the waterproof compound described above.

C. Finish and escutcheons:
   1. Smooth up rough edges around sleeves with plaster or spackling compound.
   2. Provide 1" wide chrome or nickel plated escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings, and similar locations.
      a. Size the escutcheons to fit pipe and covering.
      b. Hold escutcheons in place with set screw.

3.8 CLEANOUTS

A. Secure the Architect's approval of locations for cleanouts in finished areas prior to installation.

B. Provide cleanouts of same nominal size as the pipes they serve; except where cleanouts are required in pipes 4" and larger provide 4" cleanouts.

C. Make cleanouts accessible. After pressure tests are made and approved, thoroughly graphite the cleanout threads.

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3.9 VALVES

A. Provide valves in water, air, and gas systems. Locate and arrange so as to give complete regulation of apparatus, equipment, and fixtures.

B. Provide valves in at least the following locations:
   1. In branches and/or headers of water piping serving a group of fixtures.
   2. On both sides of apparatus and equipment.
   3. For shutoff of risers and branch mains.
   4. For flushing and sterilizing the system.
   5. Where shown on the Drawings.

C. Locate valves for easy accessibility and maintenance.

3.10 WATER HAMMER ARRESTORS

A. Provide water hammer arrestors on hot water lines and cold water lines.
   1. Install in upright position at all quick closing valves, solenoids, isolated plumbing fixtures, and supply headers at plumbing fixture groups.
   2. Locate and size as specified or as shown on the Drawings and, where not shown, locate in accordance with Plumbing and Drainage Institute Standard WH-201.
   3. Install water hammer arrestors behind access panels.

B. Where fixtures are not protected by water hammer arrestors, provide 24" high air chambers on each water supply, properly sized and designed for maintenance and drainage.

3.11 BACKFLOW PREVENTION

A. Protect plumbing fixtures, faucets with hose connections, and other equipment having plumbing connection, against possible back-siphonage.

B. Arrange for testing of backflow devices as required by the governmental agencies having jurisdiction.

3.12 CONCRETE

A. Provide concrete required for the work of this Section in strict accordance with pertinent provisions of Section 03300 of these Specifications.

3.13 PLUMBING FIXTURE INSTALLATION

A. Installation:
   1. Set fixtures level and in proper alignment with respect to walls and floors, and with fixtures equally spaced.
   2. Provide supplies in proper alignment with fixtures and with each other.
   3. Provide flush valves in alignment with the fixture, without vertical or horizontal offsets.

B. Grout wall and floor mounted fixtures watertight where the fixtures are in contact with the walls and floors.

C. Caulk deck-mounted trim at the time of assembly, including fixture and casework mounted. Caulk self-rimming sinks installed in casework.

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3.14 DISINFECTION OF WATER SYSTEMS

A. Disinfect hot and cold water systems.
   1. Perform disinfection under the Architect's observation. Notify the Architect at least 48 hours prior to start of the disinfection process.
   2. Upon completion of disinfecting, secure and submit the Certificate of Performance required under Article 1.2 of this Section, stating system capacity, disinfectant used, time and rate of disinfectant applied, and resultant residuals in ppm at completion.
   3. Use disinfectant method approved by the Architect.

B. When disinfection operation is completed, and after final flushing, secure an analysis by a laboratory approved by the Architect, based on water samples from the system, showing test negative for coli-aerogene organisms. Provide a total plate count of less than 100 bacteria per cc, or equal to the control sample.

C. If analysis results are not satisfactory, repeat the disinfection procedures and retest until specified standards are achieved.

3.15 OTHER TESTING AND ADJUSTING

A. Provide personnel and equipment, and arrange for and pay the costs of, all required tests and inspections required by governmental agencies having jurisdiction.

B. Where tests show materials or workmanship to be deficient, replace or repair as necessary, and repeat the tests until the specified standards are achieved.

C. Adjust the system to optimum standards of operation.

END OF SECTION

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SECTION 15500
HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 GENERAL

1.1 SUMMARY

A. Provide complete heating, ventilating, and air conditioning systems where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:

1. Rooftop packaged air-cooled variable air volume conditioning systems, complete with direct-expansion cooling section, dampers, damper operators, mounting frame, operating and safety controls, blowers, motors, compressors, condensers, filters, and related items;
2. Hot water boiler, accessories, pumps, and related piping;
3. Air conditioning supply and return ductwork system with grilles, diffusers, and registers;
4. Self-contained, air-cooled, gas/electric rooftop packaged air conditioning unit;
5. Exhaust systems including, but not necessarily limited to, toilet areas, with fans, motors, ductwork, grilles, registers, controls, and related items;
6. Temperature control system including low-voltage wiring, variable air volume controls, and terminal reheat coils;
7. Motors as required;
8. Acoustical and thermal insulation of ducts, piping, and equipment.

B. Provide also:

1. Detail design of all heating, ventilating, and air conditioning systems and subsystems listed above, including but not limited to engineering and design, schematic and detail drawings, calculations, and additional specifications;
2. Professional certifications and/or stamps as required by governmental agencies having jurisdiction;
3. All required permits, inspections and reports.

C. Use products recognized as energy efficient wherever possible.

D. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 60 calendar days after the Contractor has received Owner's Notice to Proceed, submit:

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1. Design drawings, signed by a properly licensed engineer and showing proposed layout of equipment, ducts, registers, grilles, controls, and other components of the system;
2. Calculations demonstrating the adequacy of the proposed systems and its compliance with these Specifications;
3. Manufacturer's catalogs, Samples, and other items needed to fully demonstrate the quality of the proposed materials and equipment.

C. Record Drawings:
1. Comply with pertinent provisions of Section 01720.
2. Include a copy of the Record Drawings in each copy of the operation and maintenance manual described below.

D. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Architect two copies of an operation and maintenance manual compiled in accordance with the provisions of Section 01730 of these Specifications.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

1.5 WARRANTY

A. Provide standard one year warranty on all labor and materials.

PART 2 PRODUCTS

2.1 DUCTWORK

A. For exhaust systems and for the heating, ventilating, and air conditioning systems, provide galvanized sheet metal ducts fabricated and installed to pertinent ASHRAE and SMACNA standards, or to the requirements of governmental agencies having jurisdiction, whichever requirement is more stringent.

B. Size the ducts for pressure drop not greater than 0.1" H_2O per 100 feet, and a maximum velocity of 1,800 feet per minute.

C. At branch ducts, provide manually operated dampers of the type and arrangement shown on the Drawings, two gauges heavier than the duct in which installed, and equipped with locking quadrants.

D. Seal all duct seams, transverse and longitudinal, air tight with 6 oz. canvas secured in place with duct sealing compound, lagging adhesive, or duct tape.

2.2 FLEXIBLE DUCT

A. Provide factory fabricated insulated low pressure flexible duct with the following attributes:
   1. Zinc-coated spring steel helix, with 1" thick fiberglass insulation, sheathed in a seamless vapor barrier jacket.
   2. Interior fire resistive coated to prevent fiber erosion;
   3. Straight run sound absorption of 3 dB/ft., and 5 dB/ft. sound absorption at 45 degree bends.
   4. Composite assembly, including insulation and vapor barrier, meeting Class 1 requirements of flame spread of 25 or less and smoke developed of 50 or less as set forth in NFPA Bulletin 90-A, and bearing UL label as an air duct.

B. Provide flexible duct in fully extended condition, free from sags and kinks.
   1. Use only the minimum length required to make the connection.
   2. Do not exceed 8'-0" in length.
   3. Where horizontal support is required, provide at least 3/4" wide banding material hangers at not more than 36" centers.
   4. Make joints and connections with 1/2" wide positive locking steel straps.

C. Acceptable products:
   1. For toilet exhaust or return air connectors and runouts, aluminum flexible ducts may be used if acceptable to the governmental agencies having jurisdiction.

2.3 INSULATION

A. General:
   1. Provide materials complying with NFPA Bulletin 90-A, as determined by UL method NFPA 225 - ASTM E84, and complying with the governing code, with flame spread rating under 25 and smoke developed rating under 50.
   2. Where vapor barriers are used, provide intact and continuous throughout.
   3. Provide products of Owens/Corning Fiberglas, Manville, Certainteed, or approved equal.

B. Concealed ducts in non-conditioned spaces:
   1. Insulate supply ducts with 1" thick fiberglass blanket.
   2. Insulate return ducts with 0.75 lbs./cu.ft. 1" thick fiberglass duct wrap blanket.

C. Acoustical duct liner: For ducts exposed to the weather, and for supply ducts from supply fan to first branch ducts:
   1. Line with 3 lbs./cu.ft. 1" thick coated material.
   2. Apply duct liner with coated side facing air stream and secured to the sheet metal with adhesive or with mechanical clips recommended by the manufacturer.
   3. Make joints tightly butted and heavily sized with lagging adhesive, assuring continuity of surfaces.

D. Hot water piping:

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1. Insulate with preformed fiberglass snap-on insulation.
2. For pipes up to 1" in diameter, provide 1" thick insulation.
3. For pipes 1" in diameter and larger, provide 1-1/2" thick insulation.
4. Where insulation is exposed to the weather, protect with waterproof corrugated aluminum cover.

2.4 AIR OUTLETS

A. Ceiling diffusers:
   1. Provide diffusers with opposed blade dampers and perforated faces, in sizes, capacities, and patterns noted on the Drawings.
   2. Provide insulated adapter boxes above each diffuser neck to permit connection of flexible duct.

B. Grilles: Match supply.

C. Registers: Provide double deflecting type with opposed blade dampers.

D. Provide factory-applied or site-applied black coating on the inside of all air outlets and connecting plenums.

E. Provide supply register in each toilet room, sized for 10% less than the required code ventilation. Provide separate zone for each toilet room if necessary.

F. Provide sponge rubber under all flanges.

2.5 VIBRATION ISOLATION AND FLEXIBLE CONNECTIONS

A. At ducts to equipment, provide vent-fabric flexible connections with a minimum of 6" full length, and approved by the governmental agencies having jurisdiction.

B. For return air connections at each floor to the return riser, provide fiberglass or lined duct with a minimum of two elbows.

C. Provide additional sound insulation as required to limit the noise level in conditioned space to a maximum of NC-40.

D. Mount vibrating equipment on Lord Corporation engineered mounts.

E. Isolate piping from the structure in a manner to prevent transmission of vibration.

2.6 ROOF EXHAUST FANS

A. Provide curb-mounted type with the following attributes:
   1. Aluminum or fiberglass hood, with hinged or removable cover for easy access to motor and fan and to backdraft dampers.;
   2. V-belt drives, with 1.5 service factor and adjustable sheave on the motor;
   3. Open drip-proof construction motors, with power disconnect switches approved by the governmental agencies having jurisdiction;
   4. Backward curved centrifugal wheel fan impeller, with deep-spun throat venturi.

2.7 MOTORS

A. Provide motors designed for the supply voltages made available for this portion of the Work, and with the following attributes:

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1. Sized to develop the required brake horsepower and to operate satisfactorily with a voltage variation of plus or minus 10%;
2. Conforming to NEMA motor standards;
3. Dynamically balanced, and held to commercial tolerance;
4. Where T-frame motors are used, oversized at least 10%;
5. Selected so that, when ambient temperature reaches 120 degrees F. for a period of 2 hours or more, the motor will operate satisfactorily without failure, and with a minimum service factor of 1.5;
6. With squirrel-cage type drip-proof enclosure, unless otherwise indicated, constant speed, across-the-line normal starting torque designed for quiet operation;
7. Each motor of ample size to operate its unit at proper full load and speed continuously, without heating in any part more than 40 degrees C. above the temperature of the surrounding atmosphere;
8. Selected for energy efficiency;
9. Manufactured in the U. S. A.

B. Where motor is used with V-belt drive, equip with a sliding base and belt guard, and motor sheave.

2.8 PACKAGE ROOFTOP VAV UNITS

A. Provide packaged air-cooled roof-mounted single-zone cooling units with all controls.

B. Provide products of Trane, Carrier, or approved equal.

C. Coils:
1. Provide non-ferrous construction with aluminum fins mechanically bonded to seamless copper tubes,
2. Factory pressure test for leaks at 450-500 psi.
3. Select for a maximum face velocity of 550 ft./min. and 45°F. refrigerant temperature.

D. Provide serviceable hermetic reciprocating type or scroll type compressors. Where two compressors are required, provide independent refrigerant circuits.

E. Provide required operating controls including inlet vanes or discharge dampers and static pressure control, all specifically designed for VAV service.

F. Where appropriate for the application, provide electronic speed controls.

G. Provide factory-installed exhaust air fan and ambient type economizer sections for each unit.

2.9 HOT WATER BOILER

A. Provide a packaged water tube water boiler having the following attributes:
1. Fitted and equipped for outdoor service;
2. Fitted with dual low-water cutoffs complying with requirements of governmental agencies having jurisdiction;
3. Electronic boiler control with electric ignition, and low silhouette vent.

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2.10 HOT WATER PUMPS

A. Provide direct connected bronze fitted centrifugal type hot water pumps with Viton seals and 4-pole motors.

B. Provide products of Bell and Gossett or approved equal.

2.11 ROOFTOP PACKAGE

A. Provide a self-contained, air-cooled, gas/electric air conditioner.
   1. Include low ambient control, hard start kit, and factory curb.
   2. Provide products of Trane, Carrier, or approved equal.

2.12 PIPING

A. For refrigerant piping, provide Type "L" copper, refrigerant grade, with wrought copper fittings, and with joints thoroughly cleaned prior to soldering.

B. For hot water piping, provide Type "M" copper with wrought copper fittings, or provide Schedule 40 galvanized steel pipe.

2.13 EXHAUST FANS

A. Provide complete system including fans, ductwork, grilles, fire dampers, and other required items.
   1. Fans:
      a. Centrifugal type with forward curved blades;
      b. In-line, single inlet or double inlet as required.
   2. Drive:
      a. Multi-belt, sized for 150% of full load power;
      b. Vari-pitch motor pulley.

B. Provide only Class 1 fans with sleeve bearings.

2.14 AUTOMATIC TEMPERATURE CONTROL

A. Provide a system of pneumatic temperature control with the attributes listed below.
   1. Include thermostats, sensors, temperature controllers, and air piping as required for a complete and operable system.
   2. Provide devices calibrated and adjusted with the actual operating conditions.
   3. Where appropriate for the application, provide electronic interface, consisting of Barber-Colman Network 8000 EMS System.

B. Equipment:
   1. Room thermostats:
      a. Fully proportional and provided with adjustable sensitivity, with the thermometer and adjustment under a blank locking cover;
      b. Provide one control zone per 1000 square feet of floor area.
   2. Duct sensors: Fixed range, without field adjustment calibration.
   3. Controllers:

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a. Provide pneumatic sensor input type with proportional bank (sensitivity) adjustable from 2-1/2" to 40% of primary sensor span, and with controllers panel mounted; or
b. Where appropriate for the application, provide electronic sensor type.

4. Damper operators:
   a. Provide with metal bodies and field replaceable diaphragms;
   b. Provide adequate capacity to handle the required load under the expected face velocities on the dampers;
   c. Pneumavalves may be used in lieu of damper operators.
5. Provide panel-mounted relays and miscellaneous equipment as required for proper operation of the system.

6. Control panels:
   a. Provide panel-mounted controllers, relays, and similar items for equipment specified in the sequence of operation;
   b. Provide steel cabinet panels, painted with beige enamel, and supplied with a tumbler lock on the door.
   c. For outdoor application, provide NEMA-4 enclosures;
   d. Except for outdoor panels, mount temperature indicators and manual switches on the face of the door;
   e. For electrical control devices within the cabinets, prewire to numbered terminal strips.
7. Instrument air supply:
   a. Provide air compressor sized to provide necessary air while operating at 50% of the time;
   b. Provide receiver ASME rated for the service, and with all required inspection openings;
   c. Provide a refrigerated air dryer with a three-valve bypass, located where shown on the Drawings;
   d. Provide automatic drain traps for the receiver and the dryer, and pipe the drain line to the nearest drain location;
   e. Provide air filter rated for one micron or less;
   f. Provide vibration isolation as required by governmental agencies having jurisdiction.

C. Control details:
1. Provide for hot water temperature to be reset from outdoor program.
2. Provide VAV boxes, pressure-independent single duct units, with reheat coil for each zone having exterior exposure.
3. Provide dry bulb controlled economizer section with exhaust fan.
4. Provide optimal start program, including air conditioning, with duration of warmup period variable depending upon outside temperature.
5. Provide that outside air damper will close during the warmup period.
6. Provide products of Barber-Colman or approved equal.

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2.15 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.3 PREPARATION

A. Holes in concrete:
   1. Provide sleeves, accurately dimensioned and shaped to permit passage of items of this Section.
   2. Deliver all such sleeves, with accurate setting drawings and setting information, to the trades providing the surfaces through which such items must penetrate, and in a timely manner to assure inclusion in the Work.

B. Flashing:
   1. Where items of this Section penetrate the roof, outer walls, or waterproofing of any kind, provide under this Section all base flashing and counterflashing required at such penetration.
   2. Provide on each pipe passing through the roof a 4 lb. seamless lead flashing and counterflashing assembly.

3.4 EQUIPMENT INTERFACE

A. Provide all required shutoff valves, unions, and final connections of piping to the work of this Section.

B. For electrically operated equipment, verify the electrical characteristics actually available for the work of this Section and provide equipment meeting those characteristics.

3.5 PAINTING

A. Paint inside of all air outlets and connecting plenums with one coat of black paint, or provide all such items factory prepainted

B. For all roof-mounted equipment, provide factory prefinish on all exposed surfaces.

C. Touchup scratches and abrasions to be invisible to the unaided eye from a distance of 5'-0".

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3.6 INSULATION

A. Wrap insulation firmly around ductwork, covering all surfaces including standing seams, and with all joints lapped at least 2".

B. Securely fasten the insulation in place with 16 gauge soft annealed black or galvanized wire spaced approximately 12" on centers for straight runs and 3" on centers for elbows and fittings.

C. Take special care to avoid excessive stretching and compressing, and to achieve securing at lapped sections where possible.

3.7 INSTRUCTIONS

A. Upon completion of this portion of the Work, and prior to its acceptance by the Owner, provide a qualified engineer and fully instruct the Owner's maintenance personnel in the proper operation and maintenance of items provided under this Section.

B. Demonstrate the contents of the approved operation and maintenance manual required under Article 1.2 above.

3.8 TESTING AND ADJUSTING

A. Test and adjust each piece of equipment and each system as required to assure proper balance and operation.

1. Test and regulate ventilation and air conditioning systems to conform to the air volumes shown on the approved design drawings.
2. Make tests and adjustments in apparatus and ducts for securing the proper volume and face distribution of air for each grille and ceiling outlet.
3. Where required, provide pulleys for fans at no additional cost to the Owner, and set to drive the fans at the speed needed to give the indicated volume.
4. For each system, take the following data in tabulated form:
   a. Air volumes at all supply, return, and exhaust outlets;
   b. Total cfm. supplied;
   c. Total cfm. returned;
   d. Total static pressure at each fan and at each system;
   e. Motor speed, fan speed, and input ampere rating for each fan.

B. Submit two sets of test and balance reports to the Architect for approval.

C. Eliminate noise and vibration, and assure proper function of all controls, maintenance of temperature, and operation in accordance with the approved design.

D. Secure required approval from governmental agencies having jurisdiction.

END OF SECTION

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SECTION 15971
CONTROL SYSTEM - BARBER COLMAN NETWORK 8000

PART I - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

Requirements of the following Division 15 Sections apply to this section:

"Basic Mechanical Requirements"
"Basic Mechanical Materials and Methods"
"Electrical Requirements for Mechanical Equipment"

WORK INCLUDED:

Temperature control shall be by distributed direct digital control.

The temperature control subcontractor shall furnish all labor, material, equipment, and services necessary for the complete installation of the temperature control system as described herein and as shown on the drawings. The basis of design is a Barber-Colman Network 8000 system. Make necessary modifications to software and hardware systems to provide performance as described in these specifications. Provide all necessary components (i.e. relays, controllers, wiring, etc.) to provide the owner with a complete & functional system, including, but not limited to, all points required to meet the specified sequence of operation.

MANUFACTURER/INSTALLER QUALIFICATIONS:

Manufacturer of the automatic temperature control system must be able to demonstrate successful experience in a project of the same relative size, control, design, and climatic conditions for a period of a minimum of ten years.

Installation of all temperature controls and control wiring shall be done by employees of a duly authorized field office of that temperature controls manufacturer. Installation by the mechanical contractor and/or wholesalers is not acceptable.

Contractors whose principal business is not that of manufacturing installing and servicing automatic temperature control systems are not acceptable.

The distributed direct digital control system and all final control elements (i.e. valves, damper actuators) shall be provided by the same manufacturer.

The controls contractor shall have sole responsibility for the entire system. Acceptable Manufacturers: Barber-Colman (Network 8000, MZII), Landis & Gyr (System 600 MBC), Robertshaw (DMS), Johnson Controls (Metasys).

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SECTION 15971
CONTROL SYSTEM - BARBER COLMAN NETWORK 8000

SCOPE:
This specification is intended to cover equipment for automatic control of:

Air Handling Units - Unit Heaters
Exhaust fans - DDC
Interface with all treatment systems and perimeter control and monitoring instruments

CODES AND STANDARDS:

Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems: where applicable to controls and control sequences.

SUBMITTALS:

General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

Product Data: Submit manufacturer's technical data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of material, and including installation instructions and start-up instructions.

Shop Drawings: Submit shop drawings for each system automatically controlled, containing the following information.

Schematic flow diagram of software sequence showing fans, pumps, coils, dampers, valves, and control devices. Label each control device with setting or adjustable range of control. Indicate factory and field wiring. Indicate each control panel required, with internal and external piping and wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling. Include verbal description of sequence of operation. Provide all data on autocad 10 compatible diskettes.

Maintenance Data: Submit maintenance instructions spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

DELIVERY, STORAGE, AND HANDLING:

Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

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PART II - PRODUCTS

SECTION 2.00

ROOM THERMOSTATS (Electric):

Single temperature electric thermostats shall utilize fast responding, bi-metal element, make and break silver contact and shall be housed under a cover which shall match exactly the appearance and features as specified. Contacts and all parts in the electrical circuit shall be enclosed under a dust cover. The differential of the thermostat shall be fully adjustable. Provide digital temperature display with minimum 1/4" numerals.

CONTROL PANELS:

Shall be manufactured of furniture grade steel with a baked prime coat enamel finish. The panel doors shall be hinged locking type. Control panels shall contain all central control devices, such as controllers, relays, switches, pilot lights, terminal blocks, and all other accessories as required for a workable environment control system. All components within the control panels shall be pre-wired to numbered terminal strips, ready for field connection to field mounted control components.

SOLID STATE DRIVES:

Drives shall have a three (3) volt span, with an adjustable starting point over the entire controller output signal range of (1-15 VDC). This permits sequencing several devices from one controller. The drive is a solid state switching device that accepts a dc signal input and drives a medium-torque actuator to a position where the positive signal from the actuator equals the input signal and stops the actuator, thus providing positive positioning control. The drives are to be mounted to the side of the control actuators.

TEMPERATURE SENSORS

Sensors shall be Underwriters Laboratory listed under Ul934 for use in air plenum applications. Finish shall be manufacturers standard, except where otherwise noted on the drawings. All sensor locations shall be submitted for approval before installation. Unless otherwise indicated or specified, provide one thermostat for each air handling unit, fan coil unit, heat pump or other unitary mechanical system shown on the drawings.

Room sensor shall be capable of being replaced without the need for controller recalibration. Room sensors shall accordingly have manufactured space temperature and setpoint signal precision tolerances of no greater than 0.1 Deg. F.

Unless otherwise indicated, each room sensor shall be provided with a momentary push button for override of unoccupied operation.

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Unless otherwise indicated, each sensor shall be provided with a plug-in jack for the portable operators terminal to access all DDC controllers on the Network.

Room sensors shall be 10 K thermistors or RTD's.

Nickel or silicone sensors shall not be acceptable.

ASHRAE 90-75 COMPLIANCE:

Room thermostats and temperature sensors for SDC and UDC controllers as indicated shall have heating and cooling setpoints constructed to prevent overlap of setpoints, and to provide for energy deadband operation in compliance with ASHRAE 90-75.

Room temperature sensors shall be provided with single or dual setpoints as indicated on the drawings. Dual setpoint devices shall be provided with an internal software interlock which provides a programmable heat/cool deadband.

OCCUPANT OVERRIDE OF UNOCCUPIED MODE:

Each room sensor shall have an integral momentary push button which can be depressed by the occupant during unoccupied mode of the unitary air handler. This push button shall cause the UDC to bring the unitary air handler to occupied setpoints for a period of up to two hours (adjustable by operator). Should occupant depress push button again later, UDC shall begin timing an additional override period; override operation shall be reported to appropriate FMCS controller to allow generation of custom reports.

SERVICE PORT CONNECTION:

For all temperature sensor locations indicated in the drawings, the temperature sensor shall be provided with a plug-in RJ-11 type communications jack for connection to a POT device.

The same POT device shall be connectable at wall sensor locations as well as at other SDC and UDC device locations. Upon connection to wall sensor, the locally connected SDC/UDC address shall be automatically displayed on the POT for the operator.

The connection of a POT device at a wall sensor location shall permit the service terminal to communicate with all other devices on the local communications network.

The POT device connection shall not cause the UDC or SDC device through which the POT device is connected to leave the communications network or generate an exception.

<u>(LOW TEMPERATURE) LIMIT THERMOSTAT:</u>

Temperature monitoring range:	34 Deg. F to 70 Deg. F
Switch type:	Manual reset, DPDT
Length:	20 feet

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1. Detection within any one (1) foot necessitates shutdown.
2. Coverage shall be at the rate of one (1) linear foot for every square foot of coil surface.
3. Switch shall remain locked in tripped position until manually reset.
4. Unit shall not be manually resetable until sensed temperature is 5 deg. F above setpoint.
5. Shutdown is by hard wire interlock, alarm is by software.
6. Provide at heating coils, subject to freezing.

BARBER-COLMAN BCS - FS-50:

DUCT (AVERAGING) TEMPERATURE:

RTD resistance	1000 ohms
Sensor element length:	22 feet long
Barber-Colman:	TS-8422

OUTSIDE TEMPERATURE:

Temperature monitoring range:	-40 to 220
RTD resistance	1000 ohm's at 70 Deg. F

Barber-Colman - TS-8501

The outside air temperature sensor shall be complete with aluminum bulb shield.

SINGLE POINT TEMPERATURE:

Temperature monitoring range:	-40/250
Accuracy:	+/- 0.1%
RTD Resistance:	1000 ohm's at 70 Deg. F

Barber-Colman - TS-8201

SPACE SENSORS:

Temperature monitoring range:	40 Deg. F/140 Deg. F
Output signal:	varying resistance
Calibration point:	10,000 ohm's at 77 Deg. F
Accuracy:	+/- 3 Deg. F
Resistance:	10,000 ohm's

1. All sensors shall be supplied with night setback override buttons, which shall be monitored as a point in the system.
2. All sensors shall be supplied with RJ-11 NETWORK WIDE communications jack. Systems which do not provide network wide access to every controller shall provide all necessary additional wiring and communication jacks to do so.
3. Setpoint adjustment at local sensor via slide wire pot.

HUMIDITY SENSOR:

Removable humidity sensors shall be removable bulk polymer resistance type.

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Control range:	0 to 100% RH (line)
Accuracy:	+/- % RH
Signal:	4 to 20 ma DC
Calibration:	None required
Span:	None required

1. Duct mounted humidity sensors shall be provided with a sampling chamber.
2. Wall mounted sensors shall be provided with covers identical to temperature sensors.

BARBER-COLMAN HSP-8142

DIFFERENTIAL PRESSURE SWITCHES:

Shall be diaphragm-actuated type with a single-pole, double-throw, snap-acting switch. Motion of the diaphragm shall be restrained by a calibrated spring that can be adjusted to set the exact pressure differential at which the electrical switch will be actuated. Motion of the diaphragm shall be transmitted to the switch button by means of a direct mechanical linkage.

CONTROL VALVES:

All valves, except radiator and unitary, 3-inches and smaller shall be screw connected globe pattern, made from high grade cast brass. Valves 2 1/2-inches and over shall be flange bodied cast iron. Valves through 2-inches shall be packed with pre-loaded Teflon rings. Those over 2-inches shall be either Teflon or molded graphite packing. Valves shall be capable of being serviced, including replacement of packing, stems, and disks.

Globe valves through 2-inches shall be rated at 250 PSIG. Union connected bodies and bodies over 2 1/2-inches shall be rated at 125 PSIG except where otherwise specified.

AUTOMATIC CONTROL DAMPERS:

Dampers shall be provided as shown on the mechanical plans and shall be of the type designed and manufactured specifically for the air flow in heating, ventilating, and air conditioning equipment. Frames and blades to be minimum 12 gauge extruded aluminum. Blades to be of the single unit design 6-inches wide maximum. Frames to be a combination of 4-inches extruded aluminum channel and angle with reinforcing houses of 4-inches extruded aluminum channel and angle with reinforcing houses and groove inserts for vinyl seals. All hardware to be of non-corrosive reinforced material or to be cadmium plated. Dampers to be engineered for minimum air leakage, by means of overlapping design and by extruded vinyl seals to fit into the integral ribbed groove inserts in both frames and blades.

Bearings shall be Teflon or oil impregnated sintered bronze. Rod bearings shall be designed so that there shall be no metal to metal or metal to bearing riding surfaces. Interconnecting linkages are to have bearings to eliminate linkage friction. Blade linkage hardware shall be installed in angle or channel frame section out of air streams.

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All dampers in excess of ten square feet shall have reinforced corners by means of gusset plates.

Dampers when closed shall have less than 8 CFM per square foot leakage at 5-inches static pressure. Pressure drop through the dampers shall not exceed .125-inches w.g. at 2000 FPM.

VALVE AND DAMPER ACTUATORS:

Valves 1-1/2" and smaller may be operated with a direct low voltage signal from the controller. No transducers are required.

All electrically operated valves shall be equipped with method to ensure a failsafe position should a power or controller occur.

Valves larger than 1-1/2" shall be driven using compressed air.

The use of pneumatic outputs integral to the control panel must be limited to situations where the control device is in close proximity to the panel. Longer distances (over 50') shall use a low voltage signal to operate a transducer (I/P or E/P) at the control device.

All signals to proportioning transducers shall be true analog (i.e. 4 to 20ma). Pulsed signals shall not be acceptable. The use of pilot positioners shall be considered to insure proper control of pneumatic devices.

Proportional, integral, and differential control (PID) shall be utilized for all control loop circuitry.

Control intervals for both inputs and outputs should be long enough to avoid constant valve movement and control input spikes and valleys. Ten seconds is recommended as a reasonable interval for HVAC control.

When pneumatic control air is not available, provide:
Gear Train Type - Actuators shall be heavy duty, reversible type, with driving motor and gear train or hydraulic, completely submerged in oil and sealed in a die cast case. Actuators shall be proportional or two-positioned as required. Proportional actuators shall have a built-in electro-mechanical system to provide for positive repeatability of positions, regardless of changes in output load. Actuators incorporating a forced-balance feedback or heat type positioning will not be acceptable.

TRANDUCER TYPES AND SPECIFICATIONS (SEE INSERTS - 2 PAGES)

SECTION 2.01 - GLOBAL CONTROL MODULE

A. The Global Network Controller (GCM) shall be a multi-tasking 16 bit microprocessor based direct digital controller and facilities management system. The GCM operating software shall be written in a high level programming language to ensure reliability, compatibility with future system enhancements and reduce system maintenance costs. The GCM shall be Underwriters Laboratories listed.

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B. The GCM shall contain an access protected user-friendly English language, alphanumeric liquid crystal display additional (LCD), full alphanumeric and function select keypad and two RS-232C communications interface ports. Both of the RS-232C ports shall be capable of being connected to host computers, printers, VT-100 class terminals or auto-dial/auto-answer modems for remote telecommunications.

C. NC software functions include a fully prompted English Man-Machine Interface (MMI), Direct Digital Control (DDC), Energy Management Control System (EMCS), Facilities Management System (FMS), floating point mathematics and relational logic functions. The unique software functionality provided for the GCM shall include the capability for many standard HVAC system applications, such as single zone air handlers, variable air volume air handlers, multizones, chillers and boilers.

Customized sequences of operation shall be implemented using the extensive built-in library of software functions.

D. The GCM shall consist of the following features:

1. Global communications handler and global control strategies accomplished in distributed fashion for entire network.
2. The English language display shall have customer defined point names.
3. The built-in keypad shall allow the user to change sequences, schedules, setpoints, limits and other operating parameters of control programs.
4. Selectable continuous displays of selected user defined system parameters shall ensure critical data are always available even to lowest level of access.
5. Display a minimum of 20 selected groups of setpoints, schedules, limits, etc., which shall make it easy to modify controller operation for the casual user.
6. Complete DDC, EMCS and FMS software libraries to control most building mechanical, electrical and lighting systems shall be inherent to the controller.
7. Floating point arithmetic and mathematical functions shall permit extensive equations to be developed for trended or displayed information.
8. Boolean, relational and logical functions shall allow control sequences to be customized for individual applications.
9. Polynomial curve fitting functions shall allow use and setup of competitively priced sensors and transducers.
10. A minimum of eight character alphanumeric point names and a minimum of 20 character attribute descriptors shall allow user to easily use the system and recognize points.
11. Unused ASD bus input/output points shall be available as satellite control points for the GCM.
12. Extensive internal self-diagnostics, diagnostic LED's and modular assemblies shall be provided to reduce Mean-Time-To-Repair (MTTR).
13. A lock shall provide security from tampering with internal components.
14. Software keypad lock and 14 level user access control shall prevent GCM software tampering and unauthorized user access.

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15. GCM network controller shall be capable of peer-to-peer communication interface to expand system point capacity to a minimum of 94,000 points in a fully modular manner.
16. Full stand-alone control capability with battery backed Real Time Clock shall allow the GCM to be used in stand-alone and dial-up applications.
17. The segregation of output information into user definable print groups shall ensure management, alarm and maintenance data are provided to those who need it automatically.
18. The auto-dial applications shall select up to three subsets of ten phone numbers for remote reporting of alarms, trend reports and maintenance reports. These subsets shall be activated automatically, based on time-of-day, calendar or initiating events, to ensure that the proper supervisory systems and personnel are notified with the correct information.
19. The GCM shall have built-in maintenance time reminder functions to ensure that system maintenance requirements are annunciated when needed.
20. The GCM shall have built-in trend reports capability, providing local diagnostic trends or system performance trends.
21. Keypad with full alphanumeric and functional select keys for parameter entry, system configuration and edit functions.
22. User defined displays with continuous VIEW (minimum of 20 points) only display of selected user defined point name and attributes. User defined VIEW/EDIT display of selected additional point name and attributes with access protection.
23. Diagnostic displays with Light Emitting Diode (LED) and alphanumeric displays annunciate hardware failures and control program errors or problems.
24. Enclosure shall be UL-916 rated for use in air plenums; key lock standard for protection of internal components; conforms to NEMA 1.
25. LAN cabling shall be a twisted shielded pair cable between each controller.

E. Communication ports shall include:

1. (2) RS-232C, dual asynchronous ports for connection to host computers, auto-answer/auto-dial modems, video display terminals, printers or portable service computers, user definable ASCII word size, start bits and stop bits. Communications with host shall use a subset of ANSI X3.28.
2. RS-485, SDC Interface Bus, shall be 19,200 baud asynchronous. The protocol shall utilize packeted data with error checking.
3. RS-485, the Application Specific Device (ASD), AHUDC Controller Bus, shall be 19,200 baud asynchronous. The protocol shall utilize packeted data with error checking, supporting up to 128 SDC controllers.

F. Agency listings shall have UL-916 listing (File # E71385 Guide PAZX), FCC Class A, UUKL.

G. System Software:

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1. Operating system shall be multi-user, multi-tasking.
2. Communications shall be local RS-232C Interface. Data Rates: 300, 1200, 2400, 4800, 9600, 19200 baud asynchronous. Characters: Non Return to Zero (NRZ) binary encoded. Word size, parity and stop bit definition: user selectable.
3. Host protocol shall be subset of ANSI standard X3.28.
4. RS-485 data rate shall be 19,200 baud asynchronous.
5. GNC/Micro RS-485 bus data rate shall be 19,200 baud asynchronous.

H. GNC shall include a Panel Mounted Man-Machine Interface:

1. Keypad, full alphanumeric function keys to create, modify and configure system software. Software keyboard access lock.
2. Display refresh rate, two seconds, nominal.
3. Time display, 24 or 12 hour format, user selectable.
4. Date display, month/day/year or day/month/year format, user selectable.
5. User access levels, 14.
6. Main menu selections: current status, view/edit, alarm, access, blocks, system, log off, reports.
7. Current status display, display of day/date/time and selected operating parameter of system such as outside air temperature.

I. Maintenance Time Reminders (MTR) shall be user definable MTR messages with event, calendar, elapsed time or number of cycles initiation. To schedule maintenance of mechanical equipment, this routine shall also print out work orders for this equipment.

J. Alarm processing features shall include: Alarm response time of 3 seconds typical; alarm priority levels, 15.

K. Arithmetic capacities shall have a calculation range if 1.7×10^{-37} to 1.7×10^{38} floating point arithmetic; functions shall include add, subtract, multiply, divide, square root.

L. Auto-Dial Modem Support:

1. Command set, DC Hayes compatible.
2. Baud rate of 300, 1200, 2400, 4800, 9600
3. Auto-dial modem support, ten phone numbers, three subsets activated by event, calendar or time of day.
4. Provide industry standard modems, preventing internal modems shall not be acceptable.

M. The GCM shall include the following software functional libraries:

1. Direct Digital Control Functions: Setpoint Reset, Ramp, Floating ON/OFF, 2 Position ON/OFF, PID Loop, Linear Sequencer, Rotating Sequencer, Rotating Sequencer,

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Binary Sequencer, High/Low Select, Energy Dead Band, Thermostat, Self Tune PID.

2. Energy Management Control Functions: Duty Cycle, Temperature Compensated Duty Cycling, Optimum Start/Stop, Electric Demand Limiting, Weekly Scheduling, Calendar Scheduling, Enthalpy Changeover, Global Control/Monitoring, VAVDC, AHUDC, PEM's and LIM's.
3. Math and Logic Functions: Add, Subtract, Multiply, Divide, Square Root, AND, OR, XOR, NAND, NOR, Invert, Averaging, Summation, Totalize, Pulse Count Conversion, Time Delay, Sensor Curve Fit, CFM Calculation, BTUH Calculation.
4. Facilities Management Functions: Analog High/Low Alarm, Digital Alarm, Trend Log Reporting, Weekly EMS Report, Monthly EMS Report, Maintenance Time Reminders, BTUH Trend.
5. Automatic control loop tuning software.

2.02 STAND-ALONE CONTROLLERS

A. Local Control Module

1. Controls shall be microprocessor based. Local control module LCM's shall be provided for. Applications as shown on the drawings shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the LCM. The application control program shall be resident within the same enclosure as the input/output circuitry which translates sensor signals. All input/output signal conversion shall be performed through a minimum of a 12 Bit A to D converter. All input/output points shall be universal in nature allowing their individual function definition to be assigned through the application software. All unused input/output points must be available as universally definable at the owner's discretion. If input/output point are not fully universal in nature, unused points must be equal in quantity between Analog Input, Digital Input, Analog Output, Digital Output.

Contractor shall provide a minimum of one LCM controller per mechanical system, as shown on the drawings.

The BAS contractor shall provide and field install all LCM specified under this section. Mechanical Equipment manufacturers desiring to provide LCM type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors which are specified to be provided by the BAS/Temperature Control Contractor.

2. All input/output signals shall be directly hardwired to the LCM. Trouble shooting of input/output signals shall be easily executed with a volt-ohm meter (VOM). As a result of this intent, it is specified that power line carrier systems or other systems which command multiple outputs over a single pair of wires, shall not be used.

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3. LCM shall be in continuous direct communication with the network which forms the facility-wide Building Automation System (BAS). The LCM shall communicate with the SDC at a baud rate of not less that 19,200 baud.

4. Non-Volatile Memory.

5. All control sequences programmed into the LCM shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained. Power failures shall not cause the LCM memory to be lost, nor shall there be any need for battery to be recharged or replaced to maintain the integrity of the controller database. The LCM shall allow for the creation of unique application control strategies. Systems that allow selection of sequences from a library or table are not acceptable.

6. All control sequences shall be fully field programmable at the LCM controller, allowing for the creation or editing of an application sequence of operations.

7. Each LCM shall be provided with a built-in Operator Interface that has a minimum of a 2 line by 20 character display. The built-in operator Interface shall allow the operator to view up to twenty dynamic, scrolling values, without accessing the controller through the keypad. Upon controller reset the scrolling values shall automatically return without operator intervention.

The built-in display shall allow access to all application program data and real time data with the LCM. All information and commands shall be fully prompted for the operator. Via the built-in operator interface, the operator shall be able to view the operation application program sequence. In addition, the built-in operator interface shall allow the operator to modify or create an application program, on-line, without disrupting the existing operation of the controller.

8. The LCM shall allow for internal processing and reporting of user defined Time of Day Schedules. Alarms, Trend Reports, Run Time Totalizations, Energy Utilization Reports, Application Program Documentation and interface with a peripheral device such as an autodial/autoanswer modem, a VT-100 Display Terminal, or a serial printer.

9. The LCM shall provide LED indication of transmit/receive communications performance as well as for the proper/improper operation of the controller itself.

10. The LCM shall be provided with a battery backed time clock that is capable of maintaining the time of day and calendar for up to thirty days without loss of setting. The battery for the time clock shall be field replaceable by the customer. Integral daily, weekly, holiday and special event scheduling shall be provided, such that all schedules can be custom tailored to the facility. Predefined schedules, with set quantities of on/off cycles are not acceptable.

11. To simplify controls, mechanical service and troubleshooting, the LCM shall be mounted directly in or on the control compartment of the mechanical system. The LCM shall be provided in a NEMA 1 enclosure to accommodate direct mounting on the equipment to be controlled. The LCM shall be constructed in a modular orientation such that service of the failed components can be performed quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of three. When required to replace a printed circuit board, it shall not be necessary to disconnect any field wiring. The LCM shall allow for the creation of, unique, application control strategies. Systems that allow selection of sequences from a library or table are not acceptable. This shall allow all controls maintenance and troubleshooting to be made while at the unit location. LCM shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

12. For compatibility to the environment of the mechanical systems, LCM shall have wide ambient ratings. LCM shall be rated for service from -40 DegF (Degrees Fahrenheit) to 140 DegF.

13. Contractor shall submit description of location for the LCM's on all mechanical equipment.

B. Graphical User Interface (GUI):

1. The CHS shall be completely icon driven, multi-tasking and employing a graphical operating environment. The GUI shall not only be for real time access to any system(s) on the LAN but shall also allow the operator an easy method of information management Information management shall mean the massaging and manipulation of any system real time or historical data into integrated applications such as report generators, spreadsheets, X,Y charts, database managers, etc. Complete file management and data transfer such as copying, moving or transferring files, automatic and manual means of "cutting and pasting" of data items from one application to another (via Dynamic Data Exchange or via manual methods such as "mark and copy") shall be provided as an integral part of this CHS. An inherent knowledge by the operator of the "operating system" shall not be required for the daily operation of this system.

C. Menuing and System Access:

1. This CHS shall provide an easy method of menuing or system access. As well as providing an entry point into the CHS's array of application programs this menuing or system access program shall serve as a shell for the MS Windows operating system. Any and all the CHS programs, MS Windows or MS DOS programs shall be accessible only through this CHS menuing system. Systems which require the use of MS Windows Program Manager or and X-Tree format as the shell or entry point to other programs shall be rejected.
2. This menuing program shall consist of a series of at least 15 dynamic push buttons. Each push-button shall be user configurable to allow access to any of this CHS's

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applications. A push-button shall display a user selectable ICON and text describing visually and verbally the application which it will lead the user into. As well as starting the application (such as Dynamic Graphics, Word Processing or Spread Sheets) it will also have the capability of bringing up a particular Dynamic Graphic, Word Processing document or Spread Sheet. As an example, a push-button may be configured to take a User to a Dynamic Graphic screen for a Particular zone in a building. This menuing system shall be able to call another menu and that menu to another menu and vice versa allowing complete versatility in how the menuing structure is designed.

D. System Security:

1. System Security shall be on an application by application basis. During the setup or editing of a particular user the system Administrator or engineer shall be allowed to chose the menu items for a particular application which this user may have access to and whether this user has monitor or change privileges. The Users shall be assigned discrete password names and codes, both of which must be entered in order to have access to any particular application or function within the system. Access privileges shall also be assignable for entry into the standard MS Windows or MS DOS array of applications such as File Manager, Task Manager or others.
2. As well as application protection each User shall be assigned to their own customized menu (see Menuing and System Access). This shall allow for each user to have their own discrete menu into the system. Upon the User logging on to the system this custom menu shall be displayed allowing only access only into those applications or Dynamic Graphics presented in this discrete menu.

E. Dynamic Graphics:

1. The Dynamic Graphic portion of this CHS shall allow the operator to access any (see System Security) system information via a "system penetration" method. "System penetration" shall allow the operator to begin at an entire site plan and then zoom in to a particular area for closer inspection and then further zoom in on this area and so on until the detailed color graphic display of a desired portion of the facility is represented. The operator shall be able in this manner to "penetrate" to any desired system information without being required to enter any commands via the keyboard. A minimum of 128 dynamic points shall be displayable on any one screen.
2. As a minimum, a Graphic screen shall be designed showing the entire facility, each building within the facility, each major piece of mechanical equipment within each building, all of which will display the data for each area dynamically.
3. Up to 8 different sites may be displayed dynamically on one screen at a time. These shall be similar or dissimilar systems with any combination of modem or "hardwired" connections to these systems.

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4. By pointing and clicking on any individual dynamic point the following shall be available for display or modification from within any specific dynamic graphic display, which shall include, but not be limited to:
   a. The current value or state may be changed; a self prompting pop up window shall be displayed giving easy to understand instruction for changing the selected point's value.
   b. Charting (X/Y) of a selected point for a user given time frame. The chart shall be "windowed" over the top of the current display, the user shall be able to move the window and adjust the size of the chart by simply clicking and dragging on the windowed chart. Trace colors and X values shall be User configurable. Up to 4 charts may be started and displayed simultaneously on one screen.
   c. Spontaneous timed override requests; the user shall be able to "on the fly" request a timed override for any digital or analog output point.
   d. Point help shall be available for each point displayed on the screen. This shall be a user editable text screen which is windowed over the top of but not covering the point in question. This help window will contain information specific to this point and its relationship to the system which is currently displayed.

F. Systems Integration:

1. The CHS shall integrate the automation system being installed as a part of this contract with the current automation system now in use at this facility. System integration shall be defined as the following:
   a. All point data from the different systems shall be viewed and manipulated through one common format (see previous section "Dynamic Graphics" for definition of "viewed and manipulated"). Therefore, from the user's perspective, interaction with either of the two or more systems shall be identical in every way.
   b. Points from the any of the different systems may be viewed concurrently on one screen.
   c. Alarms and exceptions shall be viewed and handled in a common format.
   d. Trended data shall be stored in a common database. This shall allow the data to be viewed or manipulated in common reports or charts.

G. Centralized Scheduling and Modification:

1. A calendar shall be provide for display and modification of the SDC time clock functions. The User shall be able to view an entire months scheduling at a time. Holidays and Special functions shall be clearly marked on the calendar. Calendars shall be displayed by area served. A list of "served areas" shall be displayed on the same screen, this list shall be displayed at all times, pull down menus or other means of accessing these areas shall not be accepted. The User shall only have to click on a "served area" to view its time clock schedule. A Dynamic Graphic shall be

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attached to each Calendar allowing the User to view this "served area's" real time statistics. Schedule changes may be made by clicking on a day or week and entering the new schedule. Changes shall be permanent or for "one time" only.

H. Alarm and System Exception Annunciation:

1. Upon the incidence of an alarm or system exception an alarm or exception window shall be displayed at the bottom of the screen displaying the point in alarm or system exception, the time and date of the alarm or exception and a pre- defined alarm message (and optionally printed to a user defined printer, printers and or VT-100 or dumb terminal devices). The operator may suppress the alarm/exception window which will force an alarm/exception icon to be displayed in the lower left hand portion of the screen identifying the number of current unacknowledged alarms/exceptions, a series of beeps will be initiated periodically reminding the operator that an alarm(s)/exception(s) still exist. Should the operator desire to handle alarms/exceptions, the alarm/exception window shall contain an acknowledge button and a query button (query shall be specific to alarms only). If the operator acknowledges the alarm/exception the time, date and operators name will be associated with the acknowledgment, this data will be stored to the alarm/exception history file and printed to the chosen printers or terminal devices. If the operator chooses the query option this operator will be placed automatically into a dynamic graphic display of points which are logically associated with this particular alarm. Upon exiting the alarm handling mode the User shall be placed back to the application in use at the time of alarm/exception occurrence.
2. This alarm/exception window shall be displayed regardless of the application this user may be currently running including but not limited to non-standard CHS applications including MS DOS applications.

I. Trend Management:

1. The CHS shall automatically perform time based periodic collection of real time point data. There shall be two modes of operation; local collection shall allow the CHS to directly query the SDCs for individual point samples; remote collection shall mean that the SDCs collect and store trend data on individual points releasing the entire trend table upon a request from the CHS. Manipulation and archiving of both types of data collection shall be treated commonly.
2. A trend shall be defined as a group of at least 10 data points. Quantity of sampled points shall only be limited by disk space. Sampling rates shall be user selectable from instantaneous (once a second or less) to once a week. Collection of data shall be user selectable to start and stop on a specific time and date.
3. X,Y charting and column and row reporting shall be an integral part of the trend management program. Up to 10 points shall be chartable or reportable. Four X,Y charts may be run simultaneously displaying either real time data (instantaneous) or historical. Y scaling shall be either automatic or user selectable for all 10 data points allowing for offsets of dissimilar point scales. X scales shall be user

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selectable allowing for display of data over a wide range of times and dates. The chart display shall be capable of displaying a window of time as short as 15 seconds and up to as long as 4 years. Analytical data shall be displayed for any of the 10 selected points in a clearly displayed window. This analytical data shall consist of at least the following: Average Mean, Standard Deviation, Simple Average, Current Value, Cycle Length, Cycle High and Cycle Low.

4. Trend data archiving shall be provided allowing for simple back up procedures to another disk media. File comments shall be provided allowing for up to 256 characters of comments to be added as a header to each back up. When restoring back ups the User may view the a list of back up files along with the back up comments previously added allowing for understandable restoration of previously archived data.

J. Reporting:

1. The report section of the CHS shall be the "gateway" to the CHS' database for all solicited and unsolicited data collected and shall provide for an easy means of reporting and information management.
2. Daily, weekly, monthly or any additional reporting may be generated. This report generator shall allow an operator to easily and quickly define the contents of a report as well as define a print time and date if so desired. Information contained in the reports shall be derived from alarm history, CHS or SDC generated exceptions, trend data and timed overrides.
3. The operator shall be able to compile reports by user, company/department, time and date period, point or points. A combination report may also be printed. The combination report option shall allow the operator to define any or all of the information types to be reported on within one compilation sorted by the above definitions. A report definition shall be able to be printed once or printed on a time and date schedule. A cover page shall be printed automatically identifying the operator, the time and date and the parameters by which the report was compiled.

K. Multi-Tasking:

1. The CHS shall be capable of true multi-tasking capabilities. The User shall be able to use other non-related programs in the CHS while still running all CHS applications with no interruptions. This shall include the use of real time data in other applications. This CHS shall allow Spread Sheet programs to gather data from the SDCs dynamically while running a dynamically updating Graphic screen. Up to 16 applications may collect data dynamically and simultaneously from the SDC's without CHS speed degredation. The CHS shall have the ability to allow the passing of data freely to MS Windows applications which incorporate the use of Dynamic Data Exchange.

L. Telephone Use:

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1. As an integral part of the EMS the operator shall be able to communicate with the CHS via any standard touch tone telephone or Cellular touch tone radio. The telephone use will be active at all times, as an example; an operator may be on the system requesting real time values via a touch tone telephone while, at the same time, another operator may be signed on to the system via the keyboard monitoring or changing values dynamically on a graphic screen with no interruption of each others operation.

M. Two Way Communications:

1. Any user with a valid pass number shall be able to establish Two-Way communications with the BAS through a standard touch tone telephone system. The CHS software shall prompt the user with easy to understand conversational HUMAN VOICE instructions (synthesized voice commands and non-interactive (voice feedback) telephone interface systems will not be accepted), the user will respond by pressing the various keys on the touch tone telephone which shall result in the following basic modes of operation:

a. Monitor: Point values, current status' and any other definable point attribute such as setpoint, throttling range, etc. shall be accessible and have the capability of being read out to the user on the telephone.

b. Change: Current states (on/off) and setpoints (as well as other point attributes such as throttling ranges, alarm limits, etc.) shall be accessible and have the capability of being read out and changed over the telephone by the use of the touch tone keypad. Changes shall be verified (in real time) and read back to the user for positive confirmation of the change.

c. Override: This system shall allow the telephone user to override any "controlled" equipment or any other changeable parameters,(normally changeable through standard keyboard sequences), via telephone. These overrides shall be definable for certain user defined periods of time. The default value of the point shall be reestablished when the override has expired. The override period shall be user selectable over the phone to start and stop at any time up to one year in advance. The user shall have the ability to program in multiple overrides for the same or different zones or points. The system shall read back, for user confirmation, the zone to be overridden along with the start and stop date and time, all of which shall be spoken by the computer in plain conversational English language.

d. Callback: The user shall, after confirming that the requested override is correct, have the option of entering a telephone number for each individually requested override whereby the system can call this same user to confirm the expiration of the requested override. The feature shall allow the user to extend their override with no interruption of equipment operation or comfort levels.

e. Restrictive use: Any user of the system may be restricted through pathing and other limitations. This shall restrict the user to override capability and for only certain operator defined zones or points. This will serve to simplify

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the use and to restrict the access to other areas of the system. Further, this restricted user may be limited to only certain hours of access and to only certain "states" for pre-defined points. An example may be of a tenant; this tenant may be restricted to his/her tenant space for lighting and A/C override for weekdays after 5:00 pm for an override of "on" and for a specific period of time. Overrides shall be cancelled at any time by the same user.

f. Override Accounting: This system shall compile all override activity by a single user, all users on the system or for a particular company/department. This information shall then be passed to the Tenant Billing portion of the CHS.

N. Alarm Management Via Telephone:

1. As part of the telephone interconnect system, any alarmed point may be flagged for dial out to a user. Each alarm shall have up to four pre-defined conditions as well as a "free form" no condition message handler. These pre-defined conditions shall be items such as HIGH LIMIT, LOW LIMIT, CHANGE OF STATE, etc. Each condition shall have operator definable verbal messages attached to them. The system operator shall be able to record in new messages or assign pre-defined messages from the standard voice library.

O. Alarm Handling:

1. Alarms shall be logged to a disk file as well as sent to a printer for hard copy. Concurrently the system shall determine which user(s) is responsible for handling the alarm and shall attempt to reach this user by TELEPHONE, AUDIBLE PAGER and/or DIGITAL PAGER. If contact was not successful, this system shall retry for a user specifiable number of retries before the system logs the attempts as unsuccessful at which time the alarm will be "retired". The alarm shall continue to be displayed on screen as an unacknowledged alarm.
2. In the case of multiple alarms, the alarms shall be stacked by user and alarm point before initiating the dial out. If additional dissimilar alarms come in for this user while the user is "on-line", the system shall notify the user before allowing a disconnect.
3. Alarm notification by digital pager - the pager shall display the phone number and alarm number. The user shall then be able to call this number and request the displayed alarm number, the system shall then read out the alarm by site location, alarm point and its alarm condition.
4. Alarm notification by audible pager - the system shall, through the pager, read out, by verbal description, the alarm number, site location, alarm point and its alarm condition.
5. Alarm notification by telephone - upon receiving an answer, the system shall identify itself and ask for the individual who is responsible for handling the alarm. The user must enter a valid pass number before the system will release the alarm message. The system shall then read out the alarm by alarm number, site location, alarm point and its alarm condition.

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P. Alarm Outdial Management:

1. A minimum of 1000 outdial lists shall be available, each of which shall contain a minimum of 10 different users. Each user shall have a minimum of 2 phone numbers and/or pager numbers assigned. Each alarm point shall have one of these lists attached, an outdial list may be attached to more than one alarm point. Upon the system going through the list without successfully reaching a user, the system shall wait an operator assigned number of minutes before going through the list again. The system shall "retire" the alarm from the outdial list if no users are reached within a certain operator assigned number of hours. The retired alarm shall remain in the unacknowledged state.

Q. Alarm Interrogation:

1. For the purposes of allowing a user to quickly diagnose an alarm problem over the phone, the system shall allow for an alarm group to be attached to each alarm point defining up to 9 associated points or groups. This shall allow the user to interrogate associated points when handling alarms without complicated menu penetrations.

R. Point Management for Telephone Use:

1. Groups shall be used to logically guide the user through the various points contained within the EMS. Each group shall be comprised of at least 9 selections (corresponding to the 9 touch tone keys on the telephone), a selection may be a point or a link to another group. Any group shall be linkable to any other group.
2. The number of groups shall be a minimum of 1000 per individual site.
3. Any point within a group may be selected for a change, override or repeat function as described elsewhere in this specification (Two Way Communications).

S. Group Scanning:

1. The above described groups shall have the capability of being dynamically scanned. On each scan, the point name shall be read out with the newly updated real time current value as they are reported by the EMS network. Each scan shall not exceed 4 seconds per point value. Each scan shall be a true update of the values displayed.

SEQUENCE OF OPERATION:

1. Radiation Control

a. Perimeter radiation system will have zone control exposure as shown on plans. Zone sensor shall modulate two way control valve to maintain setpoint. Sensors shall be grouped to

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control by average or lowest temperature of the zone. Provide space temperature reduction during the unoccupied mode.

2. Unit Heater Control

Provide single-temperature room thermostat cycle fan motor to maintain constant space temperature. Provide strap-on aquastat on unit return piping, to de-energize fan motor when fluid falls below adjustable setting of aquastat. Provide thermostat sub-base containing summer fan Off-ON switch.

3. Cabinet Heater Control

Provide single-temperature room thermostat to cycle fan motor to maintain constant space temperature. Provide strap-on aquastat on unit return piping, within cabinet piping end pocket, to de-energize fan motor when fluid temperature falls below adjustable setting of aquastat.

4. Heating, Ventilating & Air Conditioning Unit.

AHU shall be energized through a start time optimization program. The unit will operate continuously during the occupied mode and cycle at night to maintain reduced temperature.

Upon signal from the air flow switch, the outside air damper shall open to its minimum position. The sensing element in the mixed air stream shall modulate outside air damper, return damper, and exhaust air damper to maintain its adjusted setpoint.

An enthalpy control shall position outside air dampers to their minimum position should return air "total heat" be less than the outside air total heat.

Return air humidity sensor through high limit discharge sensor shall control a humidifier valve to maintain a reset schedule based on outside air temperature. Close valve on no air flow.

Duct sensor and low limit discharge sensor will then modulate steam control valve and chilled water valve in sequence to maintain set position. Chilled water return sensor shall override control sequence to close chilled water valve to maintain low limit return to the chilled system.

Zone sensors with adjustable setpoints and manual override switch in their respective areas will modulate terminal reheat hot water control valves through DDC to maintain zone temperature conditions. Reduce setpoints during the unoccupied mode. Manual override switch will start unit and set the zone to occupied mode for a predetermined time. Provide manual adjustment for setpoints.

AHU shall have outside air damper closed during the unoccupied cycle and override mode.

During the unoccupied cycle outside air damper shall close.

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Provide freezestat serpentined across leaving side of steam coil adjacent to outside air connection. De-energize unit fan when temperature falls to 35 DEGF (2 DEGC) and close outside air damper and indicate alarm back at the central station by activating a graphic display with all actual information of the air handling system.

Duct humidistat will operate humidifier to maintain its setpoint through a high limit. Humidifier valve will close on loss of air flow.

Emergency stop switch shall be located near the mechanical room door.

5. AHU

AHU shall be energized through a start/stop time optimization program.

The unit will operate unit during the occupied cycle and be off during the unoccupied cycle. An override switch will allow the system to operate during the unoccupied cycle.

When system is energized and upon a signal from the flow switch, the outside air damper shall open to its minimum position, a sensing element in the mixed air stream shall modulate outside air damper, return damper, and exhaust air damper to maintain its adjusted setpoint.

An enthalpy control shall position outside air dampers to their minimum position should return air "total heat" be less than the outside air total heat.

Space sensor with adjustable setpoint and manual override switch shall modulate steam control valve and outside air damper to maintain space condition. During the unoccupied cycle the space sensor shall energize unit with outside air damper closed and run unit until it is satisfied.

Provide freezestat serpentined across leaving side of steam coil adjacent to outside air connection. De- energize unit fan when temperature falls to 35 DEGF (2 DEGC) and close outside air damper and indicate alarm back at the existing central station by activating a graphic to be displayed with all actual information of the air handling system.

Emergency stop switch shall be located near the mechanical room door.

6. Exhaust Fan Control

Exhaust Fans _____ - From central station, energize exhaust fans during occupied cycle and de-energize during unoccupied cycle.

Exhaust Fans EXF 14, 15, 16, 28, 29 and 30 will be manually energized through wall switch.

ACCEPTABLE MANUFACTURERS:

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A. Model numbers used in this specification are from Barber-Colman unless otherwise noted. The owner has an existing Network 8000 campus-wide Energy Management System and it is the intention of the owner to continue the expansion with this manufacturer for standardization of software and hardware.

B. Barber-Colman

PART III - EXECUTION

CUTTING AND PATCHING:

All cutting and patching required for installation of temperature control equipment shall be the responsibility of the temperature control contractor.

CONTROL WIRING:

All electrical wiring associated with the control system shall be installed by the control contractor. All interlock wiring required for proper operation of the system is to be included as part of the control wiring.

All power wiring to electrical starters and motors shall be furnished by the Electrical Contractor. Power wiring to the Network 8000 panels is to be furnished by the temperature control contractor unless otherwise shown on the drawings by the electrical contractor.

All wiring shall be installed in accordance with the Project Electrical Specifications Division 16.

All cable less than 25 volts which is concealed accessible may be run without conduit. Where ceilings are return air plenums, only approved plenum cable may be used. All low voltage wire shall be twisted shielded cable.

All wiring shall be installed according to local and National Electric codes.

CONCEALED WIRING:

a. Low voltage wiring shall be run exposed in accordance with NEC article 725 for class 2 and 3 circuits.

b. For high abuse areas, wiring is to be run in either EMT or rigid steel conduit depending on "level" of abuse.

EXPOSED WIRING:

a. Wiring is to be run in EMT unless a high abuse condition exists. In that case, utilize rigid steel conduit.

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POST-INSTALLATION INSTRUCTION:

Upon completion of work, the temperature control subcontractor shall instruct the operating personnel in all phases of the control installation (minimum of 16 hours). Eight hours at turn over and two 4-hour sessions at three months and six months.

SERVICE AND GUARANTEE:

SYSTEM ACCESS AND MONITORING:

Installation: The contractor shall complete the installation of the energy management control system, install system software, debug and commission the system and then notify the engineering that the EMCS is ready for initial acceptance testing.

Acceptance Testing Procedures: The contractor shall submit, in writing, a detailed acceptance procedure to the engineer to demonstrated compliance with specified system requirements. This written procedure shall be submitted at least ninety (90) days prior to the period of the initial acceptance testing.

Spare Parts: The contractor shall supply the facility the following quantity of spare parts:

Temperature sensors	10% of total
Pressure sensor	10% of total
Relays	10% of total
Valves (each size)	10% of total

These items shall be delivered to the facility at the time of the acceptance testing and a copy of the receipt signed by the facility shall be included in the acceptance test. The facility will not issue its letter of acceptance without receipt of spare parts.

Owner Acceptance: The Energy Management Control System shall be considered acceptable to the Owner when the following conditions have been met:

a. Successful completion of the acceptance test.
b. Receipt of operation and maintenance manuals.
c. Receipt of spare parts.
d. Correction of all punch list items.
e. Receipt of all other documentation required, as noted below.
f. Phase I of instructions to Owner's personnel, as specified below.

Documentation: After successful completion of the acceptance test, the control contractor shall provide the facility with the three copies of the following documentation; technical information, manufacturer's literature, catalog cuts, warranty information, point to point termination drawings, instrumentation location and identification drawings and troubleshooting procedures.

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Monitoring: The contractor shall monitor the Energy Management System via phone modem for the duration of the warranty period from his office. Monthly status reports shall be prepared by the contractor and submitted to the Owner. Status reports shall:

a. Alert the facility to abnormal operating conditions.

b. Report on maintenance performed under the maintenance guarantee during the preceding month.

c. Advise the facility of maintenance measures required on equipment not covered under the maintenance agreement that affect operation of the Energy Management System.

d. Track fuel and electric usage and estimated savings.

Training: Instructions to Owner's personnel:

a. The contractor shall include in his bid price, the cost of providing the services of competent instructors to fully instruct designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and systems specified. The training shall be oriented toward the installed system rather than being a general (canned) training course. Each instructor shall be thoroughly familiar with all aspects of the subject to be taught. The number of man-days of instruction furnished shall be specified below. All equipment and material required for classroom training shall be provided by the contractor.

Training Program:

a. The training program shall be accomplished in three (3) phases for the time interval specified for each phase. A training day is defined as eight (8) hours of instruction including two 15-minute breaks and excluding lunch time.

Phase I:

a. This phase will be for a period of three (3) days prior to the acceptance test period at a time mutually agreeable between the contractor and the Owner. Operating personnel will be trained in the functional operations of the installed system, the procedures employed for system operation and the maintenance of EMCS equipment.

b. The first two (2) days of training shall include:

1. General EMCS architecture.
2. Operation of computer and peripherals.
3. Command line mnemonics.
4. Report generation.
5. Operation control functions.

6. Graphics generation.

c. The third day of training shall include:

1. General equipment layout.
2. Troubleshooting of EMCS components.
3. Preventative maintenance of EMCS components.
4. Sensor maintenance and calibration.

Phase II:

a. This phase of training shall be conducted approximately four (4) weeks after system acceptance testing for a period of three (3) days. The first day of training will be considered review of the entire first phase subject material.

The second and third days will be based upon subject matter proposed by Owner personnel. One week prior to the date of the first Phase II training session, the Owner shall submit to the contractor a detailed list of subject matter which shall determine the content of the program (e.g. system software operational problems, software utilization, capability, and usage, etc.).

Phase III:

a. Provide a third phase of training after the completion of one heating and cooling season. The particulars of this phase of training will be similar to that of Phase II.

Three neatly bound vinyl notebooks shall be provided by the contractor containing a summary of each topic discussed during the three phases of training.

EXTENDED MAINTENANCE AND MONITORING

The contractor shall include in his bid proposal the cost of an annual service agreement covering remote monitoring and maintenance for each of the first four years after the end of the warranty period. A separate cost for each year 2, 3, 4, and 5 shall be included in the bid proposal. Renewal shall be at the option of the Owner.

The contractor shall provide all labor and materials to maintain the system in operable condition. The extent of maintenance work to be performed by the control contractor shall be closely coordinated with the mechanical contractor. The intent is to ensure that the entire HVAC system and associated controls are maintained. As a minimum, the controls contractor will be responsible for maintaining the host computer and printer on one end and the sensors, transducers and all final control elements on the other end, inclusive. All items in between shall be included in this contract (i.e. panels, programs, wiring, relays, contacts, etc.).

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The following list of work shall be performed annually at the beginning of each maintenance period. The contractor shall, within (4) four weeks after his work, submit a report showing a completed check list with comments on each item for each building or system.

a. Clean and vacuum EM unit components.

b. Clean and vacuum I/O boards.

c. Review operation of the software program.

d. Review applicable program features and verify operating parameters. Such features may include: optimized start/stop, electrical demand limiting, duty cycle control, enthalpy optimization and time based control.

The following list of work shall be performed (4) four times per year in January, April, July and October. The contractor shall, within (4) four weeks of concluding his visit, submit a report showing the results of each checklist item for each system or building.

a. Energy Management System: Preventative maintenance inspection:

1.Inspect cooling fan operation.

PART 3 EXECUTION

3.01 GENERAL

A. Install all hardware, field devices and wiring in accordance with manufacturer's published instruction.

B. All required electrical materials shall be furnished and installed by the contractor.

C. Conduit or surface metal raceway shall be required in all exposed areas. The term "exposed" shall apply to all Janitor's Closets and areas exposed where wiring would be visible, regardless of ceiling height. Concealed areas are areas above ceilings, shaftways or mechanical areas. When making a transition from an exposed to a concealed area, the conduit shall be stubbed up to an elevation of 8 inches above the division between the two spaces. In areas with no finished ceiling, conduit shall be stubbed up to a minimum of 10 feet above floor level.

3.02 VERIFICATION OF CONDITION

A. The EMCS contractor shall be expected to have visited the premises to become thoroughly familiar with all details of the desired EMCS. Verify all conditions in the field and advise the Engineer of any discrepancy before purchasing/installing any equipment.

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B. The EMCS contractor shall verify that the pneumatic system including air compressors will have sufficient capacity to support system additions without extending compressor run time beyond 50%.

C. The EMCS contractor shall verify the operation of the existing controls system before starting the installation. The contractor shall notify the Owner and Engineer of any equipment not functioning properly.

3.03 DIGITAL FIELD PANELS

A. Field panels shall be installed in dry interior areas of building. Do not install panels adjacent to heat generating devices.

B. All conduit entering the field panels shall enter from the bottom or sides of the enclosure to insure that moisture cannot enter the cabinets by traveling naturally down the conduit and through the conduit/enclosure fitting.

3.04 SENSORS AND CONTROLS

A. Wiring from sensors and control devices shall be to a terminal block located in the field panels or outboard gear panels. The terminal block shall be permanently marked for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions which might adversely affect the connected devices. Number the blocks by circuit pairs, such as one to 25, 26, to 50, etc. Classify each individual signaling circuit as a circuit pair. All wiring is to be installed per Division 16000.

B. Label or code each field wire at each end. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color coded cable diagrams may be used to accomplish cable identification.

C. Temperature Sensor Installation Requirements:

1. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

2. Water temperature sensors shall be installed in stainless steel wells.

3. Outdoor installations shall be of weatherproof construction.

4. Temperature sensors shall be located within 500 wire feet of their associated card.

5. Mount sensors in ducts in locations to sense the correct temperature of the air only. Do not locate in dead air spaces or positions obstructed by ducts, equipment, etc. The location of installation shall be within the vibration and velocity limits of the

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sensing element. Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct in an approved manner and shall be positioned to measure the best average temperature. Thermally isolate elements from brackets and supports to respond to air temperature only. Securely seal ducts where elements or connections penetrate ducts.

6. Provide all sensors measuring temperatures, in pipes larger than one inch in diameter (except as noted), or in pressure vessels, with wells properly fabricated for the service. Wells shall be non-corrosive to the medium being measured and shall have sufficient physical strength to withstand all (including test) pressure and velocities to which they are subjected. Install wells in the piping at elbows where piping is smaller than the length of the well to effect proper flow across the entire area of the well. Install wells either oriented upstream or downstream. Provide suitable thermal transmission material (i.e., conductive silicon grease) within the well to speed the response of temperature measurements. Provide wells with sealing nuts to contain the thermal transmission material and to allow for easy removal. Well shall not restrict flow area to less than 70 percent of line-size pipe normal flow area.

3.05 FIELD TESTS AND INSPECTIONS

A. Upon completion of installation of each piece of equipment, field inspect and mechanically and electrically test equipment for proper functions. Submit a certification to the Engineer that each piece of equipment has been field inspected and tested for proper function prior to final system test.

3.06 WIRING

A. Also refer to Division 16. All referenced provisions regarding wiring apply to this Section of the Specification.

B. Network Cable:

1. Ample shielding, to prevent interference and distortion from adjacent power cables, television cables, etc. shall be an integral part of the network cable.

2. Care shall be taken to route the cable as far from interference generating devices as possible.

3. All shields shall be grounded (earth ground) at one end only, preferable at the field panel terminal strip, to eliminate ground loops.

C. Sensor and Control Wiring:

1. Field panel wiring shall be twisted-shielded, No. 20 gage.

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2. All wiring to be installed per Division 16000.

D. Splices:

1. Splices in shielded cables shall consist of terminations and the use of shielded cable couplers which maintain the integrity of the shielding. Terminations shall be in accessible locations. Harness cables with cable ties as specified herein.

2. Splices in coaxial cables shall consist of terminations and the use of shielded coaxial cable couplers which maintain the integrity of the shielding. Each cable shall be cut to length required and terminated in a connector, impedance matched to the specified coaxial cable applied. Harness cables with cable ties as specified herein. If necessary, to solder cables, do not overheat the insulating material or dielectric. The same precaution applies when using heat-shrink tubing. Use "Scotchcast" type kits, or approved equal, for splicing cables which are susceptible to heat or water damage. maintain polarity at all connections.

E. Fit all equipment contained in cabinets for panels with service loops. Each loop shall be a least 12 inches long. All cabinets shall be self-supporting, code gauge steel enclosures. Painting on steel panels shall be, at a minimum: one full coat of primer and two coats of finish paint.

F. Cable runs:

1. Keep cable runs as short as possible, allowing extra length for connecting to the terminal board.

2. Do not bend flexible coaxial cables in a radius less than ten time the cable outside diameter.

3. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.

G. Grounding:

All grounding shall be in accordance with NFPA 70 (National Electric Code). All ground wire shall be bare copper.

3.07 TESTS

A. This work shall include pre-delivery testing of major components, field testing and adjustment of major subsystems and of the complete EMCS, and an on-site final operational acceptance test of the complete operational EMCS. Provide performance certifications of the required tests. Acceptance of test by the Owner/Engineer shall not relieve the

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contractor of responsibility for the complete system meeting the requirements of these specifications after installation.

B. Field Test: After installation of the field panels and related peripherals, and the field interface devices and sensors, calibrate equipment and check transmission media.

C. Operational Acceptance Test: Conduct final operational test on the complete, totally installed and operational Energy Monitoring and Control System to demonstrate that is functioning properly in accordance with all requirements of this specification. Demonstrate the correct operation of all monitored and controlled points as well as the operation and capabilities of all sequences, reports, specialized control algorithms, diagnostics, and all other software. Final acceptance of the system shall be made, provided the contractor has satisfied all other requirements of this specification.

D. The EMCS contractor shall provide to the engineer for operational acceptance the following documents generated by the EMCS.

1. All Points Summary

2. Alarm Point Summary

3. Alarm Message Summary

4. Totalization Summary

5. Trend Log of Temperature Points Over 24 Hour Period

6. Start/Stop times for all Mechanical Systems

7. Optimal Start/Stop Parameters

8. Software Documentation for all EMCS Programs Installed In Application Specific Controllers and Central Station

E. Where it is required for the contractor to modify, alter, add or remove hardware or software programs of the EMCS or related accessories for the purpose of testing, these changes shall be done as required by the contractor until such time acceptable performance of the EMCS has been established. Problems which occur within approved hardware or software shall be corrected in an appropriate fashion under guarantee. Any such occurrence shall not void previous approval; however, the contractor shall be responsible for prompt remedial action. Appropriate logs, schedules, and reports shall be maintained by the engineer to reflect these items and their address.

1. Prior to final acceptance, a complete demonstration and readout of the computer real-time responsibilities of surveillance and command shall be performed in the presence of

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the Engineer. This demonstration, having satisfactorily met previously approved submittals, shall, with the Owner's authorized representative's written acceptance, allow commissioning of the EMCS for on-line testing.

2. Upon successful completion of system installation, the Engineer shall be requested in writing to inspect and approve the satisfactory operation of all components of the EMCS. Upon receipt of a detailed "punch list" from the Engineer, an installation inspection report shall be submitted by the EMCS contractor showing each outstanding item on the punch list. After all items appearing on the installation-inspection report are completed, a second written request for system approval will be made to the engineer. As each or all items are approved, an appropriate notation will be entered at the time of joint, inspection on the system report with counter signature of the Owner and Engineer. A copy of this report will be made for the Owner.

3. Problems which occur within approved hardware or software shall be corrected in a an appropriate fashion under guarantee. Any such occurrence shall not void previous approval; however, the contractor shall be responsible for prompt remedial action. Appropriate logs, schedules, and reports shall be maintained by the Engineer to reflect these items and their redress.

3.08 MAINTENANCE

A. The EMCS contractor shall present to the Owner, for his consideration, a Preventative Maintenance Contract to cover service incidental to the continued proper performance of the EMCS and devices during the guarantee period.

B. Where the Owner elects to perform the required preventive maintenance with his own staff or qualified personnel, the EMCS contractor shall furnish to the Owner a schedule of the maintenance tasks necessary to keep the warranty in effect through the guarantee period. The lists to tasks furnished shall indicate a recommended frequency of the preventive maintenance and the necessary tools required to perform the tasks.

C. The Owner having elected to perform the required preventive maintenance, agrees to keep records, schedules and other reports documenting that the prescribed maintenance has been performed. The EMCS Contractor shall not be liable for defective systems, devices, or components of their repair of the recommended preventive maintenance for them has not been performed and documented.

D. The EMCS Contractor shall provide quarterly training during the warranty period in sessions of 4 hours each to keep Owner's maintenance personnel current in the operation of this system. Scheduling of training will be the responsibility of the EMCS Contractor, which will be signed for by the Owner's representative.

3.9 DEFECTIVE WORK AND MATERIALS

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A. Any material or work found on inspection to be defective or not in strict conformance with requirements of the specifications, or defaced or injured through the acts of fire or elements or any other cause shall be removed immediately from the premises and satisfactory materials or work or both substituted therefore without delay.

B. If the contractor does not remove such materials condemned by the engineer within the time limit fixed by written notice, the owner may cause the same to be done and may store all materials at the expense of the contractor. If the contractor does not pay the expense of such removal within ten (10) days thereafter, the Owner may, upon ten (10) days written notice, sell such materials at auction or at a private sale and shall account for the net proceeds thereof, after deducting all costs and expenses that h should have been borne by the contractor.

C. No previous inspection or certificates of payment shall be held as an acceptance of defective work or materials, or to relieve the contractor from obligations to furnish sound materials in accordance with contract requirements.

3.10 GUARANTEE

A. All hardware components, parts, and assemblies, and system software components of the EMCS shall be guaranteed against defects in material and/or installation of a period of one year after final written acceptance by the Owner. Expressed warranties are conditionally based on the maintained in accordance with the manufacturer's recommendations. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Owner.

3.11 DELIVERY AND STORAGE

A. Deliver materials and equipment safely, properly store, adequately protect and carefully handle to prevent damage before and during installation.. Handle, store and protect equipment and materials in accordance with the manufacturer's recommendations and as approved by the Owner. Replace damaged or defective items at no cost to the Owner.

B. All delivery and storage of materials shall be coordinated beforehand with the Owner.

END OF SECTION

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LORD SHOPE LANDFILL
REMEDIAL DESIGN PLANS
CONTROLS AND MONITORING PROPOSAL
FOR ALL THE TREATMENT SYSTEMS

SECTION A

Attached is a summary of the NETWORK 8000 Integrated Building Automation System. Pages 1, 2, 3

SECTION B

Shope's Landfill site controls/monitoring vapor extraction system. Control and monitoring points as noted Pages 1, 2, 3

SECTION C

Ground water treatment system control and monitoring equipment (Lord-Shope Landfill Remedial Design) Pages 1, 2

SECTION D

Groundwater treatment system major electrical equipment Lord-Shope Landfill. Pages 1, 2

SECTION E

Visual print schematic of the control and monitoring system local and remote. Shope Landfill Remedial Design Print # LF92050C

NETWORK 8000
The Control System with Integrated Building Automation

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Executive Summary

NETWORK 8000 is the first advanced generation system to integrate the advantages of traditional building control systems with full Building Automation System (BAS) functions. NETWORK 8000 is based on distributed direct digital controllers with integral communication ability - providing for truly intelligent buildings. NETWORK 8000 integrates total building control capabilities with the building automation functions previously provided only by separate "Central Processing Unit (CPU) based" Building Automation Systems. It satisfies "integrated system" requirements and provides functionally-integrated Fire Alarm, Security and Access Control.

Centralized management and control of single buildings, single sites or multiple site facilities is made possible with NETWORK 8000 and its colorgraphic host computer, Host 8000. Real-time colorgraphic displays of facility areas or equipment systems combined with remarkable user friendliness make NETWORK 8000 an extremely usable facility tool.

Fundamentally, NETWORK 8000 is designed to provide a complete tool to manage any facility. NETWORK 8000 is unique in that each controller is designed to assist building operators and managers improve productivity.

Multitasking "Self-contained BAS" controllers provide the capability for control of all types of building mechanical systems and coordination of facility-wide control strategies. The distributed control system architecture also makes information accessible to local treatment facilities.

NETWORK 8000 controllers are directly compatible with the sensors and outputs required for the Lord-Shope treatment facility.

Information Management is a primary benefit provided by NETWORK 8000. NETWORK 8000 gives building maintenance personnel the information and control necessary to do their respective jobs. Custom reports and alarms can be created and segregated to manage information. Together with the Host 8000 host computer, NETWORK 8000 provides long-term archiving of facility and operational data.

This document describes the components, system architecture and capabilities of NETWORK 8000.

Integrated Systems Capabilities

NETWORK 8000 interfaces to Host 8000 personal computers and to separate security, access, fire safety and life safety control systems to provide functionally integrated facility systems. Host 8000 "central stations" deliver integrated systems capabilities appropriate to any type of facility.

Information Management

The diverse facility information available through NETWORK 8000 becomes more valuable when it is meaningfully presented and accessible where needed. NETWORK 8000 allows "distributing" information access throughout the facility to the local panel located at each treatment package. This information can be displayed constantly to allow servicemen to quickly diagnose, troubleshoot and remedy problems. And, in addition to standardized reporting, centralized information management is provided through powerful flexibility for data selection, for grouping of information and for reporting and archiving of selected system activity - with sophisticated but simple operator access to the above information.

Documentation

Documentation provided by NETWORK 8000 allows facility managers and owners to predict and prevent problems. Equipment performance reports or alarms may be used to prevent costly breakdowns of equipment.

Improved Accuracy, Sophistication and Optimization of Control Capabilities

NETWORK 8000 distributed controllers provide a coordinated facility-wide control system that allows

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maintenance personnel to modify hours of operation and control from one central location. The ability to optimize and adjust to facility and usage changes is simplified and less time-consuming.

Reliability Despite Power Failures

Computers depend upon continuous power to retain the volatile "program memory" which allows them to operate. Through the use of nonvolatile memory, NETWORK 8000 eliminates dependence on batteries to maintain application programs following power failures.

Host 8000

As a true facility management tool, NETWORK 8000 supports both traditional, centralized management of all system information and activity, as well as unique decentralized capabilities. As a result, NETWORK 8000 is a valuable tool facility-wide. Centralized management functions are provided by Host 8000, the NETWORK 8000 host computer.

Host 8000 is a powerful multitasking system which includes a variety of commercially available peripherals. These options and features allow Host 8000 to be configured to the appropriate needs of the facility. Host 8000 is a unique software package operating in the Compaq Deskpro 286 and 386 families of personal computers or select compatibles.

Multiple Host 8000's can integrate with one or multiple multitasking networks of NETWORK 8000 components to deliver the power and capacity to meet the requirements of any facility size.

NETWORK communication may utilize media appropriate to any facility type, including fiber optics, coaxial cable and twisted shielded cable.

Host 8000 Capabilities
Software Maintenance

The individual application programs and historical information in each NETWORK 8000 controller may be routinely archived by Host 8000. If a building maintenance person changes any application program such as a time clock in a NETWORK 8000 controller through its user-friendly keyboard display, the change is automatically reported to the host and filed for later review. This unique feature allows NETWORK 8000 users to know that controller application programs are kept current and correct.

Direct Dial NETWORKS

Regardless of the communications methods used to connect Host 8000 to NETWORK 8000 systems, the full range of Host 8000 capabilities is available. Host 8000 is equally as applicable to auto-dial/auto-answer communications as to hard-wired communication media. Auto-polling of remote NETWORK 8000 locations is fully supported, and manual monitoring is supported in both dynamic colorgraphic and text modes. Dialing operations are user-friendly and do not require the operator to remember a directory of telephone numbers.

Attended or Unattended Operation

Facilities have varying requirements for monitoring, as well as varying resources available to do the monitoring. NETWORK 8000 allows for attended operation to fit in smoothly with the experience and knowledge of existing personnel; all aspects of NETWORK 8000 are easily understood and operated. Unattended operation is readily obtained; define your needs for Information Management and NETWORK 8000 will then automatically operate the facility to meet them, provide multiple methods of gaining your attention in "emergencies" and provide the documentation determined to be of use.

Alarm Handling and Notification

Facility operational procedures determine which of multiple available methods is typically utilized.

- **Continuous Display** of current alarms status is made in every Host 8000 screen.

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- **Alarm Reporting Response** can be prioritized individually for every alarm. Critical alarms will interrupt any current operation with an individual graphic display, requiring the operator to respond immediately. For less drastic conditions, Host 8000 can signal the operator to respond without causing interruption. Automatic alarm acknowledgment and archiving to the Winchester hard disk can also be specified for any desired system activity as it is reported.

- **Exception Processing** provides extreme flexibility for information management. Behind the Alarm icon, the Exception status log provides a continuous log of alarms, program modifications, maintenance requests and other system functions. Each record in the log includes a complete description of the time and type of occurrence. These records allow the building operator to track the time/date that application programs were modified and the persons responsible, insuring that the facility continues to run on a "fine-tuned" basis. Standardized reports for custom-selected sets of data may be defined for output at specific times of the day. Reports may include the entire status log or user-defined sub-sets such as operator actions, program modifications, alarms and a variety of others.

Maintenance Time Reminder Reports

Host 8000 provides centralized tracking and documentation of required maintenance operations. The Maintenance Time Reminder (MTR) system manually or automatically generates work requests based on elapsed run time, number of cycles, calendar date or event. If work is not completed within a user-specified time, an overdue maintenance report is issued. Completed work may be entered by the user to provide an accurate record of work pending, overdue or completed. MTR messages generated within a NETWORK 8000 panel are also accessible via the optional local panel display.

NETWORK 8000 host trends provide global data gathering from one or more connected sub-systems. Host trend files may be printed as a formatted report, viewed via CRT display or plotted using the optional graphics display and plotter programs. Any gathered trend file may be used, either in real-time or as an archived data file which is saved for later analysis.

SECTION B

Note: Network 8000 Control System Interface
CP = Control Point
MP = Monitoring Point

SHOPE'S LANDFILL SITE
CONTROLS/MONITORING
VAPOR EXTRACTION SYSTEM

SENSOR/CONTROL LOCATION	TYPE	READOUT LOCATION	CONTROL/MONITOR (c) / (m)	RECORDING FREQUENCY	PURPOSE
Well Head	MP Temp. Vacuum Flow Globe Valve	Local / T. B. Local Local N/A	(m) Extracted Vapor (m) Applied Vacuum (m)Flow Rate (c)Flow Rate	As Needed As Needed As Needed N/A	Monitor Vapor Temp. To Balance System Mechanical,To Balance System Manual,To Balance System
Temp. Probe	MP Vacuum MP Temp.	Local Local / T. B.	(m) Applied Vacuum (c&m)Landfill Temp.	As Needed 4/Day	To Monitor System Performance Early Warning Of Potential LF. Fire & to Deactivate Blower & Therm. Ox.
Main Header Pipe: **Landfill Header**	MP Flow Globe Valve	Local / T. B. N/A	(m)Landfill Area Flow Rate (c)Landfill Area Flow Rate	1/Day N/A	To Monitor Landfill Area Flow Rate Manual,To Balance System
Crest Header	MP Flow Globe Valve	Local / T. B. N/A	(m)Crest Area Flow Rate (c)Crest Area Flow Rate	1/Day N/A	To Monitor Crest Area Flow Rate Manual, To Balance System
Toe Area Header	Vacuum Globe Valve	Local N/A	(m) Applied Vacuum (c)Flow Rate	As Needed N/A	To Balance Each Leg Of System Manual, To Balance System
Condensate Tank	MP Ball Valve CP Liquid Level	N/A N/A	(c)Tank By - Pass (c)Pump	N/A N/A	To By - Pass or Take Vacuum Off Tank To Control Liquid Level In Tank & Deactivate System

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SECTION B

Note: Network 8000 Control System Interface
CP = Control Point
MP = Monitoring Point

SHOPE'S LANDFILL SITE
CONTROLS/MONITORING
VAPOR EXTRACTION SYSTEM

Extraction Equipment (@ Blower)(1)					
	MP Flow	Local / T. B.	(m) Extracted Vapor Flow Rate	2/Day	Internal To Packaged System
	MP Flow	Local / T. B.	(m)Ambient Air Influent	As Needed	Internal To Packaged System
	MP Temp.	Local / T. B.	(m) Extracted Vapor Temp.	2/Day	Internal To Packaged System
	MP Vacuum	Local / T. B.	(m)ISVS Applied Vacuum	2/Day	Internal To Packaged System
	MP Opacity	Local / T. B.	(m) Extracted Vapor	4/Day	Internal To Packaged System
	MP CO2	Local / T. B.	(m) Extracted Vapor	4/Day	Internal To Packaged System
(@ Therm. Ox.)(1)					
	MP Flow	Local / T. B.	(m)Total Flow Rate	2/Day	Internal To Packaged System
	Air Valve	T. B.	(c) Ambient Air	As Needed	Internal To Packaged System
	MP Temp.	Local / T. B.	(c)Therm. Ox.	As Needed	Internal To Packaged System
	MP Oxygen	T. B.	(c)Therm. Ox.	As Needed	Internal To Packaged System

Note 1 - Vapor Extraction System controls may be provided integral to a packaged system.

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SECTION B

Note: Network 8000 Control System Interface
CP = Control Point
MP = Monitoring Point

SHOPE'S LANDFILL SITE
CONTROLS/MONITORING
EXTRACTION SYSTEM

SENSOR/CONTROL LOCATION	TYPE	READOUT LOCATION	CONTROL/MONITOR (c) / (m)	RECORDING FREQUENCY	PURPOSE
Recovery Well	CP Liquid Level	N/A	(c)Pump (high level on, low level off)	N/A	To Control Pump Cycle
	Air Relief Valve	N/A	(c)Traped Air	N/A	To Provide Protection To System
	MP Pressure	Local	(m)Pump Pressure	As Needed	To Monitor Recovery Well Pressure
	Flow / Totalizer	Local	(m)Flow Rate	As Needed	To Monitor Well Flow Rate & Quantity
	Globe Valve	N/A	(c)Flow Rate	N/A	Manual, To Throttle / Control Flow Rate
	Ball Valve	N/A	(c)Forcemain Drain	N/A	Manual (Normally Closed) - For Servicing
	Check Valve	N/A	(c)Forcemain Backflow	N/A	Automatic, To Control Flow Back To Well

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SECTION C

GROUNDWATER TREATMENT SYSTEM
CONTROL AND MONITORING EQUIPMENT
Lord-Shope Landfill Remedial Design

Sensor/Control Location		Type	Readout Location	Control/Monitor Function	Recording Frequency	Purpose
Equalization Tank:						
(T-1)	CP	Level (HH)[a]	Local[b]/T.B.[c]	(C) Well Header Pump(s)	As Needed	To control water level in the tank (pump off)
	MP	Alarm (HH)	Local/T.B.	(M) Water Level	As Needed	To alert operator to high water in the tank
	CP	Level (H)[d]	Local/T.B.	(C)[e] P-1 and P-2	As Needed	To control water level in the tank (pump on)
	CP	Level (L)[f]	Local/T.B.	(C) Operator Alarm System	As Needed	To control early warning to low water level
	MP	Alarm (L)	Local/T.B.	(M) Water Level	As Needed	To alert operator to low water level in the tank
	CP	Level (LL)[g]	Local/T.B.	(C) P-1 and P-2	As Needed	To control water level in the tank (pump off)
	MP	Alarm (LL)	Local/T.B.	(M) Water Level	As Needed	To alert operator to low water level in the tank
	MP	Flow	Local/T.B.	(M)[h] Flow Rate	Continuous	To balance and monitor the system
	MP	Monitor/Totalizer	Local/T.B.	(M) Flow Total	Continuous	To balance and monitor the system
	MP	Flow	Local/T.B.	(M)[h] Flow Rate	Continuous	To the feed rate through the sand filters
	CP	Monitor/Controller	Local/T.B.	(C) Flow Rate	Continuous	To control the feed rate through the sand filters
		Control Valve	N/A	(C) Flow Rate	N/A	To control the feed rate through the sand filters
Potassium Permanganate Tank:						
(T-2)	CP	Level(L)	Local/T.B.	(C) P-3 and P-4	As Needed	To control water level in the tank (pump off)
	MP	Alarm (L)	Local/T.B.	(M) Water Level	As Needed	To alert operator to low water level in the tank
	CP	Level (H)	Local/T.B,	(C) Alarm	As Needed	
	MP	Alarm (H)	Local/T.B.	(M) Water Level	As Needed	To alert operator to high water level in the tank
		Gate Valve	N/A	(C) Flow Rate	N/A	Manual, To balance and add water to the system
Effluent Holding Tank:						
(T-3)	CP	Level (HH)	Local/T.B.	(C) P-5 and P-6	As Needed	To control water level in the tank (pump off)
	MP	Alarm (HH)	Local/T.B.	(M) Water Level	As Needed	To alert operator to high water level in the tank
	CP	Level (H)	Local/T.B.	(C) P-7 and P-8	As Needed	To control water level in the tank (pump on)
	CP	Level (L)	Local/T.B.	(C) P-7 and P-8	As Needed	To control water level in the tank (pump off)
	CP	Level (LL)	Local/T.B.	(C) P-9 and P-10	As Needed	To control water level in the tank (pump off)
	MP	Alarm (LL)	Local/T.B.	(M) Water Level	As Needed	To alert operator to low water level in the tank
	MP	pH Analyzer	Local/T.B.	(M) pH	Continuous	To analyze and record discharge pH
	MP	Flow	Local/T.B.	(M) Flow Rate	Continuous	To control auto sampler
	MP	Monitor/Totalizer	Local/T.B.	(M) Flow Total	Continuous	To balance and monitor the system
		Globe Valve	N/A	(C) Flow Rate	N/A	Manual, To balance the system
Sludge Holding Tank:						
(T-4)	CP	Level (HH)	Local/T.B.	(C) P-9 and P-10	As Needed	To control water level in the tank (pump off)
	MP	Alarm (HH)	Local/T.B.	(M) Water Level	As Needed	To alert operator to high water level in the tank
	CP	Sludge Level	Local/T.B.	(M) Sludge/Water Interface	As Needed	To monitor depth of sludge
	CP	Sludge Level Alarm	Local/T.B.	(M) Sludge Level	As Needed	To alert operator to high sludge level in the tank
	CP	Timer	Local/T.B.	(C) Decant Rate	As Needed	To open and close decant valve
	CP	Decant Valve	Local/T.B.	(C) Decant Rate	As Needed	To control flow for decanting

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SECTION C

GROUNDWATER TREATMENT SYSTEM
CONTROL AND MONITORING EQUIPMENT
Lord-Shope Landfill Remedial Design
(Continued)

Sensor/Control Location		Type	Readout Location	Control/Monitor Function	Recording Frequency	Purpose
Filtrate Tank:						
(T-5)	CP	Level (HH)	Local/T.B.	(C) Decant Valves	As Needed	To control decant level in the tank (close decant valve)
	MP	Alarm (HH)	Local/T.B.	(M) Water Level	As Needed	To alert operator to high water level in the tank
	CP	Level (H)	Local/T.B.	(C) P-12 and P-13	As Needed	To control water level in the tank (pump on)
	CP	Level (L)	Local/T.B.	(C) P-12 and P-13	As Needed	To control water level in the tank (pump off)
		Gate Valve	N/A	(C) Flow Rate	N/A	Manual, To balance the system
Sand Filters:						
(F-1 & F-2)	MP	Pressure	Local/T.B.	(M) Influent/Effluent Presure	As Needed	
	MP	Pressure Control	Local/T.B.	(C) Differential Pressure and P-9 and P-10	As Needed	Control backwash operating mode (pump on)
	CP	Electric Valve(s)	Local/T.B.	(C) Backwash direction	N/A	To control filter in backwash/filter in rinse
		Gate Valve(s)	N/A	(C) Flow Rate	N/A	Manual, To balance the system
Air Stripper:						
(AS-1)	CP	Level (H)	Local/T.B.	(C) P-1 and P-2	As Needed	Control water level in air stripper sump (pump off)
	MP	Alarm (H)	Local/T.B.	(M) Water Level	Continuous	To Alert operator of high water level in stripper
	CP	Level (H)	Local/T.B.	(C) P-1 and P-2 (Redundant)	As Needed	Redundant high water control
	MP	Alarm (H)	Local/T.B.	(M) Water Level (Redundant)	Continuous	Redundant high water control
	CP	Level (L)	Local/T.B.	(C) P-5 and P-6	As Needed	Control water level in the air stripper (pump off)
		Globe Valve	N/A	(C) Flow Rate	N/A	Manual, To balance the system
Blowers	MP	Pressure	Local/T.B.	(M) Flow Rate	Manual/As Needed	To monitor flow rate for air/water ratio
(B-1 & B-2)	CP/MP	Motor Frequency	Local	(C) Flow Rate	Manual/As Needed	Control flow rate (air/water ratio) in air stripper
	MP	Current	Local/T.B.	(M) Current	Manual/As needed	Indicate power current being used by the blower
	CP	On/Off Switch	Local/T.B.	(C) Operation	N/A	To control blower operation

SECTION C

GROUNDWATER TREATMENT SYSTEM
CONTROL AND MONITORING EQUIPMENT
Lord-Shope Landfill Remedial Design
(Continued)

Sensor/Control Location		Type	Readout Location	Control/Monitor Function	Recording Frequency	Purpose
Pumps:						
P-1 through P-10, P-12, and P-13						
	MP	Pressure	Local/T.B.	(M) Discharge Pressure	As Needed	
	CP	On/Off Switch	Local/T.B.	(C) Operation	N/A	Automatic with manual override
		Gate Valve(s)	N/A	(C) Flow Rate	N/A	Manual, To balance the system
		Check Valve(s)	N/A	(C) Back flow	N/A	Prevent back flow to pump
		Globe Valve	N/A	(C) Flow Rate	N/A	Control discharge rate for P-7/P-8
		Mechanical Valve	N/A	(C) Flow Rate	N/A	Control backwash feed rate for P-9/P-10
P-11	CP/MP	Pressure	Local/T.B.	(C) Discharge Pressure	As needed	Control and stablize line pressure into filter press
		Gate Valve(s)	N/A	(C) Flow Rate	N/A	Manual, To balance the system
		Check Valve	N/A	(C) Back flow	N/A	Prevent back pressure damage to pump
	CP	On/Off Switch	Local	(C) P-11	Manual	To control pump operation
Mixers:						
M-1	CP/MP	On/Off Switch	Local/T.B.	(C) Operation	N/A	To control mixer operation
M-2	CP/MP	On/Off Switch	Local	(C) Operation	Manual	To control mixer operation

[a](HH) Indicates high high water level
[b]Local-Readout is at a specific location within the system or in a panel in the building.
[c]T.B.-Treatment Building Data Management System (DMS) computer
[d](H) Indicates high water level
[e](C) Control
[f](L) Indicates low water level
[g](LL) Indicates low low water level
[h](M) Monitor

Note: 1. See Piping and Instrumentation Diagram
2. Network 8000 Control System Interface
CP = Control Point
MP = Monitoring Point

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SECTION D

GROUNDWATER TREATMENT SYSTEM
MAJOR ELECTRIC EQUIPMENT
LORD SHOPE LANDFILL

Equipment	Function	Remarks
P-1, P-2	Pump water from EQ tank to filter and air stripper - one pump on, another on standby. Centrifugal	3 hp, 1,800 rpm 3 Ø/per pump Worthington Series 814
P-3, P-4	Pump permanganate solution from permanganate tank to EQ tank. Positive displacement metering pump, one operating, one on standby.	Power input; 115 VAC/50-60 Hz/1 Ø or 230 VAC/50-60 Hz/1 Ø Peak input power - 300 watts
M-1	EQ tank mixer, continuous operation	Brawn Mixer 1 hp 3 Ø option
M-2	Permanganate tank mixer, continuous operation	Brawn Mixer 1/3 hp, 115 v TEFC 3 Ø option
P-5, P-6	Pump water from air stripper sump to effluent holding tank. One operating, one on standby.	1 hp TEFC, 1,800 rpm 3/60/230 V/per pump Worthington Series 814
P-7, P-8	Pump water from effluent tank to the discharge point, centrifugal cycle pump	3 hp TEFC, 1,800 rpm 3/60/230 V/per pump Worthington Series 814
P-9, P-10	Backwash pumps that operate only during backwash for 10 minutes per cycle. Centrifugal.	20 hp, 3 Ø motor on each pump 3,600 rpm Worthington Series 814

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SECTION D

GROUNDWATER TREATMENT SYSTEM
MAJOR ELECTRIC EQUIPMENT
LORD SHOPE LANDFILL
(Continued)

Equipment	Function	Remarks
P-11	Air Diaphragm pump with dedicated air compressor	10 hr air compressor
P-12, P-13	Centrifugal cycle pumps used to pump water from the filtrate tank back to the EQ tank.	1 hp, 3 Ø motor on each pump 1,800 rpm Worthington Series 814
B-1, B-2	Blowers for air stripper, continuous operation of one blower, the other a spare.	V-belt centrifugal - type fan powered by 3/60/230 V, 2 hp, TEFC motor with variable frequency controller

Notes

1. The filters will be controlled with electrically actuated values (1.5 in., 2 in. and 3 in.) for automatic control of the filtering and backwashing sequence. Filter backwash will be automatically initiated by pressure differential. The system will come as a package and all operating controls and motor starters will be prewired and completely assembled in a NEMA 12 enclosure. Power to the panel will be required.

2. The air stripper and blower will also come as a package and power to the panel will be required.

3. The filter press and sludge pump will also come as a package and will include the pressure controls and air compressor required on the pump. Power to a panel will be required.

4. The contingent system will include small metering pumps (like P3, P4) and one additional centrifugal pump (approximately 1 hp).

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DIVISION 16

ELECTRICAL

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SECTION 16400
ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

A. Provide complete electrical power, lighting, monitoring, control, and telephone systems where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:

1. Main switchboard, metering facilities, main switch, and distribution board or boards as needed;
2. Feeder system, in conduit to branch circuits panels;
3. Branch circuit panels for power and lighting;
4. Branch circuit wiring, in conduit, for lighting, receptacles, junction boxes, and motors;
5. Telephone conduit and terminal boards;
6. Hangers, anchors, sleeves, chases, supports for fixtures, and other electrical materials and equipment in association with;
7. Lighting fixtures and lamps;
8. Wiring system, in conduit, for equipment and controls provided under other Sections of these Specifications including, but not necessarily limited to, Plumbing and Fire Protection Sprinkler Sections;
9. Motor starters and controls for motors provided under the Contract, but for which motor starters and controls are not otherwise provided;
10. Freeze protection system consisting of electric heat tape and monitoring crircuits, to protect all designated outdoor piping systems from freezing.
11. Interlock circuits, to stop and properly protect each piece of equipment.
12. Master interlock circuit, to shut off all motors and close all automatic valves in a predetermined sequence. This system to be triggered by floor sump third float switch and/or sump pump operating timer.
13. Labeling of all instruments and control devices per ISA standards.
14. Other items and services required to complete the systems.

B. Provide also:

1. Detail design of all electrical systems and subsystems listed above, including but not limited to engineering and design, schematic and detail drawings, calculations, and additional specifications;
2. Professional certifications and/or stamps as required by governmental agencies having jurisdiction;
3. All required permits, inspections, and reports.

C. All work to be performed in accordance with NEC and local electrical codes.

D. Use products recognized as energy efficient wherever possible.

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E. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these Specifications.

1.2 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 60 calendar days after the Contractor has received Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
   3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

C. Samples:
   1. When so requested by the Architect, promptly provide Samples of items scheduled to be exposed in the final structure.
   2. When specifically so requested by the Contractor and approved by the Architect, approved Samples will be returned to the Contractor for installation on the Work.

D. Manual: Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Architect two copies of an operation and maintenance manual compiled in accordance with the provisions of Section 01730 of these Specifications. Include within each manual:
   1. Copy of the approved Record Documents for this portion of the Work;
   2. Copies of all circuit directories;
   3. Copies of all warranties and guarantees.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Section 01620.

1.5 WARRANTY

A. In addition to standard one year warranty on all labor and materials, provide a two year warranty on ballasts for all fluorescent lighting fixtures.

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PART 2 PRODUCTS

2.1 GENERAL

A. Provide only materials that are new, of the type and quantity specified. Where Underwriter's Laboratories, Inc. have established standards for such materials, provide only materials bearing the U.L. label.

B. Temporary power:

1. In addition to providing temporary power as described in Section 01500 of these Specifications, provide and pay the costs for installing permanent electrical meter or meters as required.
2. When permanent metering is in place and connected, Owner will pay the costs for electrical power charged against the meter or meters.

2.2 ENTRANCES AND SWITCHBOARD

A. Main switchboard:

1. Provide factory assembled, dead front, braced as shown on the Drawings, with equipment bussing connection, current-limiting fuses, circuit breakers, and similar components as shown on the Drawings or required for proper completion.
2. At fused switches, provide etched plastic nameplates secured by two cadmium plated screws.

B. Distribution switchboard:

1. Provide factory assembled, dead front, braced as shown on the Drawings, with equipment bussing connection, current-limiting fuses, circuit breakers, and similar components as shown on the Drawings or required for proper completion.
2. At fused switches, provide etched plastic nameplates secured by two cadmium plated screws.
3. Provide same construction and manufacture as the main switchboard, but equip with eye bolts to facilitate hoisting and placement of sections.

C. Switches:

1. Provide quick-make, quick-break, fused type, rated 240V A.C. for 120/208 V systems, and rated 600 V for 277/480 V systems.
2. Provide one of the following:
   a. General Electric: "QMR" up to 1200 amps.
   b. Westinghouse: "FDP" up to 1200 amps.
   c. ITE: "Vacu-break" up to 1200 amps.
   d. Square D "QMB" up to 600 amps;
      "AV" for 800-1200 amps.
3. For switches rated 1600 amps and higher, provide bolted pressure type such as Pringle "QA".

D. Provide current-limiting fuses:

1. For above 600 amps, provide Class L "Hi-Cap" manufactured by Bussman, or equal manufactured by Chase-Shawmut.

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2. For below 600 amps, as shown for short circuit duty, provide Class K-1 "Limitron", or Class K-5 "Low Peak", or Class K-9 "Fusetron" manufactured by Bussman, or equal manufactured by Chase-Shawmut.

E. At all sections, provide a micarta nameplate with white lettering on a red background, reading WARNING, REPLACE ONLY WITH CURRENT-LIMITING FUSES AS ORIGINALLY INSTALLED.

F. Provide 100% spare fuses for each feeder, housed in a suitable cabinet near the main distribution board.

G. Provide copper busing full height.

H. Motor control center:
1. Equip with means for locking each circuit separately.
2. Provide completely Class A, factory wired, including breakers, contactors, starters, relays, transformers, and other required items, totally enclosed, free-standing type, with structures joined to form one assembly but with structure designed so that units may be readily removed and other structures added as required in the future.
3. Provide lifting angles or eye-bolts to facilitate hoisting and placing.
4. Provide each structure with two horizontal wiring spaces, one at the top and one at the bottom, which will line up with adjacent units to form convenient wiring raceways the entire length of the control center.
5. Provide permanent identification of each item of equipment by means of plastic laminate nameplates, black face with white core letters, showing service and location of each motor.
6. Individually tag all conduits and conductors.
7. Provide copper busing.

2.3 GROUNDING SYSTEM

A. Ground all equipment, including switchboards, transformers, conduit systems, motors, and other apparatus, by conduit or conductor to cold water main or to independent grounding electrode as shown on the Drawings, using ground clamps manufactured by Burndy or T&B, and approved by the Architect.

B. Use ground rods if water mains or piping are not metallic, or if isolation couplings have been used.
1. Locate ground rods in planters or similar areas which will receive water regularly, and drive to a depth of at least 8'-0".
2. Make meg ground tests to measure ground resistance, and provide not more than 5 ohms resistance, adding ground rods as required to achieve that level.
3. Make ground rods accessible for inspection.
4. Provide "Ufer" ground if so required by governmental agencies having jurisdiction.

2.4 DISTRIBUTION SYSTEM

A. Identification:

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1. Identify all panelboards, cabinets, safety switches, and other apparatus used for operation and control of circuits, appliances and equipment.
2. Provide plastic laminate nameplates, black face with white core letters, showing proper and complete identification.

B. Branch circuit panels:
1. Provide branch circuit panels for lighting and single-phase loads, using copper busing with "Quicklag" circuit breakers and main lugs only.
2. Provide one of the following:
   a. General Electric: "NLABB"
   b. Westinghouse: "NQB"
   c. ITE: "NLAB" with box-type breaker
   d. Square D" "NQQB"
3. Motor control center for air conditioning equipment:
   a. Study Drawings and Specifications for air conditioning system, and coordinate as necessary to determine motor control center requirements;
   b. Provide floor-standing, dead rear and front ventilation, with louvers at top and bottom of each section, Class B-1 wired, complete with starters, relays, breakers, time switches, and other items as needed for a complete and proper installation.
4. Provide units of same manufacture as the main switchboard.

C. Wiring devices:
1. Provide duplex receptacles of 3-pole grounding type with the third pole U-shaped and grounded to the conduit system, and one of the following:
   a. Bryant, Hubbell, Arrow-Hart: No. 5242
   b. General Electric: No. 4050 or 4060
   c. Sierra No. 1402
   d. Hubbell (208 V-lb-ac-20 a) No. 7310 BU
   e. Hubbell (240 V-3a-20 a, gw) No. 7410 BU
2. For flush-mounted receptacles, provide super stainless steel type 302 cover plates.
3. For flush-mounted switches, provide super stainless steel 3200 series cover plates and, where grouped, set in gangs with one cover plate.
4. Provide tumbler switches of commercial-industrial type, 20 amp, 120/277 V A.C., and one of the following:

	Single Pole:	Two Pole:	Three Way:	Four Way:
Bryant:	4,901	4,902	4,903	4,904
Hubbell:	1,221	1,222	1,223	1,224
Arrow-Hart:	199	1,992	1,993	1,994
Sierra:	5,021	5,022	5,023	5,024
General Electric:	5,951	5,952	5,953	5,954
P&S:	20AC1	20AC2	20AC3	20AC4

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D. Abovefloor raceways:
   1. Provide rigid galvanized or sherardized steel conduit, or electrical metallic tubing, with compression or tap-on style fittings, for all conduit concealed in the walls, above the ceilings, or exposed in work areas.
      a. Indenter fittings are not acceptable.
      b. Where conduit is installed underground or in the floor slab, provide rigid galvanized steel conduit.
   2. Where electrical metallic tubing is used, comply with pertinent requirements of the National Electrical Code.
   3. PVC conduit may not be used without the specific written approval of the Architect.
   4. Provide flush floor boxes, cast iron, watertight, equal to Russell & Stoll No. 2511, with combination 1/2" and 1-1/8" plug.
   5. For floor boxes with convenience outlets, provide Lew No. 632SB-DFB, unless otherwise shown on the Drawings.
   6. Outlets, junction boxes, and switch boxes:
      a. Provide standard one-piece units, galvanized or sherardized, of shape and size best suited to that particular location, of sufficient size to contain enclosed wires without crowding.
      b. Provide deep boxes with 1" and larger conduit.
      c. For lighting outlets, provide standard 4" octagon or square units, with 3/8" malleable iron fixture studs and box hangers where required.
      d. For switches and receptacles, provide standard gang switch boxes with stainless steel covers; except for exposed work provide pressed steel boxes with galvanized or cadmium plated steel covers.
         (1) Provide boxes 4" square by 1-1/2" deep, except for boxes at ends of run where containing a single device.
         (2) These may be No. 180 handy boxes if permitted by the governing code.
      e. For telephone outlets, provide 4" square boxes with single device cover and one-hole bakelite telephone outlet.
   7. For pull boxes, provide galvanized code-gauge sheet steel units with screwed-on covers, of size and shape required to accommodate wires without crowding, and to suit the location.
   8. Provide sleeves and chases where conduits pass through floors and walls.

E. Conductors:
   1. For line voltages, provide 600 V insulated copper wire and cable, NEC standard, of types specified below for difference applications, with UL label, and color coded as required by governmental agencies having jurisdiction.
   2. With conductors No. 4 and larger, provide insulating bushings or insulating sleeves.
   3. For wire and cable all sizes, provide THHN, copper, stranded type.
      a. Identify feeder neutrals with white tape or white paint.

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4. Where branch circuit wiring is installed in wiring channels of continuous row-mounted fixtures, provide UL type THHN or other approved 90° "C" wires, rated at 600 V.

2.5 LIGHTING FIXTURES

A. Provide fixtures of the types shown on the Drawings, and with the following accessories as applicable.
   1. Recessed fixtures:
      a. Provide units having an attached pull box, and with UL label.
      b. Provide local label in addition if so required by governmental agencies having jurisdiction.
   2. Fluorescent fixtures:
      a. Provide electronic ballasts thermally protected against overheating by built-in thermal protectors sensitive to ballast winding temperature and current.
      b. Provide protector preventing winding temperature from exceeding 120° C, allowing winding temperatures to reach 105° C under normal operating conditions at 40° C ambient and, after opening, not reclosing above 80° C.
      c. Provide ballasts compatible with T8 lamps.
      d. Provide three (3) level lighting complying with IES standards.

B. Where fixtures substitutes are proposed, submit a Sample fixture with the materials list required to be submitted under Article 1.2 above.

2.6 TELEPHONE AND INTERCOM

A. provide conduits, service entrance equipment, outlets, terminal boards, and other items shown on the Drawings or required for a complete, approved, and operating telephone and intercom service, except for such items and equipment as are furnished by the serving telephone company.

B. Provide access pull boxes so that no conduit run is longer than 100 feet, or contains more than two 90° elbows.

C. Provide pull wires in all telephone and intercom units.

D. Provide the intercom system shown on the Drawings.

2.7 MOTOR STARTERS

A. General: Provide Square D units, or equal as approved in advance by the Architect, of the sizes and types needed for the operations shown on the Drawings, specified herein, and otherwise required for the facility, and with the following attributes:
   1. Comply with pertinent requirements of NEMA and NEC.
   2. Include required accessory items.
   3. Horsepower rated, with interchangeable thermal overloads and with double-break contacts capable of interrupting 10 times the rated motor current.
   4. Normally reset without entering the starter enclosure.
   5. Equipped with overloads in each ungrounded leg.

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B. Manual starters:
   1. For both single-phase and three-phase starters, provide units that open all ungrounded conductors simultaneously.
   2. For single-phase starters, provide units of tumbler switch type that clearly indicate ON, OFF, and TRIPPED positions.
   3. For three-phase starters, provide push-button operated units with START, STOP-RESET button on the enclosure cover.

C. Magnetic starters:
   1. Provide units with operating coils designed to operate on line voltage or any other auxiliary voltage shown on the Drawings.
   2. For starters with line voltage operating coils, provide built-in under-voltage release.
   3. Provide units with the accessories and auxiliary contacts needed for automatic or remote operation as shown on the Drawings.

D. Combination starters:
   1. Provide units complying with requirements for magnetic starters and, in addition, with a circuit breaker in the same enclosure.
   2. Provide circuit protection complying with NEC requirement for the motor being operated.

2.8 SAFETY SWITCHES

A. Provide safety switches of heavy-duty type, horsepower rated, quick-make and quick-break design, externally operated with provision for padlocking, fusible or non-fusible as shown on the Drawings.

B. Provide enclosures clearly marked for maximum voltage, current, and horsepower rating, and:
   1. Indoor: NEMA type 1.
   2. Outdoor: NEMA type 3R, raintight.

C. For switches having dual ratings (higher rating when used with dual-element fuses), provide ratings indicated on a metal plate riveted or otherwise permanently fastened to the enclosure.

2.9 TRANSFORMERS

A. Provide Westinghouse Type DS-3 and ST-3, or equal transformers manufactured by General Electric or Jeffries, with the following attributes:
   1. Dry type, with the ratings shown on the Drawings.
   2. For lighting transformers, provide four 2-1/2% FCBN taps.
   3. For power transformers, provide two 5% FCBN taps.
   4. Adjust all taps to nominal 120 V, 240 V, or 480 V as close as practicable and as required for the Work.
   5. Do not provide taps on isolating transformers.

B. Provide Group II insulation with temperature rise not exceeding 80° C, or Group II with rise not exceeding 150° C, under full load, in an ambient temperature of 40° C.

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C. Build transformers in accordance with current standards of AIEE, ASA, and NEMA, and provide UL listing and label.

D. For units of 5 kV class, provide a BIL of 25 kV on the primary and 10 kV on the secondary.

E. For units of 600 V and less, provide BIL of 10 kV.

F. Locate terminal compartment in the bottom of the transformer to assure termination of cable leads in ambient temperature levels and to provide for side or bottom entrance of the cables.

G. Separate transformer core and coils from case by suitable vibration isolators. Install the transformer case on suitable vibration isolators, and connect on primary and secondary sides with minimum of 18" of flexible conduit.

H. Provide a minimum of 10% overload capacity at rated voltage.

I. Provide the following tests at the factory:

1. Applied voltage test to other winding and ground:

600 V class:	5 kV class:
H.V. - 4 kV	12 kV
L.V. - 4 kV	4 kV

2. Induced voltage test: Two times normal voltage.
3. Ratio, polarity, and sound level tests.
4. Perform sound level tests in test room, with an ambient sound level not exceeding 23 db's, and achieve sound level not exceeding:
   a. 0 to 150 kVa: 45 db's.
   b. 167 to 300 kVa: 50 db's.
   c. 500 kVa and more: 53 db's.
5. Prior to proposing any new design, secure the Architect's approval of a certified rating test report of similar standard ratings, with proper explanatory drawings, showing the above tests have been performed with satisfactory results on the first rating of the new design, including ratio, resistance, copper loss, iron loss, sound level, applied voltage, induced voltage, temperature rise, impulse test, and short circuit tests.
6. When so required by the Architect, provide performance data stating whether figures shown are average, typical, or guaranteed, and corrected to the corresponding NEMA reference temperatures.

2.10 SUMP PUMPS

A. Provide, where shown on the drawings, quantity 2, all 316 stainless steel vertical sump pumps, with float switches, 1/2 h.p. 460 volt 3 phase motors, 1,920 g.p.h. at a 25 ft. head, 1-1/4" discharge outlet, minimum height 30".

B. Also provide a third float switch for third level monitoring.

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2.11 THERMAL PROTECTION OF PIPING

A. Provide heat tapes and controls for all outside piping requiring protection from freezing.
   1. Provide Chromalox Heating Cable, type SRL-C, 4 watts/foot, 208 volts 1 phase or 240 volts 1 phase, or approved equal.
   2. Insulate as specified for outdoor piping.
   3. Install monitoring sensors in case of tape failure.

2.12 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the Architect.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Coordinate:
   1. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interference with the work of this Section.
   2. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total Work.
   3. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide required supports and wiring to clear the encroachment.

B. Data indicated on the Drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels, and other conditions will be governed by actual construction and the Drawings and Specifications should be used only for guidance in such regard.

C. Where outlets are not specifically located on the Drawings, locate as determined in the field by the Architect. Where outlets are installed without such specific direction, relocate as directed by the Architect at no additional cost to the Owner.

D. Verify all measurements at the building. No extra compensation will be allowed because of difference between work shown on the Drawings and actual measurements at the site of construction.

E. Branch circuit wiring and arrangement of home runs have been designed for maximum economy consistent with adequate sizing for voltage drops and other considerations. Install the wiring with circuits arranged exactly as shown on the Drawings, except as otherwise approved in advance by the Architect.

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F. The Electrical Drawings are diagrammatic, but are required to be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual construction and the work of other trades, make such deviations without additional cost to the Owner.

3.3 TRENCHING AND BACKFILLING

A. Perform trenching and backfilling associated with the work of this Section in strict accordance with the provisions of Section 02220 of these Specifications.

3.4 INSTALLATION OF RACEWAYS AND FITTINGS

A. Where conduit is installed concealed in walls or above the ceiling, or exposed in work areas, provide rigid galvanized conduit or electrical metallic tubing with compression type fittings.
   1. Paint or wrap elbows.
   2. Seal joints to prevent entrance of water.
   3. Provide ground wire of proper size.
   4. Use nylon (rather than steel) fish tape.

B. Use flexible conduit only for short motor connections, or where subject to vibration.

C. Provide necessary sleeves and chases where conduits pass through floors and walls, and provide other necessary openings and spaces, arranging for in proper time to prevent unnecessary cutting in connection with the Work. Perform cutting and patching in accordance with provisions for the original Work.

D. Where conduit is exposed, run parallel to or at right angles with lines of the building.
   1. Make bends with standard conduit elbows or conduit bent to not less than the same radius.
   2. Make bends free from dents and flattening.

E. Securely and rigidly support conduits throughout the Work.

F. Where conduits pierce the roof, provide 24 gauge galvanized iron roof jacks and flashing collar brazed onto the conduits and covering the top of the roof jacks.

3.5 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures complete and ready for service in accordance with the Lighting Fixture Schedule shown on the Drawings.

B. Wire fixtures with fixture wiring of at least 50° C rating. Where fixtures are mounted in continuous rows, provide conductors in wiring channels of the same size as the circuit wires supplying the row of fixtures.

C. Use only bonderized, galvanized, or sherardized steel for fixture installation for protection against rust and corrosion, and install fluorescent fixtures straight and true with reference to walls.

D. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported, either directly or indirectly, by a sound and safe

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structural member of the building, using adequate number and type of fastenings to assure safe installation.

1. Screwed fastenings, and toggle bolts through ceiling material or wall paneling, are not acceptable.
2. Do not support from sub-purlins of panelized roof systems.

3.6 INSTALLATION OF POWER EQUIPMENT

A. Provide power and control wiring for motor starters and safety switches as shown on the Drawings.

B. Connections to miscellaneous building equipment:
   1. Wire to, and connect to, all items of building equipment not specifically described but to which electrical power is required.
   2. Coordinate as necessary with other trades and suppliers to verify types, numbers, and locations of equipment.

3.7 INSTALLATION OF CONDUCTORS

A. Unless otherwise shown on the Drawings, use No. 12 type THHN conductors for all branch circuits, protected by 20 amp circuit breakers. Where so indicated on the Drawings, use larger wires to limit voltage drops.

B. The number of wires in a conduit run is indicated on the Drawings by cross lines on the conduit runs.
   1. Where wire size is not shown, install No. 12 conductors.
   2. Where conduit size is not shown, install 1/2" conduit.
   3. Provide code-sized conduit for number and size wires shown or required, unless a larger size conduit is shown on the Drawings.

C. Use identified (white) neutrals and color-coded phase wires for all branch circuit wiring.
   1. Make splices electrically and mechanically secure with pressure-type connectors, or by soldering.
      a. For wires size 6 AWG and smaller, provide "Scothlock" connectors.
      b. For wire size 4 AWG and larger, provide Burndy "Versitaps" and heavy-duty connectors, or T&B "Locktite" connectors.
   2. Insulate splices with a minimum of 2 half-lapped layers of Scotch Brand No. 33 vinyl-plastic electrical tape where insulation is required.

D. Tape all joints with rubber tape 1-1/2 times the thickness of the conductor insulation, then cover with the friction tape or the vinyl-plastic tape specified above.

E. The Drawings indicate the general direction of home runs. Continue all such home runs to the panel as though the routes were shown completely.

3.8 INSTALLATION OF PANELS

A. Unless otherwise shown on the Drawings, install panels with the top of the trim 6'-3" above the finished floor.

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B. Mount a typewritten directory behind glass or plastic on the inside of each panel door and, on the directory, show the circuit number and complete description of all outlets on each circuit.

C. Provide three 1" conduits only, stubbed out the top of each flush-mounted panel and terminated in an accessible ceiling space, with each conduit tagged with panel description.

3.9 TESTING AND INSPECTION

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. Make written notice to the Architect adequately in advance of each of the following stages of construction:
   1. In the underground condition prior to placing concrete floor slab, when all associated electrical work is in place;
   2. When all rough-in is complete, but not covered;
   3. At completion of the Work of this Section.

C. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

D. In the Architect's presence:
   1. Test all parts of the electrical system and prove that all such items provided under this Section function electrically in the required manner.
   2. Immediately submit to the Architect a report of maximum and minimum voltages, and a copy of the recording voltmeter chart.
   3. Also measure voltages between phases and between phase wires and neutrals, and report these voltages to the Architect.

3.10 PROJECT COMPLETION

A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

B. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the operations and maintenance manual required to be submitted under Article 1.2 of this Section of these Specifications.

C. On the first day the facility is in operation, for at least 8 hours at a time designated by the Architect, provide a qualified foreman and crew to perform such electrical work as may be required by the Architect.

D. Provide approved electrical inspection documents.

END OF SECTION