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CONTRACT DOCUMENTS

Well 4 Water Treatment Facility Improvement No. 89-07

Prepared for
City of St. Louis Park, Minnesota

March 1991

00002

Engineering Company

CONTRACT DOCUMENTS

Well 4 Water Treatment Facility Improvement No. 89-07

Prepared for
City of St. Louis Park, Minnesota

March 1991

Barr
Engineering Company
7803 Glenroy Road
Minneapolis, MN 55439
Phone: (612) 830-0555
Fax: (612) 835-0186

CERTIFICATIONS

CITY OF ST. LOUIS PARK IMPROVEMENT NUMBER 89-07

WELL 4 WATER TREATMENT FACILITY

I hereby certify that Divisions 1, 2, 9, and 11 of these Specifications (or portions thereof) were prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Date March 6, 1991

Gregory D. Keil

Gregory D. Keil Reg. No. 18245

I hereby certify that Divisions 3, 4, and 5 of these Specifications were prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Date MARCH 6, 1991

Paul K. Nielsen

Paul K. Nielsen Reg. No. 19006

I hereby certify that Divisions 2, 6, 7, 8, and 10 of these Specifications (or portions thereof) were prepared by me or under by direct supervision and that I am a duly Registered Professional Architect under the laws of the State of Minnesota.

Date MARCH 6, 1991

William H. Hennemuth

William H. Hennemuth Reg. No. 9910

2327455/SLPTOC.CON/PLS

I hereby certify that Division 15 of these Specifications was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Date MARCH 6, 1991

Thomas A. Wentz Reg. No. 18609

I hereby certify that Division 16 of these Specifications were prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Date March 6, 1991

Sheldon J. Sorensen Reg. No. 18925

DIVISIONS 12, 13, AND 14 -- NOT USED.

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Advertisement For Bids

CITY OF ST. LOUIS PARK
ADVERTISEMENT FOR BIDS

FOR

WELL 4 WATER TREATMENT FACILITY
IMPROVEMENT NO. 89-07

NOTICE IS HEREBY GIVEN that the City Council of the City of St. Louis Park, Minnesota, will receive sealed Bids for Improvement 89-07 in the office of Public Works until 11:00 a.m. (CST), Friday, April 5, 1991. Bids received after that time will not be accepted. Bids will be publicly opened and read aloud in the Council Chambers in the City Hall immediately following the specified closing time.

The project consists of construction of a water treatment facility for City Well No. 4 and includes:

demolition of an existing wellhouse; construction of an approximately 5,700-square foot concrete and masonry structure; package pressure iron/manganese removal system for treatment of 1,200 gpm design flow; four 10-foot diameter ASME pressure vessels; approximately 80,000 pounds of granular activated carbon; approximately 1,000 feet of ductile iron process piping; deep well pump and motor; building mechanical systems including dehumidification and chlorine scrubber; controls and building electrical; buried site utilities; concrete curb and gutter; bituminous and concrete paving; and landscaping.

All Bids shall be on the Bid Form supplied with, and in accordance with the requirements of, the Contract Documents describing the Work. Copies of the Contract Documents may be examined at the offices of the Owner and the Engineer at the following locations:

OWNER:

City of St. Louis Park
Office of the Director of Public Works
City Hall
5005 Minnetonka Boulevard
St. Louis Park, MN 55416-2290

ENGINEER:

Barr Engineering Company
7803 Glenroy Road
Minneapolis, MN 55439-3123

Copies of the Contract Documents may be obtained at the office of the Engineer on or after March 6, 1991, in person or by written request clearly stating the project name and improvement number. A deposit of $200 will be required for each set of Contract Documents. The deposit will be returned in full to bona fide Bidders who return the Contract Documents to the office of the Engineer within ten (10) calendar days following the Bid opening. No partial sets will be issued. Deposit checks shall be made payable to Barr Engineering Co.

Bids will not be considered unless accompanied by Bid security in the form of a cash deposit, cashier's check, bid bond, or certified check payable to the City Treasurer for not less than (5%) of the Bid Price. Bids shall be on the basis of the entire project and segregated bids will not be accepted.

Bidders are encouraged to review the Contract Documents early and to note the addenda procedures and pre-bid meeting.

The Owner reserves the right to reject any and all Bids and to accept any Bid deemed to be in the best interests of the Owner.

"EQUAL OPPORTUNITY EMPLOYER"

William C. Dixon
City Manager

Published St. Louis Park Sailor	Wednesday, March 6, 1991 Wednesday, March 13, 1991 Wednesday, March 20, 1991
Published Construction Bulletin	Friday, March 8, 1991 Friday, March 15, 1991 Friday, March 22, 1991
Placed at Minneapolis Builders Exchange	March 6, 1991
Placed at St. Paul Builders Exchange	March 6, 1991

Instructions To Bidder

INSTRUCTIONS TO BIDDERS

IB-1.0 DEFINED TERMS

Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract (No. 1910-8, 1983 ed.) have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-bidder, who submits a bid to Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

IB-2.0 CONTRACT DOCUMENTS

The documents that comprise the Contract Documents are set forth in the Agreement.

IB-3.0 COPIES OF PROPOSED CONTRACT DOCUMENTS

IB-3.1 Complete sets of the proposed Contract Documents in the number and for the deposit sum stated in the Advertisement for Bids may be obtained from the Engineer. The deposit will be refunded according to the conditions stated in the Advertisement for Bids. Contract Documents will not be considered in good condition for refund of deposit if they are incomplete, not bound by the original binding, contain non-erasable markings, or are otherwise defaced. Determination of condition for purposes of refund shall be the sole judgement of Engineer.

IB-3.2 Complete sets of the proposed Contract Documents must be used in preparing Bids. Neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of the proposed Contract Documents.

IB-3.3 Owner and Engineer in making copies of the proposed Contract Documents available on the above terms do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

IB-4.0 QUALIFICATIONS OF BIDDERS

To demonstrate qualifications to perform the Work, the low Bidder shall submit to Owner (with copy to Engineer) by April 8, 1991 written evidence as called for below that demonstrates the Bidder's

ability to complete the Work as specified. The documentation shall include a description of present commitments; description of the Bidder's project experience in the past five years including nature of project, owner's name, dollar value and name of bonding company; and a description of the Bidder's equipment, key personnel and resources that demonstrate the Bidder's ability to successfully complete the Work. If the Bidder is a corporation, the documentation shall include the names of all current officers of the corporation and the names of all corporations, partnerships or sole proprietorships with which these persons have served as officers, partners or owners within the past five (5) years. If the Bidder is a partnership or sole proprietorship, the same information shall be provided for current partners or owners.

The submittal shall also include a list of subcontractors that are proposed to be used for the following major elements of the Work:

1. fabrication of precast structural components;
2. fabrication of contactor vessels;
3. fabrication of package iron removal system;
4. fabrication of electrical control panels;
5. building electrical installation;
6. building mechanical systems installation;
7. process piping installation;
8. chemical feed system installation;
9. site utility piping installation;
10. curb, gutter and pavement.
11. painting;
12. bituminous pavement;
13. masonry; and
14. concrete.

The subcontractors used for these elements of the Work shall not be changed without the prior written approval of the Owner. A thorough description of the qualifications and experience of each subcontractor shall be included with the submittal.

IB-5.0 EXAMINATION OF CONTRACT DOCUMENTS AND SITE

IB-5.1 It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly; (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work; (c) consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work; (d) study and carefully correlate Bidder's observations with the Contract Documents; and (e)

notify Engineer of all conflicts, errors or discrepancies in the Contract Documents.

IB-5.2 Reference is made to the Supplementary Conditions and Division 1 (General Requirements) of the Specifications for identification of:

IB-5.2.1 Explorations, reports and other information that may be helpful for Bid preparation. These reports are available for review by any Bidder as set forth in the Supplementary Conditions.

IB-5.2.2 Information and data concerning surface and subsurface conditions and Underground Facilities at or contiguous to the site, and known by Owner and Engineer. Owner and Engineer do not assume responsibility for the completeness thereof for Contractor's purposes. This information and data are available for review by any Bidder as set forth in the Supplementary Conditions.

IB-5.2.3 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities, and other physical conditions, and possible changes in the Contract Documents due to differing conditions.

IB-5.2.4 Descriptions of other work that will be conducted concurrently on or near the site by others and that may affect the cost, progress, performance or furnishing of the Work.

IB-5.3 Before submitting a Bid, each Bidder shall, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies, and obtain any additional information and data that pertain to the physical conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site or otherwise that may affect the cost, progress, performance or furnishing of the Work, and that Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

IB-5.4 It is the Bidder's responsibility to obtain access to the site to conduct such explorations and tests as Bidder deems

necessary for submission of a Bid. Bidders may visit the site by appointment only. Appointments may be made by contacting the City of St. Louis Park, Department of Public Works (Attention: Mr. Bob Burke) at telephone number (612) 924-2557 between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday.

IB-5.5 The lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor.

IB-5.6 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this paragraph IB-5.0 and that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

IB-5.7 No plea of ignorance of conditions that exist or that may hereafter exist, or of difficulties that will be encountered in the execution of the Work, as a result will be accepted as a sufficient excuse for any failure or omission on the part of the Contractor to fulfill in every detail all the requirements of this contract, or will be accepted as a basis for any claim whatsoever for extra compensation or for an extension of time.

IB-6.0 INTERPRETATIONS AND ADDENDA

IB-6.1 If any potential Bidder is in doubt as to the true meaning, or finds discrepancies in or omissions from the Contract Documents, that potential Bidder shall submit to the Engineer a written request for an interpretation or correction thereof. The Bidder submitting the request shall be responsible for prompt delivery. Interpretations, clarifications or corrections considered necessary by Engineer in response to such requests will be issued by Addenda mailed or delivered to all parties recorded by

Engineer as having received the Contract Documents. Requests received less than ten (10) calendar days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

IB-6.2 It is the intent of the Contract Documents to cover all aspects of the Project. Paragraph 3.2 of the General Conditions describes Contractor's obligations with respect to items required but not specifically addressed by the Specifications.

IB-7.0 BID SECURITY

IB-7.1 Each Bid must be accompanied by Bid security in the amount and form set forth in the Advertisement for Bids. Bid Bond shall be issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions.

IB-7.2 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement within fifteen (15) calendar days after Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited.

IB-7.3 The Bid security of the second and third low Bidders may be retained until the earlier of the seventh (7) day after the Effective Date of the Agreement or the sixty-first (61) day after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid security of all other Bidders will be returned within seven (7) days after the Bid opening.

IB-8.0 CONTRACT TIME

The number of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Time) are set forth in the Agreement.

IB-9.0 LIQUIDATED DAMAGES

Provisions for liquidated damages are set forth in the Agreement.

IB-10.0 SUBSTITUTE OR "OR-EQUAL" ITEMS

The Contract, if awarded, will be on the basis of materials and equipment described in the Contract Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Contract Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if approved, application for such approval will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application and consideration of application is set forth in Paragraphs 6.7.1, 6.7.2 and 6.7.3 of the General Conditions and as supplemented in Division 1 (General Requirements) of the Specifications.

IB-11.0 BID FORM

IB-11.1 Bids shall be submitted on the Bid Form included with the Contract Documents or copies thereof.

IB-11.2 All blanks on the Bid Form must be completed in ink or by typewriter. Bidders must quote on all items appearing on the Bid Form. Failure to quote on all items may be considered cause to reject the Bid.

IB-11.3 Alternate Bids will not be considered unless specifically called for.

IB-11.4 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.

IB-11.5 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

IB-11.6 All names must be typed or printed in ink below the signature. The signatory to the Bid Form shall initial each page of the Bid Form where indicated.

IB-11.7 The Bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.

IB-11.8 The address and telephone number for communications regarding the Bid must be shown.

IB-11.9 The Bid Form must include the Bidders E.I. number. This is the number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

IB-11.10 The Bid Form must be endorsed by a Notary Public.

IB-11.11 Telegraphic Bids and Bids submitted by facsimile will not be considered.

IB-12.0 SUBMISSION OF BIDS

Bids shall be submitted before the time and at the place indicated in the Advertisement for Bids. Bids shall be enclosed in an opaque sealed envelope, marked with the name and address of the Bidder and clearly labeled as follows:

BID FOR
CITY OF ST. LOUIS PARK IMPROVEMENT 89-07
WELL 4 WATER TREATMENT FACILITY

If the Bid is sent through the mail or other delivery system, the sealed envelope containing the Bid Form shall be enclosed in a separate envelope with the notation "SEALED BID ENCLOSED" on the face of it and shall be addressed to:

Mr. Jim Grube
Director of Public Works
City of St. Louis Park
5005 Minnetonka Boulevard
St. Louis Park, MN 55416-2290

Each bid shall be accompanied by the required Bid security and an executed Affidavit of Non Collusion (on the form included in these Contract Documents) indicating that the contents of the Bid have not been, and will not be, communicated to any person not an employee or agent of the Bidder or its surety on any Bond furnished with the Bid.

IB-13.0 MODIFICATION AND WITHDRAWAL OF BIDS

Bids may be withdrawn anytime prior to the opening of Bids without prejudice to the Bidder by submitting a written request to the Owner at the address specified for the submission of Bids. The request for withdrawal shall be executed in the manner a Bid must be executed. Requests shall be clearly marked "Request for Withdrawal of Bid" and labeled with the project name and improvement number.

Withdrawn Bids may be modified and resubmitted anytime prior to the time set for opening of Bids. Resubmission of Bids shall conform to the same requirements as the original submission. All corrections shall be clearly legible and shall be initialled by the signatory to the Bid Form.

IB-14.0 OPENING OF BIDS

Bids will be opened and (unless obviously nonresponsive) read aloud publicly at the time and place set forth in the Advertisement for Bids. An abstract of the amounts of the Bids will be made available at the office of the Engineer within seven (7) days after the opening of Bids.

IB-15.0 BIDS TO REMAIN SUBJECT TO ACCEPTANCE

All bids will remain subject to acceptance for sixty (60) calendar days after the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.

IB-16.0 AWARD OF CONTRACT

IB-16.1 Owner reserves the right to reject any and all Bids, to waive any and all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, nonresponsive, unbalanced or conditional Bids. Also, Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Owner to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Discrepancies in the multiplication of units of Work and unit prices (if used) will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

IB-16.2 If the contract is to be awarded, it will be awarded to the lowest Bidder whose evaluation by Owner indicates to Owner that the Award will be in the best interests of the Owner.

IB-16.3 If the contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within sixty (60) calendar days after the day of the Bid opening.

IB-17.0 CONTRACT SECURITY

Paragraph 5.1 of the General Conditions and the Supplementary Conditions set forth Owner's requirements as to performance and payment bonds. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by the required performance and payment Bonds in the form included in the Contract Documents (Bond of Public Contractor).

IB-18.0 OTHER SUBMITTALS REQUIRED WITH EXECUTED CONTRACT

When the Successful Bidder delivers the executed Agreement to the Owner, it shall be accompanied by the following submittals:

1. An Insurance Agent/Broker's Certification Form (included in Contract Documents), completed by each insurance agent/broker representing companies providing insurance required by Contractor under the terms of the Contract Documents.

2. If requested by Owner, furnish copies of policies or other evidence of insurance, which Contractor is required to purchase in accordance with Paragraphs 5.3 and 5.4 of the General Conditions. Three copies shall be furnished.

3. Schedule of Operations in the quantity requested and as described in Division 1 (General Requirements) of the Specifications.

4. Schedule of Values in the quantity requested and as described in Division 1 (General Requirements) of the Specifications.

5. Equal Employment Opportunity Certification included in the Contract Documents.

IB-19.0 SIGNING OF AGREEMENT

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement. Within fifteen (15) calendar days thereafter Contractor shall sign and deliver the required number of counterparts of the

Agreement to Owner in accordance with the instructions for delivery in the Notice of Award along with the required Bonds, evidence of insurance, and other required submittals.

Owner or Engineer will review required submittals and may require Contractor to make revisions. Contractor shall make required revisions and resubmit to Owner within five (5) calendar days of Owner's request for such revision. Within thirty (30) days upon final receipt of all acceptable materials, Owner will deliver one (1) fully signed counterpart of the Contract Documents to Contractor. Each counterpart is to be accompanied by a complete set of the Contract Drawings with appropriate identification.

IB-20.0 PRE-BID CONFERENCE

A pre-bid conference will be held at 9:00 a.m. (CST) on Wednesday, March 20, 1991 at the office of the Engineer.

All Bidders are encouraged to attend and participate in the conference. Engineer will distribute to Contract Document holders of record such Addenda as Engineer considers necessary in response to comments and questions arising at the conference.

IB-21.0 PAYMENT AND RETAINAGE

Provisions concerning payment, retainage and Contractor's right to deposit securities in lieu of retainage are set forth in the Agreement.

IB-22.0 PERMITS, FEES, LICENSES, AND INSPECTION

Provisions regarding Contractor's payment of fees, construction permits, licenses, and inspections are set forth in Paragraph 6.13 of General Conditions and Supplementary Conditions.

IB-23.0 CERTIFICATIONS REQUIRED FOR FINAL PAYMENT

IB-23.1 At the time of application for final payment described in Paragraph 14.2 of the General Conditions, Contractor shall be required to show compliance with the provisions of Minnesota Statutes annotated 290.92 requiring the withholding of State Income Tax on wages paid to Contractor's employees for work performed for this contract. Receipt by Owner of the affidavit included as part of these Contract Documents (Withholding Affidavit for Contractors) will satisfy this requirement.

IB-23.2 At the time of application for final payment described in Paragraph 14.2 of the General Conditions, Contractor shall be required to submit the Sworn Construction Statement and the Contractor Guarantee - Reserveration of Rights by the Owner (included in the Contract Documents).

Bid Form

BID FORM

FOR

CITY OF ST. LOUIS PARK, MINNESOTA
IMPROVEMENT NUMBER 89-07
WELL 4 WATER TREATMENT FACILITY

THIS BID IS SUBMITTED TO:
City Council
City of St. Louis Park
5005 Minnetonka Boulevard
St. Louis Park, Minnesota 55416-2290

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. BIDDER accepts all of the terms and conditions of the Advertisement for Bids and Instructions to Bidders, including without limitation those dealing with the disposition of Bid Security. This Bid will remain subject to acceptance as set forth in the Instruction to Bidders. BIDDER shall sign and submit the Agreement with the Bonds and other documents required by the Contract Documents within fifteen (15) days after the date of OWNER's Notice of Award.

3. In submitting this Bid, BIDDER represents that:

   a. BIDDER has examined copies of all the Contract Documents including the following Addenda (receipt of all which is hereby acknowledged):

      Addendum No. ____ Dated ____ Signature_____
      Addendum No. ____ Dated ____ Signature_____
      Addendum No. ____ Dated ____ Signature _____
      Addendum No. ____ Dated ____ Signature _____

   b. BIDDER has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

c. BIDDER has studied carefully all reports and drawings of subsurface conditions which are identified in paragraph 4.2 of the Supplementary Conditions, and accepts the terms of the paragraphs 4.2.1 and 4.2.2 as to the extent of the technical data contained in such reports and drawings upon which BIDDER is entitled to rely.

d. BIDDER has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests and studies (in addition to or to supplement those referred to in (c) above) which pertain to the subsurface or physical conditions at the site or that otherwise may affect the cost, progress, performance or furnishing of the Work as BIDDER considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by BIDDER for such purposes.

e. BIDDER has reviewed and checked all information and data shown on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the completeness of said information in accordance with the appropriate provisions of the General Conditions. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by BIDDER in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.3 of the General Conditions.

f. BIDDER has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

g. BIDDER has given ENGINEER written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER.

h. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted

in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other BIDDER to submit a false or sham Bid; and BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding.

i. This Bid has been arrived at by the BIDDER independently, and has been submitted without collusion with, and without any agreement, understanding, or planned common course of action with any other BIDDER or vendor of materials, supplies, equipment or services described in the Contract Documents designed to limit independent bidding or competition.

j. This Bid has not been communicated by the BIDDER or its employees or agents to any person not an employee or agent of the BIDDER or its surety on any Bond furnished with the Bid, and will not be communicated to any such person prior to the opening of the Bid.

k. BIDDER has not submitted any other Bid, either as a sole Bidder, or as a participant in a joint venture.

4. BIDDER agrees to complete the Work for the following LUMP SUM CONTRACT PRICE

_____
(use words)

$_____
(figures)

5. BIDDER agrees that the Work will be ready for use, substantially complete and completed and ready for final payment in accordance with paragraph 14.13 of the General Conditions on or before the dates indicated in the Agreement.

BIDDER accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work in time.

6. Bid Security meeting the requirements set forth in the Instruction to Bidders is attached to and made a condition of this Bid.

7. BIDDER understands and agrees that OWNER reserves the right to reject any or all Bids and to waive formalities. It is further understood and agreed that this Bid may not be withdrawn within sixty (60) calendar days following opening of Bids.

8. The terms used in this Bid which are defined in the Standard General Conditions of the Construction Contract included as part of the Contract Documents have the meanings assigned to them in the General Conditions.

SUBMITTED on _____, 19__.

If BIDDER is:

An Individual

By_____(AFFIX SEAL)
(Individual's Name, Signature)

_____
(Type Name)

doing business as_____

Business address: _____

_____

_____

Phone No:_____

Bidder's E.I. Number:_____

A Partnership

By _____(AFFIX SEAL)
(Firm)

_____
(General Partner, Signature)

_____
(Type Name)

Business Address: _____

_____

_____

Phone No: _____

Bidder's E.I. Number: _____

A Corporation

By _____ (AFFIX SEAL)
(Corporation Name)

_____
(State of Incorporation)

By _____
(Authorized Signature)

_____
(Type Name)

_____
(Title)

Attest _____
(Secretary)

Business Address: _____

_____

_____

Phone No: _____

Bidder's E.I. Number: _____

A Joint Venture

By _____
(Authorized Signature)

_____
(Type Name)

_____

_____

_____

_____

By _____
(Authorized Signature)

_____
(Type Name)

_____

_____

_____

_____

By _____
(Authorized Signature)

_____
(Type Name)

_____

_____

_____

_____

Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture shall be in the manner indicated above).

Subscribed and sworn to before me this

_____ day of _____, 19____.(AFFIX SEAL)

_____

Notary Public

My commission expires _____, 19___.

Form Of Agreement

AGREEMENT FOR
CITY OF ST. LOUIS PARK
IMPROVEMENT PROJECT 89-07
WELL 4 WATER TREATMENT FACILITY

THIS AGREEMENT is dated as of the _____ day of _____ in the year 19__ by and between the CITY OF ST. LOUIS PARK, MINNESOTA (hereinafter called OWNER) and _____ (hereinafter called CONTRACTOR).

WHEREAS, CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work, including the terms of the Instructions to Bidders and the Bid Form; and

WHEREAS, the Contract Documents hereinafter described form the Contract and are as fully a part of the Contract as if attached to this Agreement, and in the event that any provision in any of the component parts of the Contract Documents conflicts with any provision of any other component part, the provision of the component part listed first hereinafter shall govern unless otherwise specifically stated:

1. This Agreement
2. Bid Form
3. Addenda
4. Instructions to Bidders
5. Contract Drawings
6. Specifications
7. Supplementary Conditions
8. Standard General Conditions of the Construction Contract
9. Advertisement for Bids
10. Bond of Public Contractor
11. Insurance Agent/Broker's Certification Form
12. Sworn Construction Statement
13. Contractor Guarantee - Reservation of Rights by the Owner

OWNER AND CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. DEFINITION OF TERMS

The terms used in this Agreement which are defined in Article 1 of the Standard General Conditions of the Construction Contract (hereinafter referred to as the "General Conditions") will have the meanings indicated in the General Conditions.

ARTICLE 2. WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents for Improvement Project 89-07. The Work is generally described as follows: construction of a water treatment facility for City Well 4 including, but not limited to, concrete and masonry structure, deep well pump and motor, package iron and manganese removal system, ASME pressure vessels for PAH removal system, granular activated carbon for PAH removal system, motor and process controls, process piping and valving, site utilities, chemical feed systems, building electrical and mechanical systems, below grade concrete backwash tank, paving, site restoration, and landscaping.

ARTICLE 3. ENGINEER

The Project has been designed by Barr Engineering Company, 7803 Glenroy Road, Bloomington, Minnesota, 55439-3123, who is hereinafter called ENGINEER and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE 4. CONTRACT TIME

4.1 The Work shall be Substantially Complete, as defined in Article 1 of the General Conditions, and ready for use in accordance with paragraph 14.8 of the General Conditions within two hundred forty (240) calendar days following Notice to Proceed.

4.2 The Work shall be complete and ready for final payment in accordance with paragraph 14.13 of the General Conditions within three hundred sixty (360) calendar days following Notice to Proceed.

4.3 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in paragraphs 3.1 and 3.2 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties recognize OWNER will experience delays, expense and difficulties if OWNER is required to prove in a legal or arbitration proceeding actual loss suffered if the Work is not completed on time. Accordingly, instead of requiring such proof, OWNER and CONTRACTOR agree to liquidated damages for delay (but not as a penalty). CONTRACTOR shall pay OWNER a sum as set forth in the following schedule for each calendar day after the time for performance set forth in paragraphs 4.1 and 4.2 of this Agreement expires and until the Work meets the completion status set forth in paragraphs 4.1 and 4.2 herein:

4.3.1 If the Work is not substantially complete -- $1,200 per calendar day for the first thirty (30) calendar days and $3,200 per calendar day thereafter.

4.3.2 If the Work is not complete and ready for final payment (refer to Articles 14.12 and 14.13 of the General Conditions) -- $200 per calendar day.

ARTICLE 5. CONTRACT PRICE

OWNER agrees to pay CONTRACTOR for the WORK performed pursuant to this Agreement, a total price of $_____ as set forth in the Bid Form submitted by CONTRACTOR.

ARTICLE 6. PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions and General Requirements.

6.1 Progress Payments. OWNER will make progress payments on account of the Contractor Price on the basis of CONTRACTOR's Applications for Payment as approved and recommended by ENGINEER. Progress payments will be based on incremental Work completed as provided in the Schedule of Values in accordance with paragraph 2.9 of the General Conditions, and in the case of unit price work, based on the numbers of units completed.

6.1.1 Before Substantial Completion, progress payments will be made in an amount equal to ninety-five (95) percent of the Work completed, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER will determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions.

6.1.2 Upon Substantial Completion, payment will be made in an amount sufficient to increase total payments to CONTRACTOR to ninety nine (99) percent of the Contract Price, less such amounts as ENGINEER will determine, or OWNER may withhold, payment will be made in accordance with paragraph 14.7 of the General Conditions.

6.2 Final Payment. Upon final completion and acceptance of the Work in accordance with paragraph 14.13 of the General Conditions, OWNER will pay the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraph 14.13.

6.2.1 CONTRACTOR shall submit the following fully executed documents to OWNER prior to release of final payment by OWNER.

1. Withholding Affidavit for Contractors
2. Sworn Construction Statement
3. Contractor Guarantee - Reservation of Rights by the Owner

6.3 Alternative Form of Retainage. CONTRACTOR may, at its option, elect an alternative form of retainage in accordance with Minnesota Statute 15.73.

ARTICLE 7. INTEREST

All moneys due but not paid as provided in Article 14 of the General Conditions will bear interest in accordance with Minnesota Statue 471.425, Subd. 4.

ARTICLE 8. MISCELLANEOUS

8.1 By executing this Agreement, CONTRACTOR agrees to the provisions of paragraph 6.30 of the General Conditions regarding CONTRACTOR indemnification of OWNER and ENGINEER.

8.2 For purposes of this Agreement, CONTRACTOR shall be deemed to be an independent contractor and not an employee of the OWNER. Any and all employees of CONTRACTOR, or CONTRACTOR's agents or subcontractors while engaged in the performance of the WORK or under this Agreement shall not be considered employees of OWNER and any and all claims that may or might arise under the Worker's Compensation Act, Immigration Reform and Control Act of 1986, Unemployment Compensation Act of the State or other state and/or federal laws on behalf of said employees or other persons while so engaged shall in no way be the obligation or the responsibility of OWNER. CONTRACTOR shall pay as they become due, all just claims by CONTRACTOR's agents or subcontractors for work, tools, skills, insurance premiums, and supplies furnished, rendered or provided as part of this Work.

8.3 In connection with the performance of this Agreement, CONTRACTOR shall not discriminate against any employee or applicant for employment because of race, creed, religion, color, sex, national origin, age, marital status, physical or mental disability, membership or activity in a local committee, or status with regard to public assistance. CONTRACTOR shall take affirmative action to insure that applicants are employed, and that employees are treated during their employment without regard to their race, creed, religion, color, sex, national origin, age, marital status, physical or mental disability, membership or activity in a local committee, or status with regard to public assistance. Such actions shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; lay-off or termination, rates of pay, or other forms of compensation; and selection for training, including apprenticeship.

8.4 No assignment by a party hereto of any right under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation moneys that may become due and money that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

8.5 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements, and obligations contained in the Contract Documents.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR.

This Agreement will be effective as of the day and year first written above.

OWNER: CITY OF ST. LOUIS PARK, MINNESOTA

Reviewed for Administration:

_____
City Manager

Approved as to Form and Execution:

_____
City Attorney

Reviewed for Engineering:

_____
Director of Public Works

Accounting Records Posted:

_____
Director of Finance

By _____
Its Mayor

By _____
Its City Manager

Execution of Agreement Authorized By _____
(Resolution No.)

Address for giving notices:

Director of Public Works
City of St. Louis Park
5005 Minnetonka Boulevard
St. Louis Park, Minnesota 55416-2290

with copy of all notices to:

Barr Engineering Company
7803 Glenroy Road
Minneapolis, Minnesota 55439-3123

Attn: City of St. Louis Park Improvement No. 89-07

CONTRACTOR: _____

_____

_____

BY: _____

TITLE: _____

(Affix Corporate Seal)

ATTEST: _____

Address for giving Notice: _____

_____

_____

License No. _____

(If CONTRACTOR is a corporation, attach evidence of authority to sign.)

Standard General Conditions Of The Construction Contract

This document has important legal consequences: consultation with an attorney is encouraged with respect to its completion or modification.

STANDARD
GENERAL CONDITIONS
OF THE
CONSTRUCTION CONTRACT

Prepared by

Engineers' Joint Contract Documents Committee

and

Issued and Published Jointly By

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AMERICAN CONSULTING ENGINEERS COUNCIL

AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSTRUCTION SPECIFICATIONS INSTITUTE

This document has been approved and endorsed by

The Associated General Contractors of America

These General Conditions have been prepared for use with the Owner-Contractor Agreements (No. 1910-8-A-1 or 1910-8-A-2, 1983 editions). Their provisions are interrelated and a change in one may necessitate a change in the others. Comments concerning their usage are contained in the Commentary on Agreements for Engineering Services and Contract Documents, No. 1910-9, 1981 edition. For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. 1910-17, 1983 edition). When bidding is involved, the Standard Form of Instructions to Bidders (No. 1910-12, 1983 edition) may be used.

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1015 15th Street, N.W., Washington, D.C. 20005

American Society of Civil Engineers
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GENERAL CONDITIONS

ARTICLE 1—DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof.

Addenda—Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

Agreement—The written agreement between OWNER and CONTRACTOR covering the Work to be performed. other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Application for Payment—The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to include such supporting documentation as is required by the Contract Documents

Bid—The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bonds—Bid, performance and payment bonds and other instruments of security.

Change Order—A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

See SC-1

Contract Documents—The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all amendments, modifications and supplements issued pursuant to paragraphs 3 4 and 3.5 on or after the Effective Date of the Agreement

Contract Price—The moneys payable by OWNER to CONTRACTOR under the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11 9 1 in the case of Unit Price Work)

Contract Time—The number of days (computed as provided in paragraph 17.2) or the date stated in the Agreement for the completion of the Work.

CONTRACTOR—The person, firm or corporation with whom OWNER has entered into the Agreement

defective—An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14 10).

Drawings—The drawings which show the character and scope of the Work to be performed and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents.

Effective Date of the Agreement—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

See SC-1

~~*ENGINEER*—The person, firm or corporation named as such in the Agreement.~~

Field Order—A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Time.

General Requirements—Sections of Division 1 of the Specifications.

Laws and Regulations, Laws or Regulations—Laws, rules, regulations, ordinances, codes and/or orders

Notice of Award—The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement

Notice to Proceed—A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR'S obligations under the Contract Documents.

OWNER—The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided

Partial Utilization—Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

Project—The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

Resident Project Representative—The authorized representative of ENGINEER who is assigned to the site or any part thereof.

Shop Drawings—All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

Specifications—Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

Subcontractor—An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

Substantial Completion—The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if there be no such certificate issued, when final payment is due in accordance with paragraph 14 13. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof,

Supplementary Conditions—The part of the Contract Documents which amends or supplements these General Conditions.

Supplier—A manufacturer, fabricator, supplier, distributor, materialman or vendor

Underground Facilities—All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

Unit Price Work—Work to be paid for on the basis of unit prices.

Work—The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

Work Directive Change—A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4 3 or to emergencies under paragraph 6.22. A Work Directive Change may not change the Contract Price or the Contract Time, but is evidence that the parties expect that the change directed or documented by a Work Directive Change will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in paragraph 10.2.

Written Amendment—A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly Work-related aspects of the Contract Documents.

ARTICLE 2—PRELIMINARY MATTERS

Delivery of Bonds:

2.1 When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1

Copies of Documents:

2 2. OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

See SC-2.3

Commencement of Contract Time; Notice to Proceed:

2 3 The Contract Time will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. ~~In no event will the Contract Time commence to run later than the seventy-fifth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.~~

Starting the Project:

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Time commences to run, but no Work shall be done at the site prior to the date on which the Contract Time commences to run

Before Starting Construction:

2.5. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown

thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents, unless CONTRACTOR had actual knowledge thereof or should reasonably have known thereof.

See SC-2.6

~~2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:~~

~~2.6.1 an estimated progress schedule indicating the starting and completion dates of the various stages of the Work;~~

~~2.6.2 a preliminary schedule of Shop Drawing submissions; and~~

~~2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work which will be confirmed in writing by CONTRACTOR at the time of submission.~~

See SC-2.7

~~2.7. Before any Work at the site is started, CONTRACTOR shall deliver to OWNER, with a copy to ENGINEER, certificates (and other evidence of insurance requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with paragraphs 5.3 and 5.4, and OWNER shall deliver to CONTRACTOR certificates (and other evidence of insurance requested by CONTRACTOR) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7.~~

Preconstruction Conference:

2.8. Within twenty days after the Effective Date of the Agreement, but before CONTRACTOR starts the Work at the site, a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to discuss the schedules referred to in paragraph 2.6, to discuss procedures for handling Shop Drawings and other submittals and for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

Finalizing Schedules:

See SC-2.9

2.9. ~~At least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to finalize the schedules submitted in accordance with paragraph 2.6.~~ The finalized progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within the Contract Time, but such acceptance will neither impose on ENGINEER responsibility for the progress or scheduling of the Work nor relieve CONTRACTOR from full responsibility therefor. The finalized schedule of Shop Drawing submissions will be acceptable to ENGINEER as providing a workable arrangement for processing the submissions. The finalized schedule of values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

See SC-3.1

3.1. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

See SC-3.2

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result will be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe Work, materials or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to ENGINEER, or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3. If, during the performance of the Work, CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, CONTRACTOR shall so report to ENGINEER in writing at once and before proceeding with the Work affected thereby shall obtain a written interpretation or clarification

from ENGINEER; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents unless CONTRACTOR had actual knowledge thereof or should reasonably have known thereof

Amending and Supplementing Contract Documents:

3.4. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.4.1 a formal Written Amendment,

3.4.2. a Change Order (pursuant to paragraph 10.4), or

3.4.3 a Work Directive Change (pursuant to paragraph 10.1).

As indicated in paragraphs 11.2 and 12.1, Contract Price and Contract Time may only be changed by a Change Order or a Written Amendment.

3.5. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.5.1 a Field Order (pursuant to paragraph 9.5),

3.5.2. ENGINEER's approval of a Shop Drawing or sample (pursuant to paragraphs 6.26 and 6.27), or

3.5.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.6. Neither CONTRACTOR nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER; and they shall not reuse any of them on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaptation by ENGINEER.

ARTICLE 4—AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS

Availability of Lands:

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR believes that any delay in OWNER's furnishing these lands, rights-of-way or easements entitles CONTRACTOR to an extension of the Contract Time, CONTRACTOR may make a claim therefor as provided in Article 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

Physical Conditions: **See SC-4.2.1**

4.2.1. *Explorations and Reports.* Reference is made to the Supplementary Conditions for identification of those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparation of the Contract Documents CONTRACTOR may rely upon the accuracy of the technical data contained in such reports, but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to subsurface conditions at the site.

See SC-4.2.2

4.2.2. *Existing Structures.* Reference is made to the Supplementary Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities referred to in paragraph 4.3) which are at or contiguous to the site that have been utilized by ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such drawings, but not for the completeness thereof for CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to physical conditions in or relating to such structures.

4.2.3. *Report of Differing Conditions.* If CONTRACTOR believes that

4.2.3.1. any technical data on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is inaccurate, or

4.2.3.2. any physical condition uncovered or revealed at the site differs materially from that indicated, reflected or referred to in the Contract Documents,

CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.22), notify OWNER and ENGINEER in writing about the inaccuracy or difference.

4.2.4. *ENGINEER's Review:* ENGINEER will promptly review the pertinent conditions, determine the necessity of obtaining additional explorations or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5. *Possible Document Change.* If ENGINEER concludes that there is a material error in the Contract Documents or that because of newly discovered conditions a change in the Contract Documents is required, a Work Directive Change or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the inaccuracy or difference.

4.2.6. *Possible Price and Time Adjustments* In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to any such inaccuracy or difference. If OWNER and CONTRACTOR are unable to agree as to the amount or length thereof, a claim may be made therefor as provided in Articles 11 and 12.

Physical Conditions—Underground Facilities:

4.3.1. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1 OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data, and,

4.3.1.2. CONTRACTOR shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection thereof as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

4.3.2. *Not Shown or Indicated.* If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of, CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency as permitted by paragraph 6.22), identify the owner of such Underground Facility and give written notice thereof to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of. If the parties are unable to agree as to the amount or length thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

Reference Points:

4.4. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work (unless otherwise specified in the General Requirements), shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

ARTICLE 5—BONDS AND INSURANCE

Performance and Other Bonds:

5.1. CONTRACTOR shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Law or Regulation or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department All Bonds signed by an agent must be accompanied by a certified copy of the authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of

the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within five days thereafter substitute another Bond and Surety, both of which must be acceptable to OWNER.

Contractor's Liability Insurance: **See SC-5.3**

5.3. CONTRACTOR shall purchase and maintain such comprehensive general liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable.

5.3.1. Claims under workers' or workmen's compensation, disability benefits and other similar employee benefit acts,

5.3.2. Claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

5.3.3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

5.3.4. Claims for damages insured by personal injury liability coverage which are sustained (a) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (b) by any other person for any other reason,

5.3.5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom,

5.3.6. Claims arising out of operation of Laws or Regulations for damages because of bodily injury or death of any person or for damage to property; and

5.3.7. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle

The insurance required by this paragraph 5.3 shall include the specific coverages and be written for not less than the limits of liability and coverages provided in the Supplementary Conditions, or required by law, whichever is greater. The comprehensive general liability insurance shall include completed operations insurance. All of the policies of insurance so required to be purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER and ENGINEER by certified mail. All such insurance shall remain in effect until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing *defective* Work in accordance with paragraph 13.12. In addition, CONTRACTOR shall maintain such completed operations insurance for at least two years after final payment and furnish OWNER with evidence of continuation of such insurance at final payment and one year thereafter.

Contractual Liability Insurance:

5.4 The comprehensive general liability insurance required by paragraph 5.3 will include contractual liability insurance applicable to CONTRACTOR's obligations under paragraphs 6.30 and 6.31

Owner's Liability Insurance: **See SC-5.5**

5.5. OWNER shall be responsible for purchasing and maintaining OWNER's own liability insurance and, at OWNER's option, may purchase and maintain such insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Property Insurance: **See SC-5.6**

5.6 Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and ENGINEER's consultants in the Work, all of whom shall be listed as insureds or additional insured parties, shall insure against the perils of fire and extended coverage and shall include "all risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in the Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) If not covered under the "all risk" insurance or otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment.

See SC-5.7

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER AND ENGINEER's consultants in the Work, all of whom shall be listed as insured or additional insured parties.

See SC-5.8

5.8. All the policies of insurance (or the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to CONTRACTOR by certified mail and will contain waiver provisions in accordance with paragraph 5.11.2

See SC-5.9

5.9. OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are provided in the Supplementary Conditions. The risk of loss within the deductible amount, will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

See SC-5.10

5.10 If CONTRACTOR requests in writing that other special insurance be included in the property insurance policy, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

Waiver of Rights: See SC-5.11

5.11.1 OWNER and CONTRACTOR waive all rights against each other for all losses and damages caused by any of the perils covered by the policies of insurance provided in response to paragraphs 5.6 and 5.7 and any other property insurance applicable to the Work, and also waive all such rights against the Subcontractors, ENGINEER, ENGINEER's consultants and all other parties named as insureds in such policies for losses and damages so caused As required by paragraph 6.11, each subcontract between CONTRACTOR and a Subcontractor will contain similar waiver provisions by the Subcontractor in favor of OWNER, CONTRACTOR, ENGINEER, ENGINEER's consultants and all other parties named as insureds. None of the above waivers shall extend to the rights that any of the insured parties may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued

5.11.2 OWNER and CONTRACTOR intend that any policies provided in response to paragraphs 5.6 and 5.7 shall protect all of the parties insured and provide primary coverage for all losses and damages caused by the perils covered thereby. Accordingly, all such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any of the parties named as insureds or additional insureds, and if the insurers require separate waiver forms to be signed by ENGINEER or ENGINEER's consultant OWNER will obtain the same, and if such waiver forms are required of any Subcontractor, CONTRACTOR will obtain the same.

Receipt and Application of Proceeds: See SC-5.12

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as trustee for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment

See SC-5.13

5.13. OWNER as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power If such objection be made, OWNER as trustee shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If required in writing by any party in interest, OWNER as trustee shall, upon the occurrence of an insured loss, give bond for the proper performance of such duties

Acceptance of Insurance: See SC-5.14

5.14. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.3 and 5.4 on the basis of its not complying with the Contract Documents, OWNER shall notify CONTRACTOR in writing thereof within ten days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.7. If CONTRACTOR has any objection to the coverage afforded by or other provisions of the policies of insurance required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 on the basis of their not complying with the Contract Documents, CONTRACTOR shall notify OWNER in writing thereof within ten days of the date of delivery of such certificates to CONTRACTOR in accordance with paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided by each as the other may reasonably request Failure by OWNER or CONTRACTOR to give any such notice of objection within the time provided shall constitute acceptance of such insurance purchased by the other as complying with the Contract Documents

Partial Utilization—Property Insurance:

5.15 If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no

such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected the changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or lapse on account of any such partial use or occupancy.

See SC-5.16

ARTICLE 6—CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1. CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3 CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents CONTRACTOR shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6 4 Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier except as otherwise provided in the Contract Documents, but no provision of any such instructions will be effective to assign to ENGINEER, or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9 16.

Adjusting Progress Schedule:

6 6 CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2 9) adjustments in the progress schedule to reflect the impact thereon of new developments. these will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto

Substitutes or "Or-Equal" Items.

6 7.1 Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier the naming of the item is intended to establish the type, function and quality required Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other Suppliers may be accepted by ENGINEER if sufficient information is submitted by CONTRACTOR to allow ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named The procedure for review by ENGINEER will include the following as supplemented in the General Requirements Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified The application will state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or

royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute ENGINEER may require CONTRACTOR to furnish at CONTRACTOR's expense additional data about the proposed substitute

6.7.2 If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to ENGINEER, if CONTRACTOR submits sufficient information to allow ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents The procedure for review by ENGINEER will be similar to that provided in paragraph 6 7.1 as applied by ENGINEER and as may be supplemented in the General Requirements

6 7.3 ENGINEER will be allowed a reasonable time within which to evaluate each proposed substitute. ENGINEER will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute ENGINEER will record time required by ENGINEER and ENGINEER's consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Contract Documents occasioned thereby Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's consultants for evaluating each proposed substitute

Concerning Subcontractors, Suppliers and Others:

6 8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be increased by the difference in the cost occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work

6.9 CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.10 The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6 11 All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER and contains waiver provisions as required by paragraph 5 11 CONTRACTOR shall pay each Subcontractor a just share of any insurance moneys received by CONTRACTOR on account of losses under policies issued pursuant to paragraphs 5 6 and 5 7.

Patent Fees and Royalties:

6.12 CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER

or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees and court and arbitration costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights

Permits: **See SC-6.13**

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or if there are no Bids on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Laws and Regulations:

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations

6.14.2. If CONTRACTOR observes that the Specifications or Drawings are at variance with any Laws or Regulations, CONTRACTOR shall give ENGINEER prompt written notice thereof, and any necessary changes will be authorized by one of the methods indicated in paragraph 3.4. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to such Laws or Regulations, and without such notice to ENGINEER, CONTRACTOR shall bear all costs arising therefrom; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and Regulations.

Taxes:

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

Use of Premises:

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against OWNER or ENGINEER by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold OWNER and ENGINEER harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against OWNER or ENGINEER to the extent based on a claim arising out of CONTRACTOR's performance of the Work

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Directive Changes, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon com-

pletion of the Work, these record documents, samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection: **See SC-6.20**

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1 all employees on the Work and other persons and organizations who may be affected thereby;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR) CONTRACTOR's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion)

6.21. CONTRACTOR shall designate a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR's superintendent unless otherwise designated in writing by CONTRACTOR to OWNER

Emergencies:

6.22. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER or OWNER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken in response to an emergency, a Work Directive Change or Change Order will be issued to document the consequences of the changes or variations.

Shop Drawings and Samples:

6.23. After checking and verifying all field measurements and after complying with applicable procedures specified in the General Requirements, CONTRACTOR shall submit to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawing submissions (see paragraph 2.9), or for other appropriate action if so indicated in the Supplementary Conditions, five copies (unless otherwise specified in the General Requirements) of all Shop Drawings, which will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents with respect to the review of the submission. All submissions will be identified as ENGINEER may require. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable ENGINEER to review the information as required

6.24. CONTRACTOR shall also submit to ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended.

6.25.1. Before submission of each Shop Drawing or sample CONTRACTOR shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each Shop Drawing or sample with other Shop Drawings and samples and with the requirements of the Work and the Contract Documents

6.25.2. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents, and, in addition, shall cause a specific notation to be made on

each Shop Drawing submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve with reasonable promptness Shop Drawings and samples, but ENGINEER's review and approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER's review and approval of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.2 and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the provisions of paragraph 6.25.1.

6 28 Where a Shop Drawing or sample is required by the Specifications, any related Work performed prior to ENGINEER's review and approval of the pertinent submission will be the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6 29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as CONTRACTOR and OWNER may otherwise agree in writing.

Indemnification:

6 30. To the fullest extent permitted by Laws and Regulations CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER and their consultants, agents and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom and (b) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder or arises by or is imposed by Law and Regulations regardless of the negligence of any such party.

6 31. In any and all claims against OWNER or ENGINEER or any of their consultants, agents or employees by any employee of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.30 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor or other person or organization under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts

6.32. The obligations of CONTRACTOR under paragraph 6.30 shall not extend to the liability of ENGINEER, ENGINEER's consultants, agents or employees arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications

ARTICLE 7—OTHER WORK

Related Work at Site:

7.1. OWNER may perform other work related to the Project at the site by OWNER's own forces, have other work performed by utility owners or let other direct contracts therefor which shall contain General Conditions similar to these If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to CONTRACTOR prior to starting any such other work; and, if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the extent thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

7.2. CONTRACTOR shall afford each utility owner and other contractor who is a party to such a direct contract (or OWNER, if OWNER is performing the additional work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work, and shall properly connect and coordinate the Work with theirs CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CON-

TRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors

7.3 If any part of CONTRACTOR's Work depends for proper execution or results upon the work of any such other contractor or utility owner (or OWNER), CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. CONTRACTOR's failure so to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or non-apparent defects and deficiencies in the other work.

Coordination: **See SC-7.4**

7.4 If OWNER contracts with others for the performance of other work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in the Supplementary Conditions, and the specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided in the Supplementary Conditions. Unless otherwise provided in the Supplementary Conditions, neither OWNER nor ENGINEER shall have any authority or responsibility in respect of such coordination.

ARTICLE 8—OWNER'S RESPONSIBILITIES

8.1 OWNER shall issue all communications to CONTRACTOR through ENGINEER

See SC-8.2

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER. Any dispute in connection with such appointment shall be subject to arbitration.

8.3 OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and in existing structures which have been utilized by ENGINEER in preparing the Drawings and Specifications.

8.5. OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.8.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4

8.8. In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

ARTICLE 9—ENGINEER'S STATUS DURING CONSTRUCTION

Owner's Representative:

9.1. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

Visits to Site:

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-site observations as an experienced and qualified design professional, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defects and deficiencies in the Work.

Project Representation: **See SC-9.3**

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in observing the performance of the Work. The duties, responsibilities and limitations of authority of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions. If OWNER designates another agent to represent OWNER at the site who is not ENGINEER's agent or employee, the duties, responsibilities and limitations of authority of such other person will be as provided in the Supplementary Conditions

Clarifications and Interpretations:

9.4 ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If CONTRACTOR believes that a written clarification or interpretation justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Article 11 or Article 12.

Authorized Variations in Work:

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER, and also on CONTRACTOR who shall perform the Work involved promptly. If CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

Rejecting Defective Work: **See SC-9.6**

9.6. ~~ENGINEER will have authority to disapprove or~~ reject Work which ~~ENGINEER believes to be~~ *defective*, and will also have authority to ~~require special inspection or testing~~ of the Work ~~as provided in paragraph 13.9, whether or not the Work~~ is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7 In connection with ENGINEER's responsibility for Shop Drawings and samples, see paragraphs 6.23 through 6.29 inclusive.

9.8 In connection with ENGINEER's responsibilities as to Change Orders, see Articles 10, 11 and 12.

9.9 In connection with ENGINEER's responsibilities in respect of Applications for Payment, etc., see Article 14.

Determinations for Unit Prices:

9.10 ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decisions thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other party to the Agreement and to ENGINEER written notice of intention to appeal from such a decision.

Decisions on Disputes:

9.11 ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Time will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph, which ENGINEER will render in writing within a reasonable time. Written notice of each such claim, dispute and other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the occurrence of the event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after such occurrence unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

9.12 When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 and 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter.

Limitations on ENGINEER's Responsibilities:

9.13. Neither ENGINEER's authority to act under this Article 9 or elsewhere in the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.

9.14 Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed" "as approved" or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be

effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16.

9.15 ENGINEER will not be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.16 ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

ARTICLE 10—CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by a Written Amendment, a Change Order, or a Work Directive Change. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2 If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of a Work Directive Change, a claim may be made therefor as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.4 and 3.5, except in the case of an emergency as provided in paragraph 6.22 and except in the case of uncovering Work as provided in paragraph 13.9.

10.4 OWNER and CONTRACTOR shall execute appropriate Change Orders (or Written Amendments) covering:

10.4.1. changes in the Work which are ordered by OWNER pursuant to paragraph 10.1, are required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or are agreed to by the parties;

10.4.2 changes in the Contract Price or Contract Time which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5 If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11—CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at his expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3 The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

11.3.1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3, inclusive).

11 3.2. By mutual acceptance of a lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11 6 2 1)

11 3.3 On the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's Fee for overhead and profit (determined as provided in paragraphs 11.6 and 11.7).

Cost of the Work: **See SC-11.4**

11 4 The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5

11 4 1 Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto Such employees shall include superintendents and foremen at the site The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER

11 4 2 Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER All trade discounts, rebates and refunds and all returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11 4 3 Payments made by CONTRACTOR to the Subcontractors for Work performed by Subcontractors If required by OWNER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids will be accepted If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as CONTRACTOR's Cost of the Work All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable

11.4.4 Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work

11 4 5 Supplemental costs including the following

11.4.5 1 The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work

11 4 5 2 Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11 4.5 3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof—all in accordance with terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11 4 5 4 Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4 5.5. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses

11 4 5 6. Losses and damages (and related expenses), not compensated by insurance or otherwise, to the Work or otherwise sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's Fee. If, however, any such loss or damage

requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work and premiums for property insurance coverage within the limits of the deductible amounts established by OWNER in accordance with paragraph 5.9.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4—all of which are to be considered administrative costs covered by the CONTRACTOR's Fee.

11.5.2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

11.5.3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR'S capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of *defective* Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

11.5.6. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

CONTRACTOR's Fee: **See SC-11.6**

11.6. The CONTRACTOR's Fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee, or if none can be agreed upon,

11.6.2. a fee based on the following percentages of the various portions of the Cost of the Work.

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2, the CONTRACTOR's Fee shall be fifteen percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the CONTRACTOR's Fee shall be five percent; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to CONTRACTOR on account of overhead and profit of all Subcontractors shall be fifteen percent;

11.6.2.3. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.4. the amount of credit to be allowed by CONTRACTOR to OWNER for any such change which results in a net decrease in cost will be the amount of the actual net decrease plus a deduction in CONTRACTOR's Fee by an amount equal to ten percent of the net decrease; and

11.6.2.5. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's Fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.4, inclusive.

11.7. Whenever the cost of any Work is to be determined pursuant to paragraph 11.4 or 11.5, CONTRACTOR will submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be done by such Subcontractors or Suppliers and for such sums within the limit of the allowances as may be acceptable to ENGINEER. CONTRACTOR agrees that:

11.8.1. The allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the

allowances. No demand for additional payment on account of any thereof will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

Unit Price Work:

11.9.1 Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with Paragraph 9.10

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

See SC-11.9.3

11.9.3. Where the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement and there is no corresponding adjustment with respect to any other item of Work and if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof, CONTRACTOR may make a claim for an increase in the Contract Price in accordance with Article 11 if the parties are unable to agree as to the amount of any such increase.

ARTICLE 12—CHANGE OF CONTRACT TIME

12.1 The Contract Time may only be changed by a Change Order or a Written Amendment Any claim for an extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of CONTRACTOR if a claim is made therefor as provided in paragraph 12.1. Such delays shall include, but not be limited to, acts or neglect by OWNER or others performing additional work as contemplated by Article 7, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God.

12.3. All time limits stated in the Contract Documents are of the essence of the Agreement The provisions of this Article 12 shall not exclude recovery for damages (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) for delay by either party

ARTICLE 13—WARRANTY AND GUARANTEE, TESTS AND INSPECTIONS, CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

Warranty and Guarantee:

13.1. CONTRACTOR warrants and guarantees to OWNER and ENGINEER that all Work will be in accordance with the Contract Documents and will not be *defective*. Prompt notice of all defects shall be given to CONTRACTOR. All *defective* Work, whether or not in place, may be rejected, corrected or accepted as provided in this Article 13

Access to Work:

13.2. ENGINEER and ENGINEER's representatives, other representatives of OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide proper and safe conditions for such access.

Tests and Inspections:

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals

13.4. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefor, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval. CONTRACTOR shall also

be responsible for and shall pay all costs in connection with any inspection or testing required in connection with OWNER's or ENGINEER's acceptance of a Supplier of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work. The cost of all inspections, tests and approvals in addition to the above which are required by the Contract Documents shall be paid by OWNER (unless otherwise specified).

13.5. All inspections, tests or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to OWNER and CONTRACTOR (or by ENGINEER if so specified).

13.6. If any Work (including the work of others) that is to be inspected, tested or approved is covered without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation. Such uncovering shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice

13.7 Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from CONTRACTOR's obligations to perform the Work in accordance with the Contract Documents.

Uncovering Work:

13.8 If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall bear all direct, indirect and consequential costs of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, (including but not limited to fees and charges of engineers, architects, attorneys and other professionals), and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefor as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

Owner May Stop the Work:

13.10. If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any other party

See SC-13.11

Correction or Removal of Defective Work:

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work whether or not fabricated, installed or completed, or if the Work has been rejected by ENGINEER, remove it from the site and replace it with *nondefective* Work. CONTRACTOR shall bear all direct, indirect and consequential costs of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) made necessary thereby.

One Year Correction Period: **See SC-13.12**

13.12. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions, either correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with *nondefective* Work. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) will be paid by CONTRACTOR. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment

Acceptance of Defective Work:

13.13. If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall bear all direct, indirect and consequential

costs attributable to OWNER's evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14. If CONTRACTOR fails within a reasonable time after written notice of ENGINEER to proceed to correct and to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees such access to the site as may be necessary to enable OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs of OWNER in exercising such rights and remedies will be charged against CONTRACTOR in an amount approved as to reasonableness by ENGINEER, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such direct, indirect and consequential costs will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, all court and arbitration costs and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14—PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1. The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment: **See SC-14.2**

14.2. ~~At least twenty days before each progress payment is scheduled (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.~~ If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

See SC-14.4

Review of Applications for Progress Payment:

14.4. ENGINEER will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. ~~Ten days after presentation of the Application for Payment with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.~~

14.5. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a

representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the Work in progress as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules that the Work has progressed to the point indicated; that, to the best of ENGINEER's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation); and that CONTRACTOR is entitled to payment of the amount recommended. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or OWNER to withhold payment to CONTRACTOR

14.6. ENGINEER's recommendation of final payment will constitute an additional representation by ENGINEER to OWNER that the conditions precedent to CONTRACTOR's being entitled to final payment as set forth in paragraph 14.13 have been fulfilled.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such representations to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended; to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1. the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4. of ENGINEER's actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.9 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work or Liens have been filed in connection with the Work or there are other items entitling OWNER to a set-off against the amount recommended, but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action.

Substantial Completion:

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list

Partial Utilization:

14.10. Use by OWNER of any finished part of the Work, which has specifically been identified in the Contract Docu-

ments, or which OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and useable part of the Work that can be used by OWNER without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefor If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14 8 and 14 9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto

14 10.2. OWNER may at any time request CONTRACTOR in writing to permit OWNER to take over operation of any such part of the Work although it is not substantially complete. A copy of such request will be sent to ENGINEER and within a reasonable time thereafter OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If CONTRACTOR does not object in writing to OWNER and ENGINEER that such part of the Work is not ready for separate operation by OWNER, ENGINEER will finalize the list of items to be completed or corrected and will deliver such list to OWNER and CONTRACTOR together with a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work which will become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing and so informed ENGINEER). During such operation and prior to Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on said list and to complete other related Work

14.10.3. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection: **See SC-14.11**

14.11 ~~Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or *defective* CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.~~

Final Application for Payment:

14 12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in paragraph 6 19) and other documents—all as required by the Contract Documents, and after ENGINEER has indicated that the Work is acceptable (subject to the provisions of paragraph 14.16), CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu thereof and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible, have been paid or otherwise satisfied, and consent of the surety, if any, to final payment. If any Subcontractor or Supplier fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien

Final Payment and Acceptance:

14.13 If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation—all as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. Thereupon ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14 16

Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance, and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Contractor's Continuing Obligation:

14.15. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by ENGINEER, nor the issuance of a certificate of Substantial Completion, nor any payment by OWNER to CONTRACTOR under the Contract Documents, nor any use or occupancy of the Work or any part thereof by OWNER, nor any act of acceptance by OWNER nor any failure to do so, nor any review and approval of a Shop Drawing or sample submission, nor the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13, nor any correction of *defective* Work by OWNER will constitute an acceptance of Work not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents (except as provided in paragraph 14.16).

Waiver of Claims:

14.16. The making and acceptance of final payment will constitute:

14.16.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from *defective* Work appearing after final inspection pursuant to paragraph 14.11 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, however, it will not constitute a waiver by OWNER of any rights in respect of CONTRACTOR's continuing obligations under the Contract Documents; and

See SC-14.16.2

14.16.2. ~~a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.~~

ARTICLE 15—SUSPENSION OF WORK AND TERMINATION

Owner May Suspend Work:

15.1. OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

Owner May Terminate:

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time relating to the bankruptcy or insolvency;

15.2.2. if a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency;

15.2.3. if CONTRACTOR makes a general assignment for the benefit of creditors;

15.2.4. if a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR's creditors;

15.2.5. if CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

15.2.6. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents

(including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as revised from time to time);

15.2.7. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction,

15.2 8. if CONTRACTOR disregards the authority of ENGINEER, or

15.2 9. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if there be one) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) such excess will be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such costs incurred by OWNER will be approved as to reasonableness by ENGINEER and incorporated in a Change Order, but when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement In such case, CONTRACTOR shall be paid for all Work executed and any expense sustained plus reasonable termination expenses, which will include, but not be limited to, direct, indirect and consequential costs (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs)

Contractor May Stop Work or Terminate:

15.5 If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted, or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, terminate the Agreement and recover from OWNER payment for all Work executed and any expense sustained plus reasonable termination expenses In addition and in lieu of terminating the Agreement, if ENGINEER has failed to act on an Application for Payment or OWNER has failed to make any payment as aforesaid, CONTRACTOR may upon seven days' written notice to OWNER and ENGINEER stop the Work until payment of all amounts then due The provisions of this paragraph shall not relieve CONTRACTOR of the obligations under paragraph 6.29 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with OWNER.

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See SC-16

ARTICLE 16—ARBITRATION

16.1. All claims, disputes and other matters in question between OWNER and CONTRACTOR arising out of, or relating to the Contract Documents or the breach thereof (except for claims which have been waived by the making or acceptance of final payment as provided by paragraph 14.16) will be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining subject to the limitations of this Article 16. This agreement so to arbitrate and any other agreement or consent to arbitrate entered into in accordance herewith as provided in this Article 16 will be specifically enforceable under the prevailing law of any court having jurisdiction.

16.2. No demand for arbitration of any claim, dispute or other matter that is required to be referred to ENGINEER initially for decision in accordance with paragraph 9.11 will be made until the earlier of (a) the date on which ENGINEER has rendered a decision or (b) the tenth day after the parties have presented their evidence to ENGINEER if a written decision has not been rendered by ENGINEER before that date. No demand for arbitration of any such claim, dispute or other matter will be made later than thirty days after the date on which ENGINEER has rendered a written decision in respect thereof in accordance with paragraph 9.11; and the failure to demand arbitration within said thirty days' period shall result in ENGINEER's decision being final and binding upon OWNER and CONTRACTOR. If ENGINEER renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but will not supersede the arbitration proceedings, except where the decision is acceptable to the parties concerned. No demand for arbitration of any written decision of ENGINEER rendered in accordance with paragraph 9.10 will be made later than ten days after the party making such demand has delivered written notice of intention to appeal as provided in paragraph 9.10.

16.3. Notice of the demand for arbitration will be filed in writing with the other party to the Agreement and with the American Arbitration Association, and a copy will be sent to ENGINEER for information. The demand for arbitration will be made within the thirty-day or ten-day period specified in paragraph 16.2 as applicable, and in all other cases within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

16.4. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder or in any other manner any other person or entity (including ENGINEER, ENGINEER's agents, employees or consultants) who is not a party to this contract unless

16.4.1. the inclusion of such other person or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration,

16.4.2. such other person or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings, and

16.4.3. the written consent of the other person or entity sought to be included and of OWNER and CONTRACTOR has been obtained for such inclusion, which consent shall make specific reference to this paragraph, but no such consent shall constitute consent to arbitration of any dispute not specifically described in such consent or to arbitration with any party not specifically identified in such consent.

16.5. The award rendered by the arbitrators will be final, judgment may be entered upon it in any court having jurisdiction thereof, and will not be subject to modification or appeal except to the extent permitted by Sections 10 and 11 of the Federal Arbitration Act (9 U.S.C. §§10,11).

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ARTICLE 17—MISCELLANEOUS

Giving Notice:

17.1. Whenever any provision of the Contract Documents requires the giving of written notice; it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Time:

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight shall constitute a day.

General:

17.3 Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose

17.4. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.30, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply. All representations, warranties and guarantees made in the Contract Documents will survive final payment and termination or completion of the Agreement.

Supplementary Conditions

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. 1910-8, 1983 edit) hereinafter referred to as the General Conditions, and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

SC-1 The terms used in the Contract Documents which are defined in the General Conditions have the meanings assigned to them in the General Conditions except as herein modified.

Delete the definition of Contract Documents in Article 1 of the General Conditions in its entirety and insert the following in its place:

> Contract Documents -- The documents which comprise the Contract Documents are set forth in the Agreement.

Delete the definition of Engineer in Article 1 of the General Conditions in its entirety and insert the following in its place:

> Engineer -- The Engineer for the Project and the Engineer's address for official notification are given in the Agreement. Where the terms Engineer/Architect, E/A or Architect occur in the Contract Documents they shall be considered synonymous with Engineer and shall have the same meaning.

Add the following definitions to Article 1 of the General Conditions:

> Field Memorandum -- A written statement issued by ENGINEER which clarifies or interprets the Contract Documents in accordance with paragraph 9.4 of the General Conditions.
>
> General Conditions -- Standard General Conditions of the Construction Contract (No. 1910-8, 1983 edit.). Any reference to the General Conditions shall also be a reference to the Supplementary Conditions.

SC-2.3 Delete the last sentence of paragraph 2.3 of the General Conditions and replace it with the following:

> In no event will the Contract Time commence to run later than the thirtieth day after Notice to Proceed is given.

SC-2.6 Delete paragraph 2.6 of the General Conditions in its entirety and insert the following in its place:

> CONTRACTOR shall submit to ENGINEER for review schedules and submittals described in Instructions to Bidders and Division 1 (General Requirements) of the Specifications at the times and in accordance with the procedures indicated.

SC-2.7 Delete paragraph 2.7 of the General Conditions in its entirety and insert the following in its place:

> Certificates and other evidence of insurance which CONTRACTOR is required to purchase and maintain in accordance with Article 5 of the General Conditions shall be submitted in accordance with the procedures described in Instructions to Bidders on the forms included in these Contract Documents.

SC-2.9 Delete the first sentence of paragraph 2.9 of the General Conditions and replace it with the following:

> Before CONTRACTOR starts the Work at the Site, a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to finalize the schedules submitted in accordance with paragraph 2.6.

SC-3.1 Add the following language to the end of paragraph 3.1 of the General Conditions:

> The Contract Documents are intended to be complementary; however, in the case of a discrepancy in the documents, the order of precedence for the documents shall be as established in the Agreement.

SC-3.2 Add the following language prior to the last sentence of paragraph 3.2 of the General Conditions:

> If there is any conflict between the provisions of the Contract Documents and any such referenced provisions, the language of the Contract Documents will take precedence over that of any standard specification, manual or code.

SC-4.2.1 Delete the term "Supplementary Conditions" from the second line of paragraph 4.2.1 of the General Conditions and replace it with the following:

> Division 1 (General Requirements) of the Specifications.

Add the following after the term "such reports" in the seventh line of paragraph 4.2.1 of the General Conditions:

specifically prepared for or by the OWNER.

SC-4.2.2 Delete the term "Supplementary Conditions" from the second line of paragraph 4.2.2 of the General Conditions and replace it with the following:

Division 1 (General Requirements) of the Specifications.

SC-5.3 The insurance required by paragraph 5.3 of the General Conditions shall be written under the following policy forms and shall provide coverage for not less than the following amounts:

Worker's Compensation	Statutory
Employer's Liability	$100,000 Each Occurrence
Commercial General Liability (Bodily Injury and Property Damage Combined Single Limit)	$1,000,000 Each Occurrence
Commercial Automobile Liability (Bodily Injury and Property Damage Combined Single Limit)	$1,000,000 Each Occurrence

The CONTRACTOR may at its option provide the limits of liability set out above by a combination of the above described policy forms and an umbrella excess liability policy.

Add the following new paragraphs to the end of paragraph 5.3 of the General Conditions:

Where used in this paragraph 5.3, "completed operations" shall be replaced by "products and completed operations."

The insurance policy or policies required by this paragraph 5.3 and by paragraph 5.4 of the General Conditions shall include the interests of OWNER and ENGINEER both of whom shall be listed as insured or additional insured parties.

The insurance required by this paragraph 5.3 shall include policy or policies which afford coverage for damage arising out of the perils of explosion, collapse, damage to

Underground Facilities, and operation of boilers and pressure vessels. The policy or policies shall afford the same limits of liability as set forth in these Supplementary Conditions for liability assumed under the contract, including the contractual liability set out in paragraph 5.4 of the General Conditions.

All responsibility for payment of any sums resulting from any deductible provision, corridor, or self-insured retention condition of the policy or policies shall remain with the CONTRACTOR.

These insurance requirements are not to be construed as recommended or maximum amounts. CONTRACTOR is solely responsible for determining the appropriate limits of insurance coverage for injuries or damages resulting from the performance of the Work under the Contract Documents.

Notwithstanding the availability of, or limits on, or deductible provisions in, any insurance provided by CONTRACTOR under this paragraph 5.3, CONTRACTOR shall defend, indemnify, and hold harmless the OWNER and ENGINEER from any and all claims or causes of action alleged to arise from or on account of acts or omissions of CONTRACTOR, its officers, employees, agents, or subcontractors, in performing the Work called for in the Contract Documents.

SC-5.5 Delete paragraph 5.5 of the General Conditions in its entirety.

SC-5.6 Delete paragraph 5.6 of the General Conditions in its entirety and insert the following in its place:

5.6.1 Builders Risk Insurance -- Builders Risk Insurance shall be provided and maintained by CONTRACTOR and the loss made payable to OWNER as trustee to whom it may concern. The insurance shall be written on an "All Risk" basis. The CONTRACTOR is to be responsible for deductibles and uninsured losses, and the OWNER shall be named as an additional insured. The amount of insurance shall be for the full amount of the Contract Price on a completed value basis and the insurance shall contain a "partial occupancy clause."

5.6.2 All responsibility for maintenance of property insurance on the Work (including but not limited

to Builders Risk and Installation Floater) remains solely with the CONTRACTOR who may at its option insure against other perils, and such responsibility shall remain with the CONTRACTOR until such time as the Work is complete and accepted in writing by OWNER. It is a condition of the contract that OWNER and CONTRACTOR waive all rights of recovery against each other for damages caused by perils to the extent covered by any valid and collectible insurance, and further, that any policy not including the standard waiver of subrogation clause be so endorsed as to comply with this paragraph.

SC-5.7 Delete paragraph 5.7 of the General Conditions in its entirety.

SC-5.8 Delete paragraph 5.8 of the General Conditions in its entirety.

SC-5.9 Delete paragraph 5.9 of the General Conditions in its entirety.

SC-5.10 Delete paragraph 5.10 of the General Conditions in its entirety.

SC-5.11 Delete paragraph 5.11.1 and 5.11.2 of the General Conditions in their entirety.

SC-5.12 Delete paragraph 5.12 of the General Conditions in its entirety.

SC-5.13 Delete paragraph 5.13 of the General Conditions in its entirety.

SC-5.14 Delete paragraph 5.14 of the General Conditions in its entirety and insert the following in its place:

If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with Article 5 of the General Conditions on the basis of its not complying with the Contract Documents, OWNER will notify CONTRACTOR in writing. CONTRACTOR shall immediately take the required actions to purchase and maintain insurance in conformance with the Contract Documents. It shall be the CONTRACTOR's sole responsibility to purchase and maintain insurance meeting the requirements of the Contract Documents and failure of OWNER to furnish written comment shall not be construed as acceptance or approval of CONTRACTOR's insurance.

SC-5.16 Add the following to the end of Article 5 of the General Conditions:

General Insurance Requirements:

5.16 The insurance required under these Contract Documents shall be maintained with an insurance carrier licensed to do business in the State in which the site is located.

5.17 All insurance agents or broker's for coverage required under these Contract Documents shall have in force and effect errors and omissions coverage in limits of not less than $500,000 per occurrence and $500,000 aggregate. Evidence of such insurance shall be provided upon request of OWNER or ENGINEER.

SC-6.13 CONTRACTOR shall obtain and pay for all construction permits and licenses, except as noted below:

1. OWNER will waive all local permit fees. State and other non-local surcharges will be assessed.

CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work. CONTRACTOR shall pay all charges of utility owners for connections to the Work, except as noted below:

1. OWNER will apply for permits and pay fees required for the connection of the plant to the sanitary sewer system as required by the Metropolitan Waste Control Commission.

2. OWNER will apply for permits and pay fees required by the Minnesota Department of Health for construction of a water treatment facility (excluding costs associated with plumbing permit fees).

SC-6.20 Add the following to paragraph 6.20 of the General Conditions:

The CONTRACTOR shall be solely and completely responsible for conditions on the job site, including safety and health of all persons and property during the performance of the Work. This requirement shall apply continuously and not be limited to normal work hours.

Observation of the CONTRACTOR's performance by ENGINEER or OWNER is not intended to include review of the adequacy of the CONTRACTOR's safety measures on or near the Site.

SC-7.4 Delete paragraph 7.4 of the General Conditions in its entirety and replace it with the following:

Other contracts OWNER has for performance of other work on or related to the Project at the site are identified in Division 1 (General Requirements) of the Specifications. Responsibilities for coordination of the activities among the various prime contractors are also identified. Neither OWNER nor ENGINEER shall have any authority or responsibility in respect of such coordination.

SC-8.2 Delete paragraph 8.2 of the General Conditions in its entirety and insert the following in its place:

In case of termination of the employment of ENGINEER, OWNER will appoint a new engineer whose status under the Contract Documents will be that of the former ENGINEER.

SC-9.3 Add the following to paragraph 9.3 of the General Conditions:

9.3.1 Resident Project Representative

The Resident Project Representative will act as directed by and under the supervision of ENGINEER. He will confer with the ENGINEER regarding his actions. His dealings in matters pertaining to the on-site work will, in general, be only with ENGINEER and CONTRACTOR. His dealings with Subcontractors will only be through or with the full knowledge of CONTRACTOR or his superintendent.

9.3.1.1 Limitations of Authority

The Resident Project Representative:

a. Cannot authorize deviation from the Contract Documents or approve any substitute materials or equipment;

b. Cannot issue written clarification or interpretation of the requirements of the Contract Documents;

c. Cannot undertake or assume to fulfill any of the responsibilities of ENGINEER under the Contract Documents unless such is specifically called for in the Contract Documents;

d. Cannot undertake any of the responsibilities of CONTRACTOR;

e. Cannot expedite work for CONTRACTOR;

f. Cannot advise on or issue directions relative to any aspects of the means, methods, techniques, sequences or procedures of construction unless specifically called for in the Contract Documents;

g. Cannot advise on or issue directions as to health and safety precautions and programs in connection with the Work.

SC-9.6 Delete paragraph 9.6 of the General Conditions in its entirety and insert the following in its place:

ENGINEER will recommend in writing to OWNER to disapprove or reject Work, which ENGINEER believes to be defective, outlining the reasons the Work is believed to be defective. ENGINEER will recommend any special inspection or testing of the Work as provided in paragraph 13.9 of the General Conditions, whether or not the Work is fabricated, installed or completed.

SC-11.4 Delete paragraphs 11.4 through 11.4.5.9 of the General Conditions in their entirety and insert the following in its place:

The term Cost of Work means the sum of all actual costs necessarily incurred and paid by the CONTRACTOR in the proper performance of the Work plus 15 percent (15%) for overhead and profit. The term "actual cost" shall cover the payroll expenses for the workers employed and supervision required to perform the work including salary, worker's compensation, social security, pension and retirement allowances, and other regular payroll charges. Also included in the actual cost will be the cost of additional insurance needs for this Work and the cost of

all materials and supplies required of either temporary or permanent character including fuel and lubricants.

In addition to the Cost of Work as outlined above, the CONTRACTOR will be paid for all power-driven equipment at a rate equal to 85 percent of the rate listed in the most recent edition of the "Rental Rate Bluebook" published by Neilson/Dataquest, Inc., to which there will be no percentage added for overhead or profit. The rates used for each piece of equipment used in the performance of the work will be based on the applicable monthly, weekly, daily or hourly rate which reflects the status of the particular piece of equipment on the project. All rates shall be subject to approval by the ENGINEER.

The cost of all such work done each day shall be submitted to the ENGINEER in satisfactory form on succeeding day and shall be approved by the ENGINEER or adjusted at once.

SC-11.6 Delete paragraphs 11.6 through 11.6.2.5 of the General Conditions in their entirety.

SC-11.9.3 Delete paragraph 11.9.3 of the General Conditions in its entirety.

SC-13.11 Delete paragraph 13.11 of the General Conditions in its entirety and insert the following in its place:

If required by OWNER, CONTRACTOR shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by OWNER, remove it from the site and replace it with nondefective Work. CONTRACTOR shall bear all direct, indirect and consequential costs of such correction or removal (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals) made necessary thereby.

SC-13.12 Add the following to the end of paragraph 13-12 of the General Conditions:

CONTRACTOR shall acknowledge responsibility for correction of defective Work within one year after substantial completion by execution and submittal of the form included in the Contract Documents titled Contractor Guarantee - Reservation of Rights by the OWNER. Said form shall be submitted prior to OWNER's release of final payment.

SC-14.2 Delete the first sentence paragraph 14.2 of the General Conditions in its entirety and insert the following in its place:

> Not more than once each month, CONTRACTOR shall submit to ENGINEER for review, in accordance with the procedures set forth in Division 1 (General Requirements), an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

SC-14.4 Delete the last sentence of paragraph 14.4 of the General Conditions in its entirety and insert the following in its place.

> Thirty (30) calendar days after presentation to OWNER of the Application for Payment with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

SC-14.11 Delete paragraph 14.11 of the General Conditions in its entirety and insert the following in its place:

> Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final review of the Work with the CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this review reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

SC-14.16.2 Delete paragraph 14.16.2 of the General Conditions in its entirety and insert the following in its place:

> A waiver of all claims by CONTRACTOR against OWNER and ENGINEER other than those previously made in writing and still unsettled.

SC-16 Delete Article 16 of the General Conditions in its entirety.

Bond Of Public Contractor

Approved as to Form and Execution

_____
Date City Attorney

CITY OF ST. LOUIS PARK
BOND OF PUBLIC CONTRACTOR

KNOW ALL MEN BY THESE PRESENTS, that _____
_____
as principal ("Contractor") and _____
_____
a corporation duly organized under the laws of the State of _____ and authorized to transact business as a corporate surety in the State of Minnesota, as surety ("surety"), are held and firmly bound to the City of St. Louis Park, Minnesota, as obligee, ("City") in the sum of _____ _____ dollars, for which payment the Contractor and surety bind themselves, their respective heirs and legal representatives, successors and assigns, jointly and severally.

The conditions of this obligation are that the Contractor has entered into a contract with the City dated _____ for _____ _____ which is specifically made a part hereof by reference.

NOW, THEREFORE, if the Contractor shall perform the contract according to its terms; shall pay as they become due all just claims for work done, tools, machinery, skill, materials, insurance premiums, equipment and supplies as may be provided for the completion of the contract in accordance with its terms; shall indemnify and save the City harmless from all damage that may arise on account of the failure of the Contractor to fully perform the contract or any part thereof, including all costs, damages, and changes that may accrue on account of the doing of the work specified; and shall pay all costs of enforcing the terms of this bond in all actions which may be brought thereon, including reasonable attorneys' fees, shall comply with all laws applicable to the contract; shall, in case the contract price specified in the contract shall for any reason be increased, furnish an additional bond in the sum of at least such increase within ten days after a demand in writing from the City; then this obligation shall become void but otherwise it shall remain in full force and effect.

No modification of the terms of the contract or of the work to be performed, or extensions of time or changes in the mode and manner of payment, nor any forbearance on the part of the City shall in any way release the Contractor of the surety from liability. Notice to the surety of any such modification, extension or forbearance is waived.

EXECUTED as of _____, 19____.

_____	_____
_____	_____
_____	_____
Surety	Principal

(Complete acknowledgments of parties on reverse and attach power of attorney from the surety certified to include the date of the bond.)

Individual Principal

State of Minnesota }
County of Hennepin } ss.

On this ..... day of ....., 19 ....., before me, a .....
within and for said County, personally appeared .....
.....
to me known to be the person described in, and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed.

.....
Notary Public, ... County, Minnesota
My Commission Expires ..... 19....

Partnership Principal

State of Minnesota }
County of Hennepin } ss.

On this ..... day of ....., 19 ....., before me, a .....
within and for said County, personally appeared .....
a member of a partnership consisting of .....
.....
doing business under the firm name and style of .....
to me known to be the person described in, and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed and as the free act and deed of said partnership.

.....
Notary Public, ... County, Minnesota
My Commission Expires ..... 19....

Corporation Principal

State of Minnesota }
County of Hennepin } ss.

On this ..... day of ....., 19 ....., before me, a .....
within and for said County, personally appeared .....
and ....., to me personally known, who, being each by me duly sworn did say that they are respectively the ..... President and the .....
..... of the Corporation named in the foregoing instrument, and that the seal affixed to said instrument is the corporate seal of said corporation, and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors and said ..... and .....,
acknowledged said instrument to be the free act and deed of said corporation.

.....
Notary Public, ... County, Minnesota
My Commission Expires ..... 19....

Surety Company

State of Minnesota }
County of Hennepin } ss.

On this ..... day of ....., 19 ..... before me, a notary public in and for said County, personally appeared ..... to me personally known and being by me duly sworn, did say, that he is the Attorney-in-Fact of .....
....., a corporation of ....., created, organized and existing under and by virtue of the laws of the State of ..... and authorized to contract as surety in the State of Minnesota, that the said instrument was executed on behalf of the corporation by authority of its Board of Directors and that the said .....
..... acknowledges said instrument to be the free act and deed of said corporation and the seal affixed to said instrument is the corporate seal of said corporation.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my official seal at ....., the day and year last above written.

.....
Notary Public, ... County, Minnesota
My Commission Expires ..... 19....

Affidavitt Of Non-Collusion

CITY OF ST. LOUIS PARK, MINNESOTA
5005 MINNETONKA BOULEVARD

AFFIDAVIT AND INFORMATION REQUIRED OF BIDDERS

Affidavit of Non-Collusion:

I hereby swear (or affirm) under the penalty for perjury:

(1) That I am the bidder (if the bidder is an individual), a partner in the bidder (if the bidder is a partnership), or an officer or employee of the bidding corporation having authority to sign on its behalf (if the bidder is a corporation);

(2) That the attached bid or bids have been arrived at by the bidder independently, and have been submitted without collusion with, and without any agreement, understanding, or planned common course of action with any other vendor of materials, supplies, equipment or services described in the invitation to bid, designed to limit independent bidding or competition;

(3) That the contents of the bid or bids have not been communicated by the bidder or its employees or agents to any person not an employee or agent of the bidder or its surety on any bond furnished with the bid or bids, and will not be communicated to any such person prior to the official opening of the bid or bids; and

(4) That I have fully informed myself regarding the accuracy of the statements made in this affidavit.

Signed_____

Firm Name_____

Subscribed and sworn to before me this

_____day of _____, 19___.

_____
Notary Public

My commission expires _____19___.

Bidder's E.I. Number

(Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941):_____.

Withholding Affidavit For Contractors

Form
IC-134
Rev 9/89

Minnesota Department of Revenue

Withholding Affidavit for Contractors

This affidavit must be approved by the Minnesota Department of Revenue before the State of Minnesota or any of its subdivisions can make final payment to contractors

Company name Address City State Zip Code	Minnesota ID number Month/year work began Month/year work ended Total contract amount
Telephone number ( )	Amount still due
Did you have employees work on this project? If none, explain who did the work.	Project number: Project location: Project owner: Address

Check the box that describes your involvement in the project and fill in all information requested in that category:

☐ **Sole contractor**

☐ **Subcontractor** If you are a subcontractor, fill in the name and address of the contractor that hired you:

☐ **Prime Contractor** If you subcontracted out any work on this project, all of your subcontractors must file their own IC-134 affidavits and have them certified by the Department of Revenue before you can file your affidavit. For each subcontractor you had, fill in the business information below, and attach a copy of each subcontractor's certified IC-134. (If you need more space, attach a separate sheet.)

Business name	Address	Owner/Officer

I declare that all information I have filled in on this form is true and complete to the best of my knowledge and belief. I authorize the Department of Revenue to disclose pertinent information relating to this project, including sending copies of this form, to the prime contractor if I am a subcontractor, and to any subcontractors if I am a prime contractor, and to the contracting agency.

Contractor's signature Title Date

For certification, mail to:
Minnesota Department of Revenue, Business Trust Tax Section
Mail Station 6610, St. Paul, MN 55146-6610

Certificate of Compliance with Minnesota Income Tax Withholding Law

Based on records of the Minnesota Department of Revenue, I certify that the contractor who has signed this certificate has fulfilled all the requirements of Minnesota Statutes 290.92 and 290.97 concerning the withholding of Minnesota income tax from wages paid to employees relating to contract services with the state of Minnesota and/or its subdivisions.

Signature of authorized Department of Revenue official Date

Instructions for form IC-134

Who should file?

If you are a prime contractor, a contractor, or a subcontractor who did work on a project for the state of Minnesota or any of its local government subdivisions — such as a county, city, or school district — you must file form IC-134 with the Minnesota Department of Revenue.

This affidavit must be certified and returned before the state or any of its subdivisions can make final payment for your work.

When to file

The IC-134 cannot be processed until you are finished with the work. Do not send the affidavit in for certification before the project is completed since it will only be returned to you unprocessed. If you are a subcontractor or sole contractor, file form IC-134 when you have completed your part of the project.

If you are a prime contractor, file form IC-134 when the entire project is completed and you have received certified affidavits from all of your subcontractors.

Where to file

Fill out form IC-134 and mail the original and one copy to:

Minnesota Department of Revenue
Business Trust Tax Section
Mail Station 6610
St. Paul, MN 55146-6610

How to file

If you have fulfilled the requirements of the withholding tax laws of Minnesota, the Department of Revenue will sign your affidavit, keep the copy, and return the original to you.

If any withholding payments are due to the state, Minnesota law (M.S. 290.97) requires that payment must be made by *only* money order, cashiers check, certified check, or cash.

Take the certified affidavit to your prime contractor or to the governmental unit for which the work was done in order to receive your final payment.

Minnesota tax identification number

You must fill in your Minnesota tax identification number on the form. You must have a Minnesota tax ID number if you have employees who work in Minnesota

If you need a number, get form MBA, Application for Tax Identification Number, and file it with the Minnesota Department of Revenue. To get form MBA, call 296-3781 from the Twin Cities area or 1-800-652-9094 from elsewhere in Minnesota, or write to Minnesota Tax Forms, Mail Station 7131, St. Paul, MN 55146-7131.

You do not need a Minnesota identification number if you have no employees and did all the work yourself. If this is the case, fill in your Social Security number in the space for Minnesota ID number and explain who did the work.

Are you a prime contractor and a subcontractor on the same project?

If you are a subcontractor who was hired to do work on a project and you subcontract all or a part of your portion of the project to another contractor, you become a prime contractor as well. If this is the case, fill out both the subcontractor and prime contractor areas on a single form.

Use of information

The Department of Revenue needs all the information, except your phone number, to determine whether you have met all state income tax withholding requirements. If all required information is not provided, the IC-134 will be returned to you for completion.

All information on this affidavit is guaranteed private by state law. It cannot be given to others without your permission, except to the Internal Revenue Service, other states that guarantee that it will be kept private, and certain state or county agencies.

If you need help or additional information to fill out this form, call 296-6181 in the Twin Cities area. From elsewhere in Minnesota and from outside the state, call (toll-free) 1-800-657-3777

Insurance Agent/Broker's Certification Form

INSURANCE AGENT/BROKER'S CERTIFICATION FORM

TO: City of St. Louis Park
City Hall
St. Louis Park, Minnesota 55416

RE: Insurance Coverage Required by Contract
for Improvement No. _____

The undersigned is an authorized representative of _____ which is the insuring company for _____, the contractor on Improvement No. _____.

In compliance with this contract of the City of St. Louis Park, we certify as follows:

1. We have fully read and checked for compliance the requirements of insurance set forth in the contract documents, a copy of which is attached to this certificate.

2. The contractor has in effect insurance that complies in every respect with the requirements of insurance set forth in the contract documents, including all of the conditions specified:

_____ Yes

_____ No (any required coverage that is not included under this certificate and will be covered by a separate certificate is as follows:_____
_____).

3. Any deductibles in excess of $500.00 applicable to any of the required coverages other than umbrella coverage are as follows:

_____
_____.

4. The name and address of the insurance agent for the coverage included in this certificate is _____
_____.

5. Attach Accord - Certificate of Insurance Form.

_____
Insurance Company

_____
Authorized Representative

Approved as to Form and Execution

_____
Date City Attorney

Enclosure

Sworn Construction Statement

SWORN CONSTRUCTION STATEMENT

Improvement Project No.(s) _____

Type of Improvement _____

Contractor _____

The undersigned, being first duly sworn, deposes and states:

1, He is the (if the general contractor is a corporation here insert the title of the signing party) General Contractor for the above project(s) for the City of St. Louis Park.

2. That there are no parties other than those designated in number 3(b) below to whom any sums will become due for furnishing labor, material, equipment, and machinery for said project(s).

3. That (check either (a) or (b), whichever is applicable):

_____ (a) All parties furnishing labor, material, equipment and machinery have been paid in full, or

_____ (b) Satisfactory financial arrangements have been made to pay all parties from whom the general contractor has secured labor (other than general contractor's own employees), material, equipment, and machinery in connection with said project(s), and fully disclosed on page two hereof, are those that have not been paid in full and waivers of claims will be presented, upon request, by all such persons to whom money is owed in connection with this project.

4. This affidavit is made for the purpose of obtaining final payment from the City of St. Louis Park.

Dated: _____, 19___.

_____
Contractor

By _____
Name and Title

Subscribed and sworn to before me this

_____day of _____, 19___.

_____
Notary Public

_____ County, _____
My commission expires _____, 19__.

Approved by the City of St. Louis Park:

_____
Public Works Department

_____
City Manager

_____
Finance Department

Contractor _____

Contract No. _____

Improvement Project Nos. _____

Type _____

SWORN CONSTRUCTION STATEMENT

TO

CITY OF ST. LOUIS PARK, MINNESOTA

INSTRUCTIONS

This Statement Must Include All Services and Supplies Pertaining to Above Construction Contract.

1. Prepare a statement for each construction contract, instructing your contractors and material men to furnish us with waivers for each certificate issued.

2. Attach names and addresses of all contractors, sub-contractors and material men.

3. Under the heading "Total Contract", enter full amount of your contract with or total amount of services or supplies obtained from each contractor, sub-contractor and material men. Likewise, enter under the heading "Amount Paid" the exact amount you yourself have paid out to the time of making this affidavit. In the next column, headed "Balance Due", enter the difference between the other amounts, or the total you still owe to each contractor, sub-contractor and material man. A statement explaining in detail any and all arrangements which you have entered into with any contractor, sub-contractor or material man to accept as part or full payment any notes, securities, or agreements in lieu of cash must accompany this sworn construction statement.

4. Statements must be properly prepared, acknowledged and filed with us at least one week before payments are desired on your contract.

5. In order to prevent annoying delays do not hesitate to consult us about any part of this statement which is not clear to you.

Contractor Guarantee-Reservation Of Rights By The Owner

CONTRACTOR GUARANTEE - RESERVATION OF RIGHTS BY THE OWNER

The CONTRACTOR warrants to the OWNER that all services, materials, and/or equipment furnished under Contract No. _____, unless otherwise specified in the contract documents, are new and free from faults and defects. All work not conforming to the requirements of the contract documents or material substitutions not properly approved and authorized may be considered defective.

The CONTRACTOR shall be responsible for any and all defects, whether in materials, design, or workmanship, which may develop in any work provided in the contract documents, and upon receipt of written notice from the OWNER or its designated representative shall repair or replace the defective design, services material, equipment, or workmanship without expense to the OWNER, including damage resulting from same. The term of the guarantee shall extend for __1__ year(s) from the date of Substantial Completion.

The OWNER reserves the right to seek recovery against the CONTRACTOR and/or its agents, successors, or insurers by any means available to the OWNER for damages incurred and/or costs associated with repairs thereof, including but not limited to attorneys' fees, expert witness fees and any and all other costs and expenses incurred by the OWNER in seeking such recovery.

This acknowledgement is made for the purpose of confirming the CONTRACTOR'S intent to abide by the provisions of the contract documents, and final payment shall be predicated upon execution of this document.

Dated: _____

_____
Contractor

By _____
Name and Title

Specifications

DIVISION 1 - GENERAL REQUIREMENTS

01010 SUMMARY OF WORK

01200 COORDINATION AND MEETINGS

01300 SUBMITTALS

01400 QUALITY CONTROL

01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

01600 MATERIAL AND EQUIPMENT

01650 PROJECT AND SYSTEMS START-UP

01700 CONTRACT CLOSE-OUT

SECTION 01010
SUMMARY OF WORK

1.01 CONTRACT DOCUMENTS

A. The Contract Documents are as defined in the Agreement. The terms of all the Contract Documents apply to these Specifications as fully as though repeated herein.

B. The format of these Specifications is based upon the CSI MASTER FORMAT. However, differences in format and subject matter location do exist. It is the Contractor's sole responsibility to thoroughly review and understand all portions of these Specifications and request written clarification of those portions which are unclear.

C. Division of the Work as made in these Contract Documents is for the purpose of specifying and describing all work which is to be completed. There has been no attempt to make a classification according to trade or any agreements which may exist between Contractor, Subcontractors, or trade unions or other organizations. Such division and classification of the Work shall be the Contractor's sole responsibility.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The overall scope of the Work which is more fully described in these Contract Documents includes, but is not limited to, furnishing all labor, tools, equipment and materials necessary to:

1. Design, fabricate, deliver and install four (4) ASME certified pressure vessels to contain granular activated carbon for the treatment of water contaminated with polynuclear aromatic hydrocarbons (PAHs). Total plant capacity under normal operating conditions will be 1,200 gallons per minute (gpm) with normal operation being 600 gpm through each of two pairs of vessels. Each pair of vessels can be operated in a series or parallel mode.

2. Furnish, deliver, and install approximately 80,000 pounds of granular activated carbon (GAC).

3. Design, fabricate, deliver, and install a package iron/manganese removal system that includes a pressure iron filter with multiple cells, filter media, all piping and valves, and controls.

4. Construct process piping to convey raw water to the treatment systems, convey treated water from the treatment systems to the Owner's distribution system, convey water at boosted pressure to the contactor vessels for backflushing, and convey water used for backflushing from the treatment systems to the sanitary sewer.

5. Construct process piping to allow transfer of carbon into and out of the contactor vessels. Carbon will be transferred as a slurry by pressurizing the vessel or transfer truck with air. The carbon transfer air compressor and piping shall be part of the Work.

6. Construct a structure to enclose the process equipment, process piping, electrical controls and mechanical equipment. Construct a below grade tank to contain water from backwash and backflush operations.

7. Furnish and install a complete chemical feed system for chlorinating and fluoridating treated water prior to its distribution for potable consumption, and for chlorinating water prior to iron/manganese filtration.

8. Furnish and install all controls and building electrical systems required to regulate the treatment processes and the Owner's Well 4 that will provide influent to the facility.

9. Furnish and install all mechanical equipment, piping and appurtenances required for complete potable water, sanitary sewer, heating, ventilating, dehumidification, and air scrubbing systems as specified.

10. Construct on-site utility piping modifications to convey water from the facility to Owner's distribution system, connect to the sanitary sewer, and connect to the storm sewer.

11. Construct access drives and parking areas including bituminous pavement, concrete pavement, concrete sidewalks, aggregate base, and concrete curb and gutter.

12. Completely finish the site to the specified grades and furnish additional fill or dispose of excess material as necessary.

13. Completely landscape the site as specified.

B. It is the intent of the Contract Documents to cover all aspects of the Project and that the Project shall be complete and fully

functional. Paragraph 3.2 of the General Conditions describes Contractor's obligations with respect to items required but not specifically identified by the Specifications.

C. The Work includes the furnishing of all equipment and machinery such as scaffolds, false work, forms, centers and other items required for the construction of a complete Project as specified. Equipment furnished shall be in safe operating condition and of adequate size, capacity and condition for the performance of the Work.

D. The Contractor shall obtain all measurements necessary for the Work and shall be responsible for establishing all dimensions, levels and layout of the Work. Where work of one trade joins to or is part of other work, there shall be no discrepancy or incompleteness in the finished Work.

E. The Contractor shall be solely responsible for coordinating all parts of the Work and at the proper time provide and set all required anchors, blocking, sleeves and inserts, whether or not specifically shown on the Contract Drawings or described in these Specifications.

F. The Work includes all cutting and patching, cleaning, testing, and systems start-up required for a complete Project meeting these Specifications whether or not specifically identified herein.

1.03 ABBREVIATIONS

A. Where used in these Specifications, the following abbreviations have the meanings indicated:

1. AASHO - American Association of State Highway Officials
2. ACI - American Concrete Institute
3. AFBMA - Anti-Friction Bearing Manufacturers Association
4. AGA - American Gas Association
5. AISC - American Institute of Steel Construction
6. AISI - American Iron and Steel Institute
7. AMCA - Air Movement and Control Association
8. ANSI - American National Standards Institute
9. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
10. ASME - American Society of Mechanical Engineers
11. ASPA - American Sod Producers Association
12. ASTM - American Society for Testing Materials
13. AWPA - American Wood Preservers Association
14. AWS - American Welding Society
15. AWWA - American Water Works Association
16. BOCA - Building Officials and Code Administrators

17. CRSI - Concrete Reinforcing Steel Institute
18. CSI - Construction Specifications Institute
19. HUD - Housing and Urban Development (United States Department of)
20. ICEA - Insulated Cable Engineers Association
21. IEEE - Institute of Electrical and Electronics Engineers
22. MnDOT - Minnesota Department of Transportation
23. MPCA - Minnesota Pollution Control Agency
24. NAAMM - National Association of Architectural Metal Manufacturers
25. NACE - National Association of Corrosion Engineers
26. NEC - National Electrical Code
27. NEMA - National Electrical Manufacturers Association
28. NFPA - National Fire Protection Association
29. NFPA - National Forest Products Association
30. NPT - National Pipe Thread
31. OSHA - Occupational Safety and Health Administration
32. PCI - Prestressed Concrete Institute
33. SMACNA - Sheet Metal and Air-Conditioning Contractors National Association
34. SSPC - Steel Structures Painting Council
35. UBC - Uniform Building Code
36. UL - Underwriters Laboratories

1.04 WORK BY OWNER

A. Owner will award a contract for the removal of the stone veneer from the existing wellhouse. That work will be complete prior to the start of Work under this contract.

B. Owner will award a contract for modification of Owner's telemetry system at its existing master control panel at City Hall. Owner's telemetry system contractor will also fabricate a telemetry panel that Owner will furnish to Contractor for installation under this contract (see Division 16 of these Specifications).

C. Contractor's obligations with regard to coordination with other work are more fully set forth in Article 7 of the General Conditions.

1.05 OWNER FURNISHED PRODUCTS

A. All labor, equipment, and materials required for a complete Project are to be furnished by Contractor under the terms of these Contract Documents, except as noted below:

1. Owner will furnish a telemetry panel for installation by Contractor under these Contract Documents. Details of

Contractor's responsibilities are set forth in Division 16 of these Specifications.

1.06 SEQUENCE OF OPERATION

A. The Owner requires that construction activities performed exterior to the proposed building (including excavation, buried utilities, foundations and below grade construction, and substantial site restoration) be performed during the period June 15 to September 7. This requirement is intended to minimize disruption of classes at the adjacent Susan B. Lindgren School. Contractor's Schedule of Operations required under paragraph 2.6 of the General Conditions shall show Contractor's proposed construction sequence so as to meet this requirement.

B. The Contractor shall schedule its operations so as to minimize the disruption of public streets. Work within the limits of street rights-of-way shall not begin, and the existing paved street surface shall not be removed, until Contractor is prepared to complete all operations that require disturbance of the pavement surface. Once disturbed, Work shall progress in an orderly fashion to permit restoration of traffic and the pavement surface in the shortest time possible. Contractor's Schedule of Operations required under paragraph 2.6 of the General Conditions shall show Contractor's proposed construction sequence so as to meet this requirement.

C. Contractor's operations shall not block vehicle access required by residents, businesses, or institutions in the vicinity of the Site without prior notification of Owner, Engineer, and affected parties at least 24 hours in advance. At no time shall access be restricted for more than 8 hours without restoring access for at least 24 hours. Contractor shall assist residents with transfer of parcels to and from their residence and their vehicle when vehicle access has been restricted by Contractor's operations.

D. Contractor shall schedule its operations so as to assure that previously completed portions of the Work are not adversely affected by Contractor's subsequent operations. Contractor's Schedule of Operations shall include sufficient detail to demonstrate how Contractor intends to meet this requirement. Alternatively, Contractor shall identify specific methods that will verifiably prevent damage caused by subsequent Work.

E. Contractor shall schedule its operations to meet the time deadlines established in the Agreement, taking into consideration all job conditions that may affect the performance of the Work.

1.07 CONTRACTOR USE OF PREMISES

A. Definition of Site

All Contractor activities shall be confined to within the construction limits shown on the Drawings. Contractor shall be responsible for making arrangements for off-site parking away from the residential streets in the vicinity of the Site, in order to minimize the number of employee vehicles parked at the Site. Parking of more than six Contractor-related vehicles on public streets in the vicinity of the Site will not be allowed. Vehicles parked on the street shall be only those used for transportation of workers to and from the Site. All other vehicles and equipment used for the Work shall be confined to the Site.

B. Hours of Operation

The Contractor's hours of operation shall be confined to between 7:00 a.m. and 6:00 p.m. (central time), Monday through Friday, and shall include official holidays, without the prior written approval of Owner. This includes starting and operation of machinery; delivery of equipment, materials and machinery to the site; construction activity and any other activity which in the opinion of the Owner is disrupting to the surrounding community.

C. Protection and Repair of Existing Facilities and Utilities

Contractor shall conduct all Work carefully and in such a manner as to protect existing facilities and utilities. Obstructions not shown on the Contract Drawings shall be exposed by the Contractor without damage. Contractor shall be responsible for any damage to existing work, structures, and Underground Facilities and utilities resulting from Contractor's operations, and shall repair or replace any damaged item to the satisfaction of and at no additional cost to the Owner.

D. Unfavorable Construction Conditions

When unfavorable weather, soil, drainage or other unsuitable construction conditions exist, the Contractor shall confine its operations to work which will not be adversely affected by said unfavorable conditions. No portion of the Work shall be constructed under conditions which would adversely affect the quality of the specified Work unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

E. Monuments and Survey Markers

The Contractor shall conduct its operations in such a manner as to preserve all monuments, bench marks, survey reference points, and stakes existing or established for the construction. In the case of damage, Contractor will be charged with the expense of replacement and shall be responsible for any mistake or loss of time that may result from such damage. The Contractor shall not move any permanent monument or bench mark without prior approval of Engineer and until such monument or bench mark has been properly referenced for relocation. The Contractor shall furnish material, equipment and assistance required for the replacement of monuments and bench marks.

F. Site Access and Access to the Work

Contractor shall at all times provide access to all aspects of the Work to Owner and Engineer by furnishing keys to all locks or other means to physically access the Work. Where vehicle access is required by Owner or Engineer for testing, removal of Owner's property or any other reason, Contractor shall provide a graded access road acceptable for the particular vehicle used.

G. Noise

Contractor shall make all reasonable efforts to minimize the intensity and duration of noise resulting from construction activities so as to minimize impacts on the surrounding residential neighborhood. Such efforts shall include, but not be limited to, maintaining mufflers and other noise reducing parts in good condition, using contemporary equipment designed to low noise output, locating equipment so as to screen potential noise receptors, sequencing operations so as to combine and complete noisy operations as quickly as possible, constructing temporary sound walls (straw bales, etc.) around noisy stationary equipment, and other similar actions as may reasonably be requested by Contractor to comply with this requirement.

1.08 PARTIAL OWNER OCCUPANCY

It is not anticipated that Owner will require occupancy or utilization of the Work prior to Substantial Completion. Warranty periods on all products will commence upon Substantial Completion as described in the General Conditions.

1.09 AVAILABLE REPORTS AND INFORMATION

A. Numerous water quality samples have been collected and analyzed that show the presence of several polynuclear aromatic hydrocarbon (PAH) compounds in the water from Well 4. A summary of these analyses is available for review in the office of the Engineer by appointment. More comprehensive reports of those analyses are available for review in the office of the Owner by appointment.

B. Soil borings have been performed at the site at the locations shown on the Drawings. Logs of those borings are available for review in the office of the Engineer by appointment.

C. Various record drawings are available that show the configuration of City-owned utilities on or near the site. A portion of these have been furnished by Owner to Engineer and are available for review in the office of the Engineer by appointment. A complete compilation is available for review in the office of the Owner by appointment.

D. The condition of Well 4 was evaluated during the summer of 1990, including video logging and determination of casing alignment. The reports and video materials produced for this evaluation are available for review in the office of the Engineer by appointment.

E. Photographs of the interior and exterior of the existing wellhouse are available for review in the office of the Engineer by appointment.

END OF SECTION 01010

SECTION 01200
COORDINATION AND MEETINGS

1.01 COORDINATION

A. Contractor shall be completely responsible for coordinating all aspects of the Work, as more fully described in Articles 6 and 7 of the General Conditions and the remainder of these Specifications.

B. Contractor shall be completely responsible for the division of the Work among the various trades and Subcontractors and for assuring that the Work of the various Sections of the Specifications is completed in an orderly sequence incorporating all interdependent elements, whether specifically identified or not.

C. Contractor shall be responsible for assuring that the Work of one trade or Subcontractor does not impact the ability of another trade or Subcontractor to provide the completed Work as specified. This includes, but is not limited to, providing all labor, equipment, and materials to protect the various portions of the Work during construction until the Work is completed. Should Contractor fail to protect the Work, Contractor shall be responsible for all costs associated with providing completed Work that meets these Specifications. This specifically includes, but is not limited to, protecting concrete and other surfaces that are to remain unpainted from chipping, staining, spills, and other damage by using all protective measures necessary.

D. Contractor shall coordinate the location, dimension, space requirements, and installation of Work that is indicated diagrammatically on the Drawings or described in the Specifications. Where requested, installation shall be as per approved Shop Drawings. Pipes, ducts, and conduits shall be run parallel to lines of the building. Spaces shall be utilized efficiently to maximize accessibility for other installations, maintenance, repairs, and operation.

E. Coordinate the submittals, correspondence, record documents, and attendance at meetings of all Subcontractors and suppliers.

F. Following Substantial Completion, coordinate access to the site for correction of Work not in accordance with the Contract Documents to minimize disruption of Owner's activities.

1.02 FIELD ENGINEERING

A. Owner has had a registered land survey performed to establish the Site property boundaries as shown on the Drawings, to be used for horizontal reference.

B. Owner has established a Temporary Bench Mark near the Site as shown on the Drawings, to be used for vertical reference.

C. Contractor shall be responsible for providing field engineering services to establish elevations, lines, and levels required for the layout of the Work. Field engineering shall be performed by trained technicians using recognized engineering survey practices. All Contractor survey records shall be kept in a bound survey field book kept specifically for this Project. A copy of all survey notes shall be furnished to Engineer as part of the Record Documents.

1.03 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching (including excavation and filling) to complete the Work, and to:

1. Fit the several parts of the Work together, and to integrate parts of the Work with other Work.

2. Uncover Work to install or correct ill-timed Work.

3. Remove and replace defective and non-conforming Work.

4. Remove samples of installed Work for testing.

5. Provide openings in elements of the Work for penetrations and anchorages.

B. Submit written request in advance of cutting, fitting, and patching elements which affects:

1. Structural integrity of element.

2. Integrity of weather-exposed or moisture-resistant elements.

3. Efficiency, maintenance, or safety of element.

4. Visual quality of sight-exposed element.

5. Work of Owner or separate contractor.

C. Employ skilled and experienced workers for cutting and patching. Where possible, use the original installer.

D. Execute work by methods which will avoid damage to Work, and provide proper and clean surfaces to receive filling, patching, and finishing.

E. Cut rigid materials using metal or masonry saws and drills or core drills to produce smooth uniform edges.

F. Restore Work with new products in accordance with the Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations.

H. Maintain integrity of wall, ceiling, and floor construction; completely seal voids.

I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest joint or intersection; for an assembly, refinish entire assembly.

J. Identify any hazardous substance or condition exposed during the Work to the Engineer for decision regarding remedy.

1.04 PRECONSTRUCTION CONFERENCE

A. After Owner and Contractor have executed the Agreement, Engineer will schedule a preconstruction conference which shall be attended by Contractor and Subcontractors identified. Representatives of Owner and utilities that will be involved with the Project will be asked to attend. The meeting will be scheduled within 14 calendar days following Notice to Proceed and no Work at the site shall proceed until the meeting is held. The purpose of the meeting will be to ensure that all parties understand their responsibilities and the procedures which will be used to assure efficient completion of the Work.

B. Minimum agenda items include:

1. Distribution and discussion of:

a. list of major Subcontractors,
b. tentative construction schedule,
c. critical work sequencing,
d. designation of responsible personnel,

e. procedures for processing change orders,
f. distribution of Contract Documents,
g. preliminary schedule of submittals and submittal procedures,
h. record documents,
i. use of premises,
j. major equipment deliveries,
k. safety procedures, and
l. housekeeping and security procedures.

1.05 PROGRESS MEETINGS

A. Weekly progress meetings will be scheduled by the Engineer at a regular time mutually agreeable to the Owner, Contractor and Engineer. The preferred time for this meeting is prior to Contractor's submittal of Application for Payment. The Contractor shall attend these meetings and shall coordinate and require the attendance of Subcontractors whose work may be in progress at the time or whose presence may be required for any purpose. Scheduling of required attendance shall meet with the approval of the Engineer.

B. Following each meeting, the Engineer will prepare and distribute to Owner and Contractor copies of the minutes-of-the-meeting. These will include a brief summary of the progress of the Work since the previous meeting.

1.06 UNSCHEDULED MEETINGS

A. The Contractor shall attend other unscheduled meetings which may be reasonably requested by Engineer or Owner to discuss unanticipated changes in the Work or conditions at the Site and that must be resolved before the next regularly scheduled meeting.

B. Prior to beginning any Work at the site, Contractor shall submit to Engineer the names of at least three (3) employees of Contractor who may be contacted after normal working hours in the event of an unanticipated condition requiring immediate attention. At least one person should be available at all times for immediate response to the site within 2 hours of being called. This person shall have authority to make field decisions for Contractor.

END OF SECTION 01200

SECTION 01300
SUBMITTALS

1.01 GENERAL SUBMITTAL PROCEDURES

A. Transmit each submittal in a separate envelope or package clearly labeled with the Project name, name of the submittal, and Section and page number of these Contract Documents in which the submittal was requested. Indicate the type or purpose of the submittal as more fully described elsewhere in this section with regard to the Schedule of Submittals. Transmit the correct number of copies as described below for each type of submittal. Each submittal shall be accompanied by a transmittal letter stating the same information.

B. Transmit all submittals to the Engineer at the address set forth in the Agreement for notices.

C. Apply Contractor's stamp, signed or initialed certifying that review and verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents. Unstamped or unsigned submittals will be returned without action. Submittals from Subcontractors or vendors will be returned without action.

D. Schedule submittals to expedite Project and in accordance with the Schedule of Submittals to be prepared by Contractor. Coordinate submission of related items.

E. Identify all variations or deviations from the Contract Documents and identify alternative products or system limitations which may be detrimental to successful performance of the completed Work.

F. Provide space for Engineer review stamps and comments.

G. Revise and resubmit submittals as required in a timely manner. Identify all changes made since previous submittal.

H. Promptly distribute copies of reviewed submittals to Subcontractors, suppliers, and other concerned parties. Instruct parties to promptly report any inability to comply with provisions.

I. Do not proceed with any Work requiring review by Engineer until submittals have been reviewed and returned to Contractor.

J. All submittals made which are not required by the Contract Documents will be returned without action.

1.02 SCHEDULE OF OPERATIONS

A. At the time specified in the Instructions to Bidders, Contractor shall submit six (6) copies of the Contractor's Schedule of Operations as described below.

B. The Schedule of Operations shall be a detailed progress schedule indicating the starting and completion dates of the various stages of the Work. The schedule shall be prepared in sufficient detail to show the starting and ending dates of each detailed phase of the Work, proposed dates for Application for Payment, and estimates of the percentage of the Work to be completed at each Application for Payment. The schedule shall be prepared using adequate contingencies for unanticipated conditions such as bad weather and material shortages and shall show how the Contractor proposes to complete the Work within the time periods set forth in the Agreement. Include fabrication schedules for shop fabricated equipment.

C. The Schedule of Operations shall be in the form of a horizontal bar chart with a separate line for each phase of the Work. The chart shall have vertical lines showing the first work day of each week and dates and time since start of Work shall be clearly displayed across the top of each sheet. Indicate early and late start dates, early and late finish dates, and duration of tasks. The bar chart shall be sufficiently annotated to define all symbols and abbreviations used.

D. The Schedule of Operations shall be based on an assumed starting date of June 15, 1991. Within seven (7) calendar days following Notice to Proceed, Contractor shall resubmit the Schedule of Operations using the Contractor's intended actual starting date.

E. If an extension in the Contract Time is granted in accordance with the terms of the Contract Documents, Contractor shall revise and resubmit the Schedule of Operations within seven (7) calendar days following the execution of the Change Order authorizing the change in Contract Time.

F. The Schedule of Operations will be reviewed by the Engineer to determine if adequate detail has been presented for Engineer and Owner to judge the progress of the Work. Engineer's review is not intended to include the adequacy of the schedule to meet the other terms of the Contract Documents. It is the Contractor's sole responsibility to schedule its operations and provide all resources necessary to complete the Work within the Contract Time and in accordance with the approved Schedule of Operations. If the Engineer requests additional detail in the Schedule of Operations, Contractor

shall correct such deficiencies and resubmit as specified in the Instructions to Bidders.

1.03 SCHEDULE OF VALUES

A. At the time specified in the Instructions to Bidders, Contractor shall submit six (6) copies of the Contractor's Schedule of Values as described below.

B. The Schedule of Values shall be a detailed cost breakdown for all of the Work which shall include quantities and unit prices of items aggregating the Contract Price and shall subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such unit prices shall include an appropriate amount of overhead and profit applicable to each item of Work.

C. The Schedule of Values shall be organized in a tabular format with the following columns (clearly labeled) as a minimum:

1.	ITEM NUMBER:	Number items according to the Section of these Specifications to which it corresponds.
2.	ITEM DESCRIPTION:	Written description of what item consists of.
3.	UNIT:	The unit of measure upon which the unit price is based.
4.	NUMBER OF UNITS:	The number of units upon which the total price for the item will be based.
5.	UNIT MATERIAL PRICE:	The cost of the raw materials or products needed for the item on a unit price basis.
6.	UNIT LABOR PRICE:	The cost of labor needed to fabricate, install or otherwise construct the item on a unit basis.
7.	UNIT OVERHEAD AND PROFIT PRICE:	Contractor's overhead and profit distributed on a unit basis.
8.	TOTAL UNIT PRICE:	Sum of unit material price, unit labor price, and unit overhead and profit price.

9. **EXTENSION:** The total price for the item determined by multiplying the number of units by the total unit price.

D. The Schedule of Values shall include a row labeled TOTAL EXTENSION which shall be the sum of the extension column for each of the individual items. The dollar value shown as the total extension shall match exactly the Contract Price as shown in the Agreement.

E. The Schedule of Values shall contain sufficient detail to serve as the basis for progress payments for process equipment which will be shop fabricated. The schedule should include such items as design, fabrication, lining, exterior painting, transportation to site, installation and any other pertinent items the Contractor wishes to break out. The GAC contactor vessels and package iron removal system will be the only shop fabricated materials for which progress payments will be made prior to delivery to the site.

F. The Schedule of Values shall be accompanied by a schedule of anticipated monthly payment requests. This shall be based on the Schedule of Operations and Schedule of Values and the two shall be closely coordinated. Whenever the Schedule of Operations is updated or revised, Contractor shall resubmit a revised schedule of anticipated monthly payment requests. The payment schedule shall also be updated each time an actual payment request varies more than 10 percent from the schedule. The monthly schedule shall take into consideration retainage as set forth in the Contract Documents.

G. The Schedule of Values is subject to the review and approval of the Engineer and Owner. If in the opinion of Engineer or Owner, the Schedule of Values does not contain sufficient detail or appears to be unbalanced, the Engineer (or Owner) may ask Contractor to revise and resubmit the Schedule of Values and/or provide documentation to justify Contractor's distribution. Contractor shall correct such deficiencies and resubmit as specified in the Instructions to Bidders.

1.04 **SCHEDULE OF SUBMITTALS**

A. Within seven (7) calendar days following Notice to Proceed, Contractor shall submit six (6) copies of the Schedule of Submittals as described below:

B. The Schedule of Submittals shall be in tabular form listing all submittals which are required by the Contract Documents and the date on which Contractor will make submittal. As a minimum, the Schedule of Submittals shall consist of the following columns:

1. **SUBMITTAL NUMBER:** Number consecutively.

2. **SECTION NO.:** Section number or description of location in Contract Documents where submittal is requested.

3. **PAGE NO.:** Page number of section in Contract Documents where submittal is requested.

4. **ITEM:** Description of item or items to which submittal pertains.

5. **SUBMITTAL TYPE:** A letter code indicating what type of submittal was requested. The type key shall be as follows:

   A - Test Results and/or Certificates
   B - Manufacturers Literature or Data (Informative only)
   C - Shop Drawings
   D - Operation and Maintenance Instructions
   E - Samples
   F - Alternate Product Supporting Data
   G - Administrative such as insurance, schedules, etc.
   H - Warranty or Guarantee Certificates

6. **DEFICIENCIES:** Manner in which submittal or proposed alternate product does not meet the requirements of the Contract Documents.

7. **ANTICIPATED SUBMITTAL DATE:** Date on which Contractor anticipates submittal to be delivered to Engineer.

8. **RESPONSE REQUIRED:** Indicate yes if Contractor anticipates response from Engineer and no if no response is anticipated.

C. The Schedule of Submittals will be reviewed by Engineer and Engineer will respond in writing to Contractor listing deficiencies. The Contractor shall not list submittals not called for in the Contract Documents. The schedule shall include all items for which Contractor proposes to use substitute or "or equal" products and for which these Specifications require approval for substitution. Contractor shall correct deficiencies and resubmit Schedule of Submittals within seven (7) calendar days following Engineer's notification of deficiencies.

1.05 APPLICATIONS FOR PAYMENT

A. General

1. Applications for progress payments shall be regularly scheduled as set forth in the Agreement. Each Application for Payment shall be accompanied by the required supporting data as specified in the Contract Documents. Submit three signed counterparts.

2. The Owner will act on payment requests on the first or third Monday of each month. To ensure proper review, recommendation, and forwarding to Owner, Applications for Payment shall be delivered to Engineer at least fourteen (14) calendar days prior to the first or third Monday of each month, but not more than once each month.

3. All Applications for Payment shall be made on forms provided by Engineer. Forms shall be completed in their entirety and all signatures and notarizations shall be completed.

4. Applications for Payment shall be consistent with the actual Work completed as of the date of application. Applications should be consistent with the current Schedule of Values and Schedule of Operations, and if not, those schedules should be modified as set forth elsewhere in this section.

5. Incomplete or deficient Applications for Payment will be returned to Contractor by Engineer without action. Resubmitted applications will be processed promptly but neither Engineer nor Owner assume any responsibility for payment, or interest on payments, for applications resubmitted after the specified time. Late submittals may be returned to the Contractor for inclusion in the next month's Application for Payments.

B. Payment for Mobilization Expenses

The Contractor may include items in the Schedule of Values for mobilization. Mobilization may include, but is not limited to, operations necessary to move personnel, equipment, supplies and incidentals to the site and removing them from the site following completion of the Work; furnishing bonds and insurance required specifically for this Project; furnishing submittals as specified; obtaining all permits required specifically for the Work; and performing all work to restore the Project site to a condition equal to or better than its original condition that is not outlined elsewhere in these Specifications.

Progress payments for any mobilization expense, or any other line item in the Schedule of Values which does not relate to a physical component of the Work at the site, will be made only in the amount of actual expenses incurred as evidenced by receipts or other evidence of incurred cost satisfactory to the Engineer and Owner. Payment for items for which satisfactory evidence is not provided will be made at the completion of the Work.

C. Initial Application for Payment

The Contractor shall not make its initial application for payment until the required administrative procedures have been complied with. These procedures include, but may not be limited to, submittal of acceptable:

1. proof of insurance,
2. Schedule of Operations,
3. Schedule of Values,
4. Schedule of Submittals.

D. First Application for Payment Following Substantial Completion

As set forth in the Agreement, retainage provisions will change following issuance by Engineer of Certificate of Substantial Completion. This change in retainage shall not be reflected in any Application for Payment until appropriate administrative procedures have been complied with. These procedures include, but may not be limited to, the following:

1. Submittal of occupancy permits and similar approvals, or certifications by governing authorities and franchised services, assuring Owner full access and use of completed Work.

2. Submittal of all warranties, guarantees, maintenance agreements and similar provisions of the Contract Documents.

3. Test/adjust/balance records, operation and maintenance instructions, meter readings, demonstration test reports, start-up performance reports, and similar information pertaining to Owner's occupancy, use, operation and maintenance of the completed Work.

4. Final cleaning of the Work.

5. Consent of surety for reduction of retainage.

6. Preparation of a tentative list of items to be completed or corrected as set forth in paragraph 14.8 of the General Conditions.

7. Removal of temporary facilities, services, surplus materials, rubbish and similar material not a part of the finished Project.

8. Changeover of door locks and other provisions for Contractor's access to Owner's property.

E. Application for Final Payment

The administrative procedures which shall be completed by Contractor prior to application for final payment include, but may not be limited to, the following:

1. Completion of contract close-out requirements as set forth in Section 01700 of these Specifications.

2. Completion of items on the tentative list of items to be completed or corrected as determined for Substantial Completion and other items related to defective Work that become apparent following Substantial Completion.

3. Assurance, satisfactory to Owner, that there are no unsettled claims including submittal of the Sworn Construction Statement included in these Contract Documents.

4. Submittal of the required construction records, including record drawings, to Owner.

5. Proof, satisfactory to Owner, that taxes, fees and similar obligations of Contractor have been paid including submittal of the Withholding Affidavit for Contractor's included in these Contract Documents.

6. Consent of surety for final payment.

7. Contractor Guarantee - Reservation of Rights by the Owner (on form included in these Contract Documents), and any other written warranties or guarantees required by the Specifications.

F. Supporting Data

Each Application for Payment shall be accompanied by such supporting data as may be required by Owner or Engineer to substantiate the Contractor's application. All Applications for Payment which include

payment for shop fabricated equipment shall be accompanied by invoices and records from the fabricator substantiating the progress of the Work on each of the individual pieces of equipment. Receipts for materials shall indicate the specific piece of equipment for which the materials will be used. Time reports and other records shall be furnished to verify the fabricator's costs. Reports shall contain only information pertinent to this Project and shall contain summaries of all detailed information. If requested, Contractor shall provide photographs showing the status of construction of the shop fabricated components. Photographs shall have the date of the photograph displayed on the photo.

1.06 SUBMITTAL OF TEST RESULTS AND CERTIFICATES

A. When required in individual sections of these Specifications, or when required by reference specification, submit six (6) copies of manufacturer's certificates and/or test results.

B. Submit at least ten (10) days prior to incorporation into the Work for mill tests, laboratory tests, and factor tests.

C. Indicate that material or product conforms to or exceeds the specified requirements and submit supporting data and affidavits.

D. When material or product meets Specifications, no action by Engineer is necessary.

1.07 SUBMITTAL OF MANUFACTURER'S LITERATURE OR INSTRUCTIONS WHEN REQUESTED FOR INFORMATIONAL PURPOSES

A. When required in individual sections of these Specifications, submit eight (8) copies of manufacturer's product data requested.

B. Submittal is for informational purposes only and no action by Engineer is necessary.

C. Mark each copy neatly to identify applicable products, models, options and other data. Identify conflicts between manufacturer's instructions and Contract Documents.

D. When material or product meets Specifications, no action by Engineer is necessary.

1.08 SUBMITTAL OF SHOP DRAWINGS

A. When required in individual sections of these Specifications, submit eight (8) opaque reproductions of Shop Drawings in accordance with the schedule of submittals.

B. Contractor shall comply with all requirements of the General Conditions, in particular paragraphs 6.23 through 6.28, with regard to Shop Drawing submittals.

C. Engineer will review and return two marked copies to Contractor within twenty-one (21) calendar days following receipt. Contractor shall not proceed with related work until approved submittal is returned.

D. If Engineer's comments require resubmittal, Contractor shall make the revisions indicated and resubmit as for an original submittal. Engineer will review as for an original submittal.

E. If Engineer's comments do not require resubmittal, Contractor shall make the revisions indicated and transmit to Engineer one (1) reproducible transparency (if larger than 11 inches by 17 inches) or one clean first generation copy suitable for reproduction. This original shall bear Contractor's certification in accordance with the requirements of the General Conditions.

F. Following preparation and submittal of final corrected reproducible, Contractor shall reproduce and distribute to Subcontractors and/or suppliers.

G. If actual installation does not conform to approved Shop Drawings, notify Engineer. Note revisions on reproducible and submit with record documents.

1.09 SUBMITTAL OF SAMPLES

A. When required in individual sections of these Specifications, submit four (4) samples of materials, finishes, colors, etc. as required.

B. Submit samples to illustrate functional and aesthetic characteristics of product, with integral parts and attachment devices. Coordinate with submittals for interfacing Work.

C. Submit samples of finishes from the full range of manufacturer's standard colors (or in custom colors if required), textures, and patterns for Engineer or Owner selection.

D. Engineer will return one sample of selected material or finish or will provide written comment on submitted material.

1.10 SUBMITTAL OF OPERATION AND MAINTENANCE INSTRUCTIONS

A. Submit eight (8) complete sets of operation and maintenance instructions for all equipment and systems furnished. Operating instructions shall be prepared specifically for each system or piece of equipment installed under this contract and shall consider the specific equipment and controls included. All references, pictures and diagrams regarding items not part of furnished equipment and systems shall be deleted. Instructions shall be complete for each separate system and shall cover:

1. Equipment functions, normal operating characteristics, and limiting conditions.

2. Assembly, installation, alignment, adjustment, and checking instructions.

3. Operating instructions for start-up, routine and normal operation; regulation and control; shutdown; and emergency conditions.

4. Lubrication and maintenance schedules and instructions.

5. Guide to "troubleshooting".

6. Parts list with manufacturer's part numbers and parts diagrams.

7. Outline, cross sections, and assembly drawings; engineering data; and wiring diagrams.

8. Test data and performance curves, where applicable.

C. Submittal of operation and maintenance instructions shall be made prior to final acceptance by Owner.

1.11 ALTERNATE PRODUCT SUPPORTING DATA

A. Submit written application as required by paragraph 6.7.1 of the General Conditions.

B. Submit as required by Section 01600 and the other relevant sections of these Specifications.

C. Submit six (6) copies of literature, drawings, and any other data necessary to substantiate that proposed substitute is equivalent or equal to the item named, and otherwise meets the conditions

established in paragraphs 6.7.1 through 6.7.3 of the General Conditions.

D. Do not proceed with product installation or use until written approval by Owner or Engineer is received in accordance with paragraphs 6.7.1 through 6.7.3 of the General Conditions. Engineer will respond with reasonable promptness.

1.12 ADMINISTRATIVE SUBMITTALS

A. Submit in accordance with requirements described in section where specified.

1.13 WARRANTY OR GUARANTEE CERTIFICATES

A. Submit three (3) executed copies prior to Substantial Completion.

B. All warranty or guarantee certificates shall be signed by Contractor and by all other parties as requested in specific sections.

1.14 RECORD DOCUMENTS

A. Submit all record documents (or clearly legible copies) prior to Substantial Completion. Failure to submit will be cause to maintain retainage as set forth for pre-Substantial Completion.

B. Submit all materials as called for under paragraph 6.19 of the General Conditions.

END OF SECTION 01300

SECTION 01400
QUALITY CONTROL

1.01 QUALITY CONTROL, GENERAL

A. Maintain quality control over suppliers, manufacturers, products, services, site conditions and workmanship to produce Work of the specified quality. Maintain records of Contractor's tests and results for reference by Engineer or Owner at any time and furnish copies of all test results and quality control procedures as part of Record Documents.

B. Comply fully with manufacturer's instructions, including each step in sequence.

C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Obtain copies of and meet the requirements of reference specifications. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Comply with specified reference standards as a minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.

F. Perform work by persons qualified to produce workmanship of specified quality. Use persons licensed to perform Work where required by these Specifications or Laws and Regulations.

G. Secure products and Work in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

H. Materials furnished and finished or intermediate stages of the Work shall be sampled, tested and inspected as specified in the individual sections of these Specifications and as required by reference specifications.

I. Performance of tests or observations by Engineer or Owner are for the sole benefit of Engineer and Owner and are not intended to replace Contractor's quality control program. Contractor is solely responsible for establishing and implementing a quality control program to ensure that the Work is in accordance with the Contract Documents.

J. It is Contractor's responsibility to notify Engineer when Contractor believes Work (or intermediate stages or parts of Work) is of specified quality and to permit Engineer or Owner to perform independent tests or analyses.

K. The contractual relationship of the parties to the Agreement shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.02 MILL TESTS

A. Mill or shop tests shall be conducted and test results, certificates and/or affidavits shall be submitted as required in the individual sections of these Specifications. Submit in the quantity and in accordance with the requirements of Section 01300. Mill tests refer to those tests typically performed as part of the manufacturer's quality control program and not specifically performed for this Project.

B. Mill or shop tests shall be accomplished by the manufacturer, fabricator or supplier of the product. Mill tests may be conducted by an independent testing laboratory and shall be conducted in accordance with specific or standard procedures as specified. ASTM procedures shall be used if other procedures are not specifically required.

C. The cost of mill tests shall be included in the lump sum Contract Price and no additional compensation will be provided.

1.03 LABORATORY TESTS

A. Laboratory tests shall be conducted and test results, certificates and/or affidavits shall be submitted as required in the individual sections of these Specifications. Submit in the quantity and in accordance with the requirements of Section 01300. Laboratory tests refer to those tests made by manufacturers, fabricators, suppliers or Contractor specifically for this Project and conducted by a testing laboratory.

B. All laboratory tests shall be made by an independent testing laboratory approved by the Owner or Engineer. These tests shall be performed in accordance with the specified procedures or in accordance with ASTM procedures if no reference is included.

C. Laboratory tests may be witnessed by the Owner or Engineer or their representatives. Contractor shall notify Engineer at least four working days (Monday through Friday) in advance of testing to allow

Owner or Engineer opportunity to witness. Failure of Contractor to notify will be grounds for rejection of the test results and Owner or Engineer may require Contractor to repeat testing and/or replace affected work.

D. Contractor shall conduct routine testing of materials used in the Work to satisfy itself that the quality of the Work meets the requirements of the Contract Documents. Owner or Engineer may also conduct routine sampling and analysis to ascertain same. Where laboratory testing or material specifications or quality control requirements are specified in the individual sections of these Specifications, Contractor shall not proceed with phases of the Work until Owner or Engineer have had opportunity to collect samples or conduct testing necessary to establish the specified quality of the Work. Such instances may include, but are not limited to, soil compaction control, soil gradation testing, moisture content testing, testing of finishes, testing for chlorine residual or other water quality parameters, testing of roofing samples, or any other specified tests.

E. Contractor shall pay for all laboratory testing Contractor desires. Owner will pay for initial testing Owner desires. If testing by Owner identifies defective Work, Contractor shall pay for all subsequent sample collection and testing costs required to convince Owner that defective Work has been repaired or replaced.

1.04 FACTORY TESTS AND OBSERVATION

A. Factory tests shall be conducted and test results, certificates and/or affidavits shall be submitted as required in the individual sections of these Specifications. Submit in the quantity and in accordance with the requirements of Section 01300. Test results shall be submitted prior to the shipment of the tested equipment.

B. Factory tests shall be conducted to establish the performance, capacity, rating, efficiency, function or other requirements of process, mechanical, electrical or other equipment or materials.

C. Factory tests shall be conducted in the factory or shop where the item is being fabricated. The test shall be set up and accomplished by the equipment manufacturer who shall provide all shop space, tools, equipment, instruments, personnel and other facilities required for the satisfactory completion of each test.

D. Factory tests may be witnessed by the Owner or Engineer or their representatives. Contractor shall notify Engineer at least four working days (Monday through Friday) in advance of testing to allow

Owner or Engineer opportunity to witness. Failure of Contractor to notify will be grounds for rejection of the test results and Owner or Engineer may require Contractor to repeat testing and/or replace affected work.

E. The cost of factory tests shall be included in the lump sum Contract Price and no additional compensation will be provided.

1.05 FIELD TESTS

A. Field tests shall be conducted and test results, certificates and/or affidavits shall be submitted as required in the individual sections of these Specifications. Submit in the quantity and in accordance with the requirements of Section 01300.

B. Field tests shall be conducted in accordance with the individual sections to establish the quality of complete systems or individual components of process, mechanical and electrical equipment including, but not limited to, piping systems, electrical systems, control systems, ventilation systems, heating systems, water mains, sewers and drains, tanks and vessels, and similar facilities.

C. Field tests shall be conducted to establish the performance, capacity, function, efficiency, tightness, leakage, operating characteristics or other special requirements. Tests shall be conducted in accordance with specified procedures or standards. Use applicable standards or codes where none are specified.

D. Field tests shall be set up and conducted by Contractor who shall provide all tools, equipment, instruments, personnel and other facilities required for the satisfactory completion of each test.

E. Field tests may be witnessed by the Owner or Engineer or their representatives. Contractor shall notify Engineer at least four working days (Monday through Friday) in advance of testing to allow Owner or Engineer opportunity to witness. Failure of Contractor to notify will be grounds for rejection of test results and Owner or Engineer may require Contractor to repeat testing and/or replace affected Work.

F. The cost of field tests shall be included in the lump sum Contract Price and no additional compensation will be provided.

END OF SECTION 01400

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.01 UTILITIES

A. Water

Water is currently available at the site. Contractor may use water from the Owner's distribution system for potable consumption and construction purposes. Contractor is solely responsible for construction, maintenance, and abandonment of a temporary water service. The temporary service shall be furnished with a reduced pressure zone backflow prevention device to prevent the entry of undesirable materials into the Owner's distribution system. All water consumption shall be metered but Owner will waive water charges provided Contractor exercises measures to conserve water.

B. Sanitary Facilities

Provide sanitary facilities for use by Contractor's employees, subcontractors, suppliers, Engineer, Owner and all other persons to be working on-site. Separate men's and women's facilities shall be provided and each shall be clearly labeled. Sanitary facilities shall be routinely emptied and cleaned and shall at all times be maintained in a clean and useable condition. Sanitary facilities shall be maintained until Substantial Completion unless removal is approved by Engineer or Owner. Sanitary facilities shall be maintained in a discrete location, screened from public observation.

C. Electricity

Contractor shall coordinate the installation of a new permanent power service for the facility in accordance with the requirements of Division 16 of these Specifications. Owner will directly pay utility charges associated with installing the new permanent service. Contractor shall coordinate, provide and pay for temporary construction power service and energy charges required for completion of the Work. These costs shall not be billed by utility to Owner. Costs shall be included in the lump sum Contract Price and no additional compensation will be provided.

D. Gas

Contractor shall coordinate the installation of a new permanent natural gas service for the facility in accordance with the requirements of Division 15 of these Specifications. Owner will

directly pay utility charges associated with installing the new permanent service. Contractor shall coordinate, provide and pay for temporary gas service and usage charges required for completion of the Work. These costs shall not be billed by utility to Owner. Costs shall be included in the lump sum Contract Price and no additional compensation will be provided.

E. Telephone

Contractor shall coordinate the installation of a new permanent telephone service for the facility in accordance with the requirements of Division 16 of these Specifications. Owner will directly pay utility charges associated with installing the new permanent service. Temporary telephone service will not be required by Owner. Contractor shall coordinate, provide, and pay for temporary telephone service required for completion of the Work.

1.02 ROADS/DUST CONTROL

A. Contractor shall maintain roads to provide access to the Work and all of the Owner's facilities for the entire duration of the construction. Roads shall be passable for their intended use at all times in all weather conditions and shall be maintained in a graded and rut-free condition.

B. Work within the right-of-way of public roads shall be sequenced to minimize disturbance as set forth in Section 01010 of these Specifications.

C. Contractor shall furnish, place, and maintain temporary surfacing of public roads and private driveways required to maintain those in passable condition under all weather conditions by typical passenger vehicles. Temporary surfacing shall consist of graded rock and granular material as required to provide a stable driving surface.

D. Contractor shall be responsible for sweeping and washing of public streets in the vicinity of the Site to remove dirt and debris resulting from the performance of the Work, whether as a result of Contractor's direct operations or not. This requirement applies whenever dirt and debris are present at noticeable levels, with cleaning required as frequently as the end of each working day if necessary. If Contractor refuses to clean streets, Owner may, after giving notice to Contractor, perform cleaning and deduct Owner's cost from Contract Price due Contractor.

E. Contractor shall provide all equipment and materials necessary for the control of dust arising during the performance of the Work. Dust

shall be controlled so as to not be a nuisance to adjacent property owners or occupants. When requested by Engineer or Owner, or at other times as necessary, Contractor shall take measures to reduce dust.

1.03 SIGNS, FENCES, BARRICADES, AND WATCHMEN

A. No signs, billboards or other advertisements shall be erected on the premises by Contractor without Owner's written permission.

B. Contractor shall furnish and maintain all warning lights, barricades, informational signs, and watchmen as needed for the execution of the Work as required by the Contract Documents, Laws and Regulations, for the protection of persons and property, and control of traffic. From sunset to sunrise, each barricade in public streets or areas of potential pedestrian traffic shall be furnished with at least two operational lights.

Barricades shall be painted a color visible at night, and shall consist of, at a minimum, snow fence or a similar material securely anchored to prevent entry of small children or unknowing persons.

C. At a minimum, barricades shall be required at all excavations containing standing water or that have potential to contain standing water and at all excavations more than 18 inches deep with side slopes on any exposure steeper than 3 units of horizontal run to 1 unit of vertical rise.

D. At a minimum, warning lights shall be required at both ends of all excavations within public streets where the original pavement surface has been removed until such time as a paved surface has been restored to grade.

E. Barricades, warning lights, and traffic control signage within public streets shall, at a minimum, meet the technical requirements of the Institute of Transportation Engineers and the Minnesota Manual of Uniform Traffic Control Devices.

F. Contractor shall construct a temporary site security fence at the location shown on the Drawings. The temporary site security fence shall meet the minimum requirements for barricades established herein. It shall be Contractor's sole responsibility to design, construct, and maintain the site security fence to protect persons and property.

1.04 CONTRACTOR'S FIELD OFFICE

A. Contractor may, at Contractor's option, furnish a mobile field office for Contractor's use. Contractor shall propose a location for field office to Engineer for approval by Owner. Field office shall be neat appearing, free from dents, damage, graffiti, and other visible defacing that Owner may evaluate as objectionable for placement in a public location.

B. Field office shall remain the property of the Contractor and shall be removed from the site prior to Substantial Completion.

1.05 FIRST-AID AND SAFETY FACILITIES

A. Contractor shall furnish emergency first-aid facilities as may be required to comply with applicable Laws and Regulations. Contractor shall post in a prominent location, the telephone numbers of hospital, ambulance, fire, utilities, and Contractor's responsible staff with 24-hour phone answering duty.

B. The Contractor shall be solely and completely responsible for the conditions on the job site with regard to health and safety as more fully set forth in the General Conditions and Supplementary Conditions.

1.06 TEMPORARY ENCLOSURES AND HEAT

A. Contractor shall furnish and pay for temporary enclosures and closures needed to retain heat so that specified temperatures can be maintained for the performance of the Work. Contractor shall provide temporary closures over wall and floor openings. Unless specifically stated otherwise, temperatures inside the enclosures shall be not less than 60°F for 48 hours prior to and during the time when concrete work, cement finishing, masonry work, or painting or sealing are being done or being cured, and not less than 50°F where any personnel are working or where pipes contain water or other fluids that could freeze.

B. Contractor shall be solely responsible for furnishing, maintaining, attending, operating and paying for all temporary utilities required for heating for performance of the Work.

1.07 EROSION CONTROL

A. Contractor shall furnish, install and maintain temporary erosion controls as shown on the Contract Drawings and as otherwise necessary to prevent the erosion of soils and transport of silt, mud and other debris off of the site or to other areas of the site where damage might result.

B. Temporary erosion controls include, but are not limited to, silt fences, straw bales, geotextiles, terracing, riprap, temporary drainage piping, vegetative cover and any other construction required to prevent erosion.

C. Unless otherwise specified, silt fences shall be provided around the full perimeter of all soil stockpiles, at the entrance to all drain pipes, and at the point where all drainageways flow out of the site.

D. Contractor shall schedule its operations so as to minimize the potential for erosion by minimizing the disturbed areas on-site at any given time and completing operations and restoring the site in the shortest time possible.

E. If soil and debris from the site accumulates in low areas, storm sewers, gutters, or other areas where in Owner's or Engineer's determination it is undesirable, Contractor shall remove the accumulation and restore the area to its original condition without additional compensation. Such restoration shall be performed as frequently as Owner or Engineer deem necessary until the Work is completed.

1.08 CLEANING

A. Contractor shall clean the working area each day and shall remove all trash and waste materials, and shall maintain the site in a neat and orderly condition throughout the construction period. Contractor shall pay for all costs for rubbish removal and site cleaning.

B. Contractor shall daily, or as it becomes apparent, pick up all garbage, litter, debris, and other materials attributable to the Work or the activities of Contractor's employees, Subcontractors, and suppliers that accumulates on property in the vicinity of the Site.

1.09 SITE SECURITY

A. Contractor shall be solely responsible for the security of the site and shall furnish fences, gates, locks, lighting, guards, or any other facilities required to secure the site and the Owner's facilities. The entire site, all Work and all Owner's facilities shall be available at all times (24 hours per day) to Owner and Engineer. Owner and Engineer shall each be furnished with three keys (and additional copies as requested) to all locks required to access the Work and site.

B. As a minimum, Contractor shall provide temporary fencing as shown on the Contract Drawings and described herein.

1.10 TEMPORARY SEWER AND DRAIN CONNECTIONS

A. When existing sewers have to be moved, removed, extended, broken into, or otherwise modified, Contractor shall, at its own expense, provide and maintain temporary outlets and connections for all private and public drains and sewers. The Contractor shall also be responsible for disposition of all sewage and drainage that will be received from these drains and sewers; and shall provide and maintain adequate pumping facilities and temporary outlets or diversions. The Contractor, at its own expense, shall construct such troughs, pipes, or other necessary structures and be prepared at all times to dispose of drainage and sewage received from these temporary connections until such time as the permanent connections are built and in service.

END OF SECTION 01500

SECTION 01600
MATERIAL AND EQUIPMENT

1.01 PRODUCTS

A. Products shall mean new material, machinery, components, equipment, fixtures and systems comprising the Work. Products does not mean machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products also includes existing materials to be salvaged for reuse.

B. Do not use materials and equipment removed from existing facilities or other previously used products except as specifically permitted elsewhere in the Contract Documents.

C. All products or components of a specified type shall be completely interchangeable and of the same manufacturer and materials unless specifically stated otherwise elsewhere in the Contract Documents.

D. Products shall be commercial, industrial or institutional grade products of high overall quality. No factory seconds or products not of the manufacturer's best quality will be accepted.

1.02 TRANSPORTATION AND HANDLING

A. Contractor shall pay all transportation, handling and storage costs for products required for the Work.

B. Contractor shall have a designated representative at the site to accept delivery. Representative shall immediately on delivery inspect shipments to assure compliance with the requirements of the Contract Documents and required submittals. Representative shall assure that products are properly protected and were delivered undamaged.

C. Material and products shall be shipped with adequate protection to prevent damage due to handling and storage procedures. Products shall be delivered in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weathertight climate controlled enclosures. Pumps, motors and electrical equipment shall be maintained at 50°F

minimum temperature and in an enclosed weathertight structure. Plastic or tarps shall not be placed around equipment in such a manner as to trap moisture and form condensation.

B. For exterior storage, place on above ground supports sloped for proper drainage, protected against damage by weather, flooding, dust, sunlight or construction operations.

C. Provide off-site storage and protection when the site does not permit proper on-site storage or protection.

D. Store soils and loose granular products on solid flat surfaces in a well-drained area. Prevent loss of material and mixing with foreign matter.

E. Products shall be stored to permit access for inspection.

1.04 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Where a product is specified by reference standards and description only, the Contractor may select any product meeting the standards and description.

B. Where a product is specified by naming one or more products and is followed by the words "or approved equal" or similar wording indicating approval for substitution is required, Contractor shall select products from the approved list or shall make written request for use of a substitute item. The written request shall conform to the requirements of paragraph 6.7.1 of the General Conditions and shall be submitted in accordance with the requirements of Section 01300 of these Specifications. The request shall be accompanied by complete data on the proposed substitution including product identification and description, performance and test data, references, samples where applicable, and an itemized comparison of the proposed substitution with the products specified or named.

C. Where a product is specified by naming one or more products and is followed by the words "or equal," or "equivalent," or similar wording indicating approval for substitution is not required, Contractor may select from the product list or may select other products of equal or better function and quality. The name of a particular product, manufacturer or supplier has been used to establish the type, function and quality required. It shall be the Contractor's responsibility to select products meeting these criteria. If subsequent observation by Engineer or Owner reveals that Contractor's substitute products are less than equal in any respect compared to

the specified item, Contractor shall replace such items at no additional cost to Owner.

D. Where a product is specified by using the name of one or more products and the list is not followed by any wording indicating equivalent products are acceptable, the Contractor shall use only listed products and this will be the basis of the Contract without substitution or exception.

E. All product substitutions shall be subject to Contractor's responsibilities as set forth in paragraphs 6.7.1, 6.7.2 and 6.7.3 of the General Conditions.

F. Substitutions will not be considered when they are indicated or implied on Shop Drawing or product data submittals without separate written request, or when acceptance will require substantial revision of the Contract Documents.

END OF SECTION 01600

SECTION 01650
PROJECT START-UP

1.01 GENERAL

A. In order to make an orderly transfer of responsibility between Contractor and Owner, the steps outlined in this section shall be followed.

B. It is Contractor's sole responsibility to coordinate and plan the start-up of the individual pieces of equipment and systems and to demonstrate that the entire completed Work meets the requirements of these Contract Documents. Neither Engineer nor Owner have any responsibility with regard to such coordination and planning.

C. The raw water from Well 4 contains polynuclear aromatic hydrocarbons (PAHs). Direct discharge of this water to the storm sewer without GAC treatment will not be permitted during any phase of project start-up. Contractor shall consider this requirement in the determination of the Contract Price, and in coordinating and planning project start-up.

1.02 INITIAL START-UP OF EQUIPMENT

A. Coordinate the schedule for start-up of individual pieces of equipment with the necessary controls, piping, wiring and other related work so that start-up is attempted only after work has progressed so that additional installation or modification will not be required after start-up.

B. Notify Engineer seven (7) calendar days prior to start-up of each piece of equipment or system.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, pressure relief, wiring, operating speed or other conditions which may cause damage to the equipment or personnel.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up of equipment in accordance with requirements of relevant individual sections of these Specifications and in the

absence of other instructions in accordance with manufacturer's instructions.

F. Execute the start-up under the supervision of qualified tradesmen experienced in the installation, operation and repair of equipment of the type being started.

1.03 DEMONSTRATION TESTING AND OPERATION

A. In addition to the tests required in the individual sections of these Specifications, the Contractor shall conduct a test or tests as necessary to demonstrate that the individual systems or pieces of equipment function together as a whole to meet the design concept.

B. The Contractor shall furnish all labor, equipment and materials necessary for demonstration testing, initial setting and balancing, debugging, and other operations needed to make the entire system operational for its intended use. Personnel shall be experienced tradesmen familiar with the equipment and its installation, operation and repair.

C. All demonstration testing shall be completed prior to Substantial Completion. If initial demonstration testing reveals defective Work, said Work shall be corrected and demonstration testing repeated at no additional compensation to Contractor.

D. All process, mechanical and electrical equipment, including related control systems, shall be subjected to preliminary operation and demonstration testing by the Contractor before the individual facilities and systems are put into operation. Tests shall be conducted to determine whether the equipment has been properly assembled, aligned, adjusted, wired or connected. Any changes, adjustments or replacements of equipment which are due to defective work, or which may be otherwise necessary to comply with the requirements of the Contract Documents, shall be done without additional cost to the Owner. Upon completion of the checking and adjustment, the Contractor shall demonstrate that each separate piece of equipment in each system operates in accordance with the requirements of the Contract Documents and that the individual systems operate together as required. Where no specific performance requirements are stated, the demonstration test shall show that the equipment operates in accordance with normal application practice for the equipment. The demonstration test shall show that the equipment and systems operate smoothly and without excessive noise and vibration, free from leaks, that the equipment is responsive to manual and automatic controls, that all control and protective devices are properly set, that the equipment will run on a controlled

or intermittent basis when either operation is intended, and that all valves seat fully and provide tight shutoff. The demonstration test for each piece of equipment shall include checkout from each remote control point. All alarm systems and safety lockout systems shall also be demonstrated for proper function along with all process instrumentation and controls.

E. The Contractor shall schedule the demonstration tests with the Owner and Engineer. Owner and Engineer shall be notified at least seven (7) calendar days in advance of all tests.

F. During the testing of equipment, the Contractor shall arrange for the presence of qualified representatives of the manufacturers, fabricators or authorized distributors of all the various pieces of equipment and instrumentation.

G. Within five (5) calendar days following completion of each test, Contractor shall submit a written report describing the test, test conditions, results, instrument settings and all other relevant information. The report shall be submitted in accordance with the requirements of Section 01300 of these Specifications. Engineer will review and will either require Contractor to correct deficiencies and make additional tests or recommend acceptance of the equipment to Owner.

H. Any equipment placed into temporary operation following its demonstration testing but prior to Substantial Completion shall be adjusted and recalibrated immediately prior to Substantial Completion.

I. Equipment accepted by Owner may be put into use following Substantial Completion as evidenced by issuance of a certificate as set forth in the General Conditions.

1.04 INSTRUCTION OF OWNER EMPLOYEES

A. The Contractor shall provide competent personnel who fully understand the operation of the equipment to instruct the Owner's employees in the operation, maintenance, and repair of each item and system. Such instruction shall take place following demonstration testing and prior to Substantial Completion and at such a time or times that are acceptable to Owner and Engineer. The Contractor shall include the cost of this training in the Contract Price. Training shall be of the on-the-job type, and shall cover all areas of operation and maintenance. The training program for equipment and systems without specified requirements in the equipment specifications shall be for a minimum of five days of eight hours each. The days may not be

consecutive. Training required for all other equipment and systems shall be as required by the detailed specifications for such equipment and systems. Training shall, unless otherwise approved, be by factory representatives.

B. At least fourteen (14) calendar days prior to training described in paragraph A above, Contractor shall have delivered to Owner all operating and maintenance instructions required under the Contract Documents.

1.05 SUBSTANTIAL COMPLETION AND SYSTEM START-UP

A. Following demonstration testing acceptable to Owner and training of Owner's employees as set forth in these Specifications, Contractor will be furnished Certificate of Substantial Completion (subject to the further provisions and requirements of the General Conditions).

B. Following Substantial Completion, the entire Work may be put into service by Owner. While being operated, Owner will perform all routine operating procedures such as reading gauges, adjusting valves and operating controls.

C. All power and fuel costs following Substantial Completion will be borne by Owner. Contractor shall be responsible for notifying utility owners of change in billing.

D. Following Substantial Completion, Contractor shall provide five (5) days of 8 hours each to assist Owner with any functional or operational problems or other facility related work that Owner requests. The cost of this time shall be based on Contractor's superintendent or other highly trained workmen familiar with all aspects of the Work, and shall be included in the Contract Price. Contractor will not be required to furnish any materials or equipment under this paragraph except basic hand and power tools.

END OF SECTION 01650

SECTION 01700
CONTRACT CLOSEOUT

1.01 RECORD DOCUMENTS

A. Maintain at the site (or in Contractor's possession) one set of record documents in accordance with paragraph 6.19 of the General Conditions. Store record documents separate from documents used for construction, clearly mark, and make accessible to Engineer and Owner at all times.

B. Record information concurrent with construction progress.

C. Record for each product section of the Specifications a description of the actual products installed including the following:

1. Manufacturer's name and product model number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda or Change Order.
4. Quality control procedures and test results.

D. Record drawings shall have recorded, at a minimum, the following items legibly marked to record actual construction:

1. Approved version of all Shop Drawings.

2. Measured depths or elevations of foundations in relation to a clearly defined, reproducible datum.

3. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements or survey markers.

4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

5. Changes made by Addenda or Change Order and all minor field changes of dimension and detail.

6. Details not shown on original Contract Drawings.

E. Submit record documents along with all operations and maintenance manuals and other submittals required by the Contract Documents prior to final application for payment.

1.02 SUBSTANTIAL COMPLETION

A. When Contractor considers the Work to be substantially complete, Contractor shall notify Engineer in writing and Engineer will respond, all in accordance with paragraph 14.8 of the General Conditions.

B. Other requirements for Substantial Completion are set forth in Section 01650 of these Specifications.

1.03 CLEANUP

A. The Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work, and at the completion of the Work, shall remove all waste materials, rubbish and debris from the premises as well as all tools, construction equipment and machinery, temporary facilities, and surplus materials. Contractor shall leave the site clean and ready for occupancy by the Owner. Early acceptance of process equipment shall not waiver cleanup prior to final acceptance.

B. The Contractor shall provide cleaning of all surfaces, systems and fixtures, including removal of labels, tags, grease, oil, dirt, dust, stains, etc. Prior to final acceptance of the Work, the Contractor shall provide final cleaning of all floors, walls, windows, millwork, counters, light fixtures, cabinets, etc., so that the building will be ready for use by the Owner without further cleaning. This cleaning shall include removal of dust from all surfaces including ceilings, walls and other vertical surfaces, washing of all glass and counter surfaces. The Owner requires that the Work be cleaned to a high degree to reflect the sanitary nature of the facility.

C. Upon final acceptance, the Owner will assume the normal janitorial cleaning services. Recleaning of any soiled areas due to Contractor's operation, shall be the responsibility of the Contractor.

1.04 FINAL INSPECTION

A. When Contractor considers Work is complete and ready for final payment, Contractor shall provide written notice and Engineer will respond, all in accordance with paragraph 14.11 of the General Conditions.

B. Contractor's written notice to Engineer shall certify that:

1. Contract Documents have been thoroughly reviewed and Work has been inspected by Contractor and complies with the Contract Documents.

2. Equipment and systems have been tested in the presence of Engineer and Owner and are fully operational and adjusted in compliance with the Contract Documents.

3. Work is completed and ready for final payment.

1.05 GUARANTIES AND WARRANTIES

A. The Contractor shall guarantee all work and material against all defects as specified in paragraph 13.12 of the General Conditions or as otherwise required for specific items in these Specifications. The Contractor shall repair or replace any such defective Work and materials to conform to the provisions of the Contract and without expense to the Owner, within ten (10) days after notification in writing by the Owner or Engineer of such defective Work or material. If the Contractor does not make said repairs or replacements or have made arrangements for the correction thereof within the period specified above, the Owner will do so and will charge the cost of same to the Contractor. The Contractor shall perform repair work so as to cause the Owner a minimum of inconvenience and interruption of services.

B. The correction period for all equipment and systems, regardless of when placed into continuous service, shall commence on the date of Substantial Completion.

1.06 FINAL APPLICATION FOR PAYMENT

A. Final Application for Payment shall be accompanied by a written Final Statement of Account. Statement shall reflect all adjustments to the Contract sum including, but not limited to:

1. The original Contract sum.
2. Additions and deductions resulting from:

    a. Previous change orders
    b. Allowances
    c. Unit prices
    d. Deductions for uncorrected work
    e. Deductions for liquidated damages

f. Deductions for reinspection payments
g. Other adjustments

3. Total Contract sum, as adjusted.
4. Previous payments.
5. Sum remaining due.

B. Final Application for Payment shall be submitted in accordance with the procedures and accompanied by the other materials described in Section 01300 of these Specifications.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts and maintenance materials in quantities specified in each section, in addition to that required for completion of the Work. Coordinate with Owner and deliver to facility prior to Substantial Completion.

END OF SECTION 01700

DIVISION 2 - SITE WORK

02050 DEMOLITION

02100 SITE PREPARATION

02220 STRUCTURAL EXCAVATING, FILLING AND GRADING

02510 CONCRETE WALKS, CURBS AND DRIVES

02513 ASPHALTIC CONCRETE PAVING

02600 PIPED UTILITIES

02710 FOUNDATION DRAIN SYSTEM

02930 LAWNS AND GRASSES

02950 TREES, SHRUBS AND GROUND COVER

SECTION 02050

DEMOLITION

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs, as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered by this Section includes furnishing all materials, equipment, and labor required to demolish the existing wellhouse and appurtenances including, but not limited to:

1. Removal of interior piping and equipment.

2. Removal of the existing structure, including floor slab, below grade foundation walls, and footings.

3. Removal of below grade piping within the limits of the existing building, including the existing floor drain line and sump.

4. Removal of the existing pump base.

5. Removal of existing bituminous pavement, curb and gutter, and concrete apron.

6. Removal and salvage of existing electrical control panels.

7. Disposition of all waste materials.

C. Related Work specified elsewhere:

1. Section 02100 - Site Preparation
2. Section 02220 - Structural Excavating, Filling, and Grading
3. Section 02600 - Piped Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1.03 JOB CONDITIONS

A. The use of explosives will not be allowed.

B. The use of drop weight or wrecking ball methods will not be allowed.

C. Conduct demolition operations and the removal of debris to ensure minimum interference with roads and nearby homes, businesses, and institutions. Do not close or obstruct streets, walks, or other occupied facilities without permission from authorities having jurisdiction.

D. Record drawings accurately depicting all aspects of the facilities to be demolished are not available. Contractor shall be solely responsible for evaluating existing facilities and site conditions and considering all factors that may affect the progress or performance of the Work.

E. Owner will retain ownership of some existing materials as described elsewhere in this Section. If the salvaged equipment is identified to be retained by Owner, deliver to Owner as specified.

1.04 SEQUENCING AND SCHEDULING

A. Coordinate shut-off of all utility services. Do not begin Work under this Section until utility service has been discontinued and safe conditions have been established. Confirm electrical service has been disconnected and water pressure relieved by testing prior to proceeding.

B. Do not begin Work described under this Section until temporary erosion control and temporary Site security fencing as shown on the Drawings and described in these Specifications is in place.

C. Do not begin Work described under this Section until materials, labor, and equipment are available to proceed diligently with the Work.

D. All materials identified to be salvaged shall be removed from the Site prior to initiating any other demolition work.

E. Schedule sidewalk, pavement, and curb and gutter removal to immediately precede Work that requires removal.

1.05 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 OWNERSHIP OF MATERIALS

A. Contractor shall salvage and deliver to Owner the following products from the existing structure:

1. control panels and motor control centers as shown in the Drawings.

PART 3: EXECUTION

3.01 PREPARATION

A. Contractor shall locate all Underground Facilities and utilities and remove and cap those affected within the demolition area. Coordinate location and service shut-off with utility owners. Removal of Underground Facilities and utilities outside the demolition area is described in Section 02600.

B. Furnish and install any required fences to protect the public and surrounding facilities as set forth elsewhere in these Specifications. Maintain until no longer required for protection.

3.02 REMOVING CURB AND GUTTER, SIDEWALKS, PAVEMENT AND APRONS

A. All edges to remain shall be saw cut to a depth of at least one-half of the thickness of the element being cut.

B. Removal shall be to the limits shown on the Drawings. Where there is an existing joint or seam within 3 feet beyond the indicated limits, removal shall be to the existing joint or seam, provided joint or seam is within construction limits.

C. All material removed shall be disposed of off-site in accordance with Laws and Regulations. Use of removed material for aggregate or backfill, or otherwise incorporating removed material into the Work, will not be allowed.

D. Provide diversions, ditches, pipes, and other temporary measures required to convey surface water drainage that would otherwise have flowed over removed surfaces.

3.03 SALVAGE

A. Prior to beginning Work under this Section, coordinate and schedule a meeting at Site with Owner and Engineer. Owner will label specific products Owner requires salvaged, as generally shown in the Drawings and described in these Specifications. Contractor and Owner shall note, and Engineer will record, existing damage and condition of equipment.

B. Carefully remove identified products so as to preserve existing condition. Disassemble to component size/configuration consistent with typical delivery configuration for installation. Protect salvaged material under installed conditions until delivery.

C. Coordinate with Owner and deliver and unload materials at Owner's Public Works facilities at 3750 Wooddale Avenue or 7305 Oxford Street.

D. Repair damage caused during salvage and transportation to condition equal to or better than existing.

3.04 DEMOLITION

A. Prevent fugitive dust by providing watering, enclosures, or other control measures to limit dust emissions to levels that do not interfere with nearby activities and as required by Laws and Regulations.

B. Clean adjacent property, including roads and other public right-of-way, of all dust, dirt, and debris caused by demolition operations. Return to a condition equal to or better than existing prior to the start of work.

C. Proceed in an orderly manner, carefully removing equipment to be salvaged prior to beginning demolition. Break all materials into pieces smaller than 4 cubic feet.

D. Have in place all required protective devices and facilities (including bracing, shoring, sheeting, enclosures, nets, etc.) prior to beginning demolition activities. Provide facilities to protect adjacent property and persons as required by Laws and Regulations. Provide protective facilities and utilize methods that absolutely confine demolition debris within the construction limits shown on the

Drawings. Minimize the potential for projectiles and falling objects as a result of the Work.

E. Remove all facilities as indicated in the Drawings, specifically including floor slab and all below grade walls and footings.

F. Protect wellhead at all times during the Work. Contractor shall take all measures necessary to absolutely ensure that foreign material does not enter the well and that the well casing is not damaged during demolition. Carefully remove the existing pump base using hand-held tools so as to prevent damage to the existing casing.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. Contractor shall be responsible for providing a suitable location for off-site disposal of demolished materials outside the City limits of St. Louis Park in accordance with Laws and Regulations.

B. Transport from the Site all debris, rubbish, and other materials resulting from the demolition within two (2) calendar days of demolition. Storage or sale of removed materials will not be permitted on the Site.

C. Completely segregate all demolition debris from other materials and equipment on the site to prevent its incorporation into the Work.

D. Burning of materials will not be permitted on the Site.

3.06 CLEAN-UP

A. Remove all rubbish and debris from the Site and leave the Site in a clean and neat condition prior to construction.

B. Assure that all temporary controls required are constructed and operational.

3.07 FIELD QUALITY CONTROL

A. The Contractor shall be responsible for establishing and maintaining field quality control to assure compliance with the Contract Documents.

END OF SECTION 02050

SECTION 02100

SITE PREPARATION

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs, as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to prepare the Site for construction, including, but not limited to:

1. Cutting and removal of all trees and shrubs as required for the performance of the Work that are not specifically designated to remain.

2. Removal of all roots, grass, stumps, windfalls and other vegetative material within the construction limits.

3. Stripping and stockpiling of topsoil suitable for reuse in accordance with these Specifications.

4. Protection of all trees and vegetative material specifically designated to remain.

5. Pruning of remaining trees and shrubs and removal of deadfall around perimeter of Work.

6. Installation of temporary erosion control.

C. Related Work specified elsewhere:

1. Section 02050 - Demolition
2. Section 02220 - Structural Excavating, Filling, and Grading

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1.03 SEQUENCING AND SCHEDULING

A. Do not begin Work described under this Section until temporary erosion control and temporary security fencing as shown on the Drawings and described in these Specifications is in place.

B. Do not begin excavating or backfilling as required under Sections 02220 and 02600 until the Work required under this Section is completed.

1.04 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 TOPSOIL

Topsoil stockpiled for reuse shall meet the requirements set forth in Section 02930 of these Specifications.

2.02 TEMPORARY EROSION CONTROL

A. Bales - Bales used for temporary erosion control, whether specifically shown in the Contract Drawings or not, shall be hay or straw densely compacted and tightly wrapped with baling wire in 2 or 3 strands to resist unraveling. Provide minimum of two rows with staggered joints. Retain in place with steel fence posts or wood 2 x 4 posts driven to provide stable backing.

B. Silt Fence Fabric - Silt fence fabric shall be Mirafi 100X or equivalent.

PART 3: EXECUTION

3.01 GRUBBING

A. Mark all trees over 2 inches in diameter. Notify Engineer and Owner and confer on-site prior to beginning clearing operations.

B. Selectively cut or use other appropriate clearing methods so as to preserve trees and shrubs specifically identified by Owner to remain.

C. Conduct all clearing operations so that felled trees and other debris remains within the construction limits and off of public streets.

D. Segregate all material removed from clearing operations to prevent mixing with clean mineral soils to be incorporated into the Work.

3.02 GRUBBING

A. All stumps and other vegetative material below the ground surface within the construction limits shall be completely removed, except for trees and shrubs specifically designated to remain.

B. Segregate all material removed from grubbing operations to prevent mixing with clean mineral soils to be incorporated into the Work.

3.03 TOPSOIL

A. Remove and dispose of all heavy growths of grass, sod, ground cover and other deleterious materials that do not meet the specification for topsoil.

B. Conduct stripping operations to prevent mixing of topsoil with non-organic soils from lower soil horizons.

C. Stockpile in location so as not to interfere with other Work and so as not to become mixed with clean mineral soils to be incorporated into the Work.

D. Protect stockpile from erosion by seeding and mulching, silt fence, or other measures as necessary.

3.04 PROTECTION

A. All trees and shrubs specifically designated to remain shall be protected from damage during the performance of the Work as set forth below.

B. Surround with wire fabric or snow fence attached to wood or metal posts. Position fence a sufficient distance from tree or shrub to prevent damage from any operation outside of fence.

C. Stop topsoil stripping a sufficient distance from remaining trees and shrubs to prevent damage to root system.

3.05 PRUNING

A. Where branches or limbs from remaining trees and shrubs overhang a structure or other feature of the Work, or could otherwise interfere with or cause future damage to the Work, trim or prune following conference at Site with Owner and Engineer.

B. Use ropes, chains, booms, guys, or any other method required to prevent damage to the Work or other property or persons as a result of pruning.

C. Remove deadfall and trim and prune around the perimeter of the limits of clearing, grubbing, and topsoil removal to provide a neat transition to areas of existing vegetation.

3.06 DISPOSITION OF MATERIALS

A. Contractor shall be responsible for providing a suitable location for off-site disposal of materials generated under this Section.

B. Remove all waste materials from the Site within two (2) calendar days following generation. Storage or burial of materials on Site will not be permitted.

C. Burning of materials on Site will not be permitted.

D. Chipping of materials on Site will not be permitted.

E. All elmwood timber, stumps, roots and debris, along with bark and byproducts of elm tree origin, shall be disposed of in accordance with Minnesota Rules 1505.0230, 1505.0240, and 1505.0250.

F. All timber, stumps, roots, and debris from oak wilt infested trees of the red oak family shall be disposed of according to Minnesota Rules 1505.0320 and 1505.0340.

END OF SECTION 02100

SECTION 02220

STRUCTURAL EXCAVATING, FILLING AND GRADING

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to excavate and fill for the construction of structures and to grade the Site including, but not limited to:

1. excavate for the construction of structures (not including buried utilities);

2. backfill voids left by demolition, site preparation, and over excavation;

3. furnish, place, and compact granular materials, including riprap, as specified;

4. grade to lines shown on the Contract Drawings for placement of footings, foundations, slabs, sidewalks, driveways, and paving;

5. dispose of excess soil and other material from excavation and grading operations off-site; and .

6. furnish, place, and grade topsoil in areas to be sodded or seeded.

C. Related Sections:

1. Section 02050 - Demolition
2. Section 02100 - Site Preparation
3. Section 02510 - Concrete Walks, Curbs, and Drives
4. Section 02513 - Asphaltic Concrete Paving
5. Section 02600 - Piped Utilities
6. Section 02710 - Foundation Drain System
7. Section 02930 - Lawns and Grasses
8. Section 03100 - Concrete Formwork
9. Section 03200 - Concrete Reinforcement
10. Section 03300 - Cast-in-Place Concrete

D. Products Furnished But Not Installed Under This Section:

1. Install as per Section 02710 - Coarse Granular Drainage Material

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. MnDOT 3138.2, "Aggregates for Surface and Base Courses, Requirements"

2. MnDOT 3601.2, "Riprap Materials, Requirements"

3. ASTM D2487, "Classification of Soils for Engineering Purposes"

4. ASTM D1556, "Density of Soil In Place by the Sand Cone Method"

5. ASTM D4253, "Maximum Index Density of Soils Using a Vibratory Table"

6. ASTM D4254, "Minimum Index Density of Soils and Calculation of Relative Density"

7. ASTM D698, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.49 kg) Rammer and 12-in. (305-mm) Drop" (also referred to as Standard Proctor)

8. ASTM D1557, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop" (also referred to as Modified Proctor)

9. ASTM D422, "Particle-Size Analysis of Soils"

10. ASTM D4718, "Correction of Unit Weight and Water Content for Soils Containing Oversize Particles"

11. ASTM D2488, "Description and Identification of Soils (Visual-Manual Procedure)"

1.03 SUBMITTALS

A. Test Results/Certificates -- Submit the following test results and/or certificates in accordance with the general procedures set forth in Division 1 of these Specifications:

1. At least 2 weeks prior to delivery to Site, provide Engineer with certificate indicating compliance with Specifications for granular drainage material, coarse granular drainage material, and select granular backfill. Provide, for each material, test results for at least two random samples showing gradation (ASTM D422) and classification (ASTM D2487). Identify source of material (i.e., address, vendor, etc.) so that Engineer or Owner can sample if desired.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Upon delivery, provide access for sampling or observation of loads by Engineer or Owner prior to unloading.

B. Store on level surfaces and prevent mixing with dissimilar materials and segregation of graded materials. Graded materials shall meet gradation requirements in-place.

C. Protect from erosion and transport from stockpiles by water or wind.

D. Do not stockpile more material than will be incorporated into the Work within one working day.

1.05 SEQUENCING AND SCHEDULING

A. Coordinate sequencing of excavation operations so that excavation adjacent to previously completed portions of the Work does not disturb that Work. Support excavations to prevent disturbance of soils beneath existing footings, foundations, slabs, or other structures and features intended to remain.

B. Do not proceed with subsequent operations until Engineer or Owner has been notified and has been given opportunity to verify that Work meets requirements of these Specifications, including sampling and testing.

C. Do not proceed until all required temporary facilities and controls are in place.

1.06 JOB CONDITIONS

A. Soil borings have been installed at the Site and are available for review as described in Division 1 of these Specifications.

B. It shall be the Contractor's sole responsibility to review available tests and reports, conduct additional tests, and otherwise determine to its own satisfaction the location and nature of all surface and

subsurface features and the soil and water conditions that will be encountered, as more fully set forth elsewhere in these Contract Documents.

C. Use of explosives will not be permitted.

D. Contractor shall be solely responsible for determining the means and methods for meeting the compaction requirements specified herein, except that compaction by flooding or puddling or other means that involve saturation or over-wetting the soil will not be permitted. Contractor shall be solely responsible for utilizing means and methods that protect adjacent structures and utilities from damage resulting from Contractor's operations, specifically including, but not limited to, settlement, consolidation, displacement, cracking, vibration, undermining, washout, and uplift caused by excavating, compaction, dewatering, or any other operation. If requested by Contractor, Owner will accompany Contractor in examination of existing adjacent structures prior to beginning the Work, provided that access is granted by owners of those structures. Examination will be intended to provide Contractor opportunity to document relevant existing structural damage or problems.

E. Provide all shoring, bracing, sheet piling, trench boxes, tie backs, and other measures required to perform all Work in accordance with Laws and Regulations. Specifically, all excavations shall conform to the requirements of OSHA set forth in 29 CFR 1926, Subpart P (Occupational Safety and Health Standards-Excavations).

1.07 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 CLAY

Clay for use as clay cap over granular drainage material shall be classified as lean to fat clays with group symbols CL-CH or CH when classified in accordance with ASTM D2488. Clay shall contain no organic material and no rocks or solid mineral material in excess of 2 inches in diameter. All clay shall be furnished from a suitable off-site source.

2.02 GRANULAR DRAINAGE MATERIAL

Granular drainage material shall be a free draining mineral product consisting of sound durable particles and excluding crushed carbonate quarry rock, crushed concrete, and salvaged bituminous mixture and shall be free of organic material. Granular drainage material shall be uniformly graded from fine to coarse and shall conform to the following gradation requirements:

U.S. Standard Sieve Size	Percent Passing (dry weight)
3/4"	100
3/8"	75-100
No. 4	35-85
No. 10	15-65
No. 40	0-15
No. 100	0-2
No. 200	0

2.03 COARSE GRANULAR DRAINAGE MATERIAL

Coarse granular drainage material shall be a free draining mineral product consisting of sound, durable particles and excluding crushed carbonate quarry rock, crushed concrete, and salvaged bituminous mixture and shall be free of all organic material. The coarse granular filter shall be uniformly graded from fine to coarse and shall conform to the following gradation requirements:

U.S. Standard Sieve Size	Percent Passing (dry weight)
1-1/2"	100
1"	85-100
3/4"	50-100
3/8"	15-55
No. 4	10-25
No. 10	0-10
No. 40	0-5
No. 100	0-2
No. 200	0

2.04 GRANULAR BASE

Granular base shall conform to the requirements of MnDOT 3138.2 for Class 5 material, except that use of crushed concrete or salvaged bituminous mixture will not be allowed.

2.05 COMMON BACKFILL

Common backfill shall be native mineral soil from the Site that is free from excessive moisture, debris, roots, organic material, frozen soil, or rocks larger than 2 inches in diameter.

2.06 SELECT GRANULAR BACKFILL

Select granular backfill shall be a mineral product consisting of sound durable particles and excluding crushed carbonate quarry rock, crushed concrete, and salvaged bituminous mixture and shall be free of all organic material. The select granular backfill shall be uniformly graded from fine to coarse and shall conform to the following gradation requirements:

U.S. Standard Sieve Size	Percent Passing (dry weight)
1"	100
3/4"	90-100
3/8"	50-90
No. 4	35-80
No. 10	20-65
No. 40	10-35
No. 200	0-5

2.07 RIPRAP

Riprap shall conform to the requirements of MnDOT 3601.2 for Class II.

2.08 TOPSOIL

Topsoil shall conform to the requirements of MnDOT Standard Specification 3877 for grade "select."

2.09 SOURCE QUALITY CONTROL

A. All products of a given specification shall be from a single source or borrow area and uniform.

PART 3: EXECUTION

3.01 EXCAVATION

A. Excavate to the lines and grades shown on the Contract Drawings.

B. Stability of Excavations:

1. Slope sides of excavations to comply with applicable Laws and Regulations and to provide access for compaction equipment.

2. Provide shoring and bracing where required to comply with Laws and Regulations, or to protect adjacent surface or subsurface features, or to limit activity within construction limits. Contractor shall design shoring and bracing and provide all materials, including piling, uprights, stringers, and cross-bracing in good condition at no additional cost to Owner.

3. Remove all temporary shoring and bracing not specifically indicated in the Drawings or these Specifications to remain.

4. Carry down shoring and bracing as excavation progresses and maintain as required until excavation is filled.

C. Water Controls:

1. Provide all temporary controls, including dewatering systems and diversions, to prevent surface and subsurface water from flowing into excavations.

2. Provide all temporary controls, including drains, ditches, pumps, and sumps to prevent water from collecting in excavations. Maintain excavations in a dry and stable condition at all times.

3. Obtain all permits required to discharge water from dewatering operations and runoff and provide all facilities and testing required to assure that all water discharged meets conditions of permits and Laws and Regulations. Remove sediment prior to discharge to satisfaction of jurisdictional authorities.

4. Convey water from dewatering operations or from runoff to proper discharge point away from the excavation in hoses, pipes, or suitably constructed and protected ditches. Do not use trench excavations as temporary drainage ditches.

D. Material Storage:

1. Stockpile materials required for backfill away from edge of excavations and trenches. Shape and grade to provide drainage and minimize erosion. Provide temporary erosion control and diversions around base as necessary.

2. Dispose of excess and unsuitable material off-site promptly following excavation.

E. Excavation Under Proposed Structures:

1. Conform to elevations shown on Drawings within a tolerance of minus 0.10 foot, plus 0.00 foot. Extend excavations a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction required, and observation.

2. Excavate to sufficient depth to remove loose or disturbed native soil. Avoid overexcavating of sound native soil. Excavate by hand, if necessary, to final grade prior to placement of concrete. Trim excavation bottom to produce solid uniform base to receive concrete.

3. Notify Engineer of any unsatisfactory soil materials encountered that require additional excavation, including peat, debris, lake sediments, fat clays, or other soils subject to compressibility. If Engineer determines that additional excavation is required, through no fault or neglect of Contractor, the additional excavation will be paid for as a change in the Work.

4. Excavation beyond the lines and grades shown in the Drawings or described herein without the specific direction of Engineer will be considered unauthorized excavation and shall be remedied at Contractor's expense. Remedy shall be determined by Engineer to consist of one of the following:

   a. extend the bottom elevation of the footing, foundation, or slab to the bottom of the excavation without altering the required top elevation, or

   b. backfill and compact as specified for the appropriate situation described herein.

F. Excavation Under Proposed Embankments:

1. Remove all vegetation, debris, organic soils, and other deleterious materials from ground surface. Remove all roots and stumps from below ground surface.

2. Surface plow, strip, or break up existing surfaces so that fill material will bond with existing surface.

3. On existing slopes steeper than 4 horizontally to 1 vertically (4:1), Contractor shall, at its option: (a) flatten the existing slope to the extent that it will not be steeper than 4 to 1 or (b) construct steps in the slope, with the back surface being as nearly vertical as practicable and with the horizontal cuts being made as close together as the slope permits, but with no step being less than 1 foot in width.

G. Protect excavation bottoms against freezing when atmospheric temperature is below 35°F.

3.02 BACKFILL AND FILL

A. Provide compaction appropriate for the location as specified elsewhere in this Section.

B. Backfill shall proceed as promptly as possible, but not before completion of the following:

1. Observation by Engineer of construction below grade including, where applicable, dampproofing, waterproofing, perimeter insulation, foundation drains, sleeves, penetrations, and anchorages.

2. Observation by Engineer, testing, and recording locations of Underground Facilities and utilities.

3. Removal of concrete formwork.

4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Remove temporary sheet piling driven below bottom of structures in manner to prevent settlement of the structure or utilities, or leave in place if required. Cut-off all sheet piling to remain to specified height.

5. Removal of trash and debris.

6. Permanent or temporary bracing is in place to support walls or other components.

7. Concrete curing to sufficient strength to support loads and forces imposed during backfilling and subsequent construction.

C. Place backfill and fill materials in layers not more than 8 inches in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area

classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Scarify, remoisten, and recompact surfaces that have been dried, weathered, or loosened between lifts.

D. Place granular base in loose lifts not to exceed 4 inches. Place to prevent segregation of materials. Do not place when frozen.

E. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift. Protect waterproofing and insulation by hand placement if necessary. Notify Engineer of any damage and repair as approved before proceeding.

F. Do not proceed with backfilling adjacent to structures until foundation drain system is in place as specified in Section 02710. Along length of drain, place a 2 to 3-foot width of fine granular drainage material adjacent to structure. Bring backfill outside drainage zone to grade in lifts along with drainage material to control width. Place and compact clay cap as shown in Drawings to prevent infiltration to drainage zone. In area of plantings, place top of clay cap below root zone.

G. Do not place frozen soil or any material containing organic matter, trash, debris, large rocks, or other deleterious substances.

H. Unless shown otherwise on Drawings, all fill material under and within 2 feet of footings, foundations, and slabs shall be select granular backfill.

3.03 COMPACTION

A. General:

1. Furnish equipment suitable for soil conditions and compactive effort required to meet compaction criteria specified herein.

2. Control moisture content for placement at optimum (plus 2 percent, minus 0 percent).

a. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil to prevent fee water appearing on surface during or subsequent to compaction operations. Disc or otherwise thoroughly mix to distribute added water.

b. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction as specified. Soil material that has been removed because it is too wet may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing, until moisture content is satisfactory.

B. Compaction Under Structures:

1. Compact under structures (including footings, foundations, slabs, roads, etc.) to an in place density as measured by ASTM D1556 that is the greater of:

a. 95 percent of maximum Modified Proctor density (ASTM D1557), and

b. 85 percent relative density in accordance with ASTM D4254.

2. Prior to placement of fill, compact native soil to obtain specified compaction at depth of 6 inches.

3. Compact as specified to at least 2 feet outside of foundation limits.

C. Compaction of Non-Structural Fills and Embankments

1. Compact areas not under structures (including slabs, driveways, and sidewalks) to an in place density as measured by ASTM D1556 that is the greater of:

a. 85 percent of maximum Modified Proctor density (ASTM D1557), and

b. 75 percent relative density in accordance with ASTM D4254.

D. Granular Base

1. Compact granular base to an in-place density as measured by ASTM D1556 that is greater of:

a. 100 percent of maximum Modified Proctor density (ASTM D1557), and

b. 90 percent relative density in accordance with ASTM D4254.

E. Clay Cap

1. Compact clay cap to an in-place density as measured by ASTM D1556 that is 95 percent of maximum Modified Proctor density.

3.04 GRADING

A. General:

Uniformly grade areas within limits shown on Drawings, including adjacent transition areas. Smooth finished surface and compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Structure Limits:

Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

1. Grassed Areas: Finish areas to receive topsoil to within no more than 0.10 foot above or below the required subgrade elevations. Provide minimum slope of 2 percent where possible.

2. Slabs, Driveways, Walks, Roads and Parking: Shape surface of areas under pavement to line, grade and cross section shown in Drawings, with finish surface not more than 0.05 foot above or below the required subgrade elevation. Provide final grades within a tolerance of 0.02 foot when tested with a 10-foot straightedge.

C. Grading Inside Structure Limits:

Grade smooth and even, free of voids, compacted as specified, and to within 0.05 foot above or below the required elevation. Provide final grades within a tolerance of 0.02 foot when tested with a 10-foot straightedge.

D. After final grading, compact subgrade surfaces to the depth and percentage of maximum density specified for area.

3.05 MAINTENANCE

A. Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Install erosion bales along entire perimeter to protect nongraded areas.

B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

D. The Contractor shall comply with all Laws and Regulations applicable to the Work. This shall include the use of temporary erosion checks, where specified or as otherwise necessary, which will allow movement of water but will retain sediment so as to protect erodible or discharge areas from damaging runoff. Use erosion control bales as necessary to supplement silt fences and other temporary erosion control.

E. Generally, bales or erosion control checks shall be placed around all culverts or drainage inlets, and where polluted or sediment laden waters flow from the construction areas. Two stakes shall be placed through each hay bale to prevent movement. If prior to turf re-establishment, the erosion checks and dams become loaded with sediment in a magnitude that would lessen their effectiveness, the Contractor shall remove the sediment and/or replace the bales. After the erosion checks have served their usefulness, the Contractor shall remove the sediment and/or replace the bales. After the erosion checks have served their usefulness, the Contractor shall, upon request from the Owner, remove the stakes and bales from the drainageways and structures and remove any trapped sediment.

3.06 TOPSOIL PLACEMENT AND GRADING

A. Place topsoil over entire area to be seeded or sodded to a minimum depth of 6 inches. In event that topsoil has been disturbed or is not of acceptable depth prior to application of sod or seed, supplement topsoil in area to bring it up to the above specified depth. All areas receiving seed or sod shall be worked until the soil is completely fined and in a mellow condition, to smooth even finish grade. All holes, depressions and revulets shall be filled in to ensure no disruption of established drainage patterns. All rubble, sticks, branches, or stones and extraneous material over 3/4-inch diameter on the surface, which will interfere with the sod shall be picked up and removed.

B. Immediately prior to seed or sodding this Contractor shall loosen topsoil to a depth of 3 inches on all areas except slopes steeper than 2 horizontally to 2 vertically using discs, harrows, tiller rakes to produce fine grade. On slopes steeper than 2:1, use

cultivating equipment in general direction at right angles to the direction of surface drainage wherever practical.

C. Prepare ground so top of new seeded area of sod shall be laid flush with adjacent walks and permanent surfacing.

3.07 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove from Site all trash, debris, waste materials, and excess soil materials not required for the Work, and legally dispose of it.

3.08 FIELD QUALITY CONTROL

A. The Contractor shall utilize equipment, materials and procedures which are anticipated to meet the quality requirements specified.

B. Quality Control Testing During Construction: Contractor shall permit Engineer to observe, sample, and test subgrades and fill layers before further construction work is performed thereon. Contractor shall notify Engineer when phases of Work are completed and ready for testing.

C. Contractor shall establish and maintain quality control for Work under this Section to assure compliance with the Contract Documents and maintain records of Contractor's quality for all operations, including, but not limited to, the following:

1. volume of granular materials used,
2. monitoring of lift thickness and uniformity during backfill,
3. compaction tests and density tests to verify compliance with Specifications,
4. locations and elevations of all tests and material tested.

END OF SECTION 02220

SECTION 02510

CONCRETE WALKS, CURBS, AND DRIVES

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to construct or repair concrete drives, parking areas, curb and gutter, sidewalks, aprons, and miscellaneous slabs as shown on the Drawings and described herein.

C. Related Sections:

1. Section 02220 - Structural Excavating, Filling, and Grading
2. Section 02513 - Asphaltic Concrete Paving
3. Section 02600 - Piped Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. MnDOT 2301.3, "Concrete Pavement, Construction Requirements"

2. MnDOT 2521.3, "Walks, Construction Requirements"

3. MnDOT 2531.3, "Concrete Curbing, Construction Requirements"

1.03 SUBMITTALS

A. Submit signed certification that materials furnished for this Work have been tested and conform to the applicable requirements of these Specifications. Indicate source of materials, name and address of testing laboratory, and dates of tests.

1.04 QUALITY ASSURANCE

A. Comply with all applicable requirements of Division 3 of these Specifications except as specifically modified or supplemented by this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver concrete only in quantities that can be promptly placed and finished by forces on Site.

B. Do no initiate concrete delivery until sufficient labor and equipment is on Site and prepared to complete intended pour.

C. Do not alter concrete mix in trucks by addition of water, aggregate, cement, or any other materials after truck leaves plant.

D. Immediately remove from Site all materials not meeting requirements.

1.06 SEQUENCING AND SCHEDULING

A. Do not proceed until testing of subgrade has been completed by Engineer or Owner.

B. Do not proceed until grading has been completed in accordance with Section 02220. Touch up or regrade as necessary to provide surface free of ruts, rills, bird baths, and other undesirable features.

C. Do not proceed until necessary traffic controls, warning signs, flagmen, and other temporary controls are in place.

D. Do not proceed with delivery of concrete until all valve boxes, manhole castings, catch basin castings, and other penetrations (either previously existing or included in this Work) are set at proper height in accordance with the Drawings or these Specifications.

E. Do not proceed until all piped utilities described under Section 02600 have been installed and tested and all trenches have been backfilled.

1.07 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 CONCRETE

In accordance with the requirements of Section 03300 (Cast-in-Place Concrete) of these Specifications.

2.02 CONCRETE REINFORCEMENT

In accordance with the requirements of Section 03200 (Concrete Reinforcement) of these Specifications.

2.03 BITUMINOUS EXPANSION MATERIAL/BITUMINOUS JOINT FILLER

In accordance with the requirements of Section 03300 (Cast-in-Place Concrete) of these Specifications.

2.04 MISCELLANEOUS

Miscellaneous materials such as curing agents shall be as set forth in Section 03300 (Cast-in-Place Concrete) of these Specifications.

PART 3: EXECUTION

3.01 GENERAL

A. Adjust all manhole, valve box, curb stop, and other castings so that top of casting is ½-inch below finished grade, except that catch basin castings shall be set flush with finished grade. Slope manhole and catch basin castings to match finished grade with full mortar bed under casting. Complete adjustment of all castings at least 24 hours prior to placement of concrete.

B. Cover all castings with a ½-inch thick plywood cover cut precisely to the outer dimensions of the casting. The cover shall remain in place during concrete placement. Edge around all castings with a ½-inch radius edging tool.

3.02 SLABS, DRIVEWAYS, AND CONCRETE PAVEMENTS

A. Construct in accordance with the requirements of Division 3 of these Specifications.

B. Finish with light brush finish at right angles to centerline.

C. Where Division 3 of these Specifications does not address the requirements for the execution of the Work, perform in accordance with the applicable requirements of MnDOT 2301.3, except that MnDOT 2301.3 shall not modify or supersede the requirements of these Specifications.

3.03 SIDEWALKS

A. Construct in accordance with the requirements of Division 3 of these Specifications.

B. Finish with light brush finish at right angles to centerline.

C. Where Division 3 of these Specifications does not address the requirements for the execution of the Work, perform in accordance with the applicable requirements of MnDOT 2521.3, except that MnDOT 2521.3 shall not modify or supersede the requirements of these Specifications.

D. Joint placement, unless shown otherwise on the Drawings, shall be in accordance with MnDOT Standard Plate 7035J for sidewalk details.

3.04 CURB AND GUTTER

A. Construct in accordance with Division 3 of these Specifications.

B. Where Division 3 of these Specifications does not address the requirements for the execution of the Work, perform in accordance with the applicable requirements of MnDOT 2531.3, except that MnDOT 2531.3 shall not modify or supersede the requirements of these Specifications.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for the Work under this Section to assure compliance with the Contract Documents and maintain records of Contractor's quality for all operations, including, but not limited to, the following:

1. identification of concrete source and results of all source quality control,

2. test results demonstrating air content, slump, and cured strength.

END OF SECTION 02510

SECTION 02513

ASPHALTIC CONCRETE PAVING

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to restore asphaltic pavement removed or damaged during the performance of the Work and pave additional areas, all as shown in the Drawings and set forth in these Specifications.

C. Related Sections:

1. Section 02220 - Structural Excavating, Filling, and Grading
2. Section 02510 - Concrete Walks, Curbs, and Drives
3. Section 02600 - Piped Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. MnDOT 2331.2, "Plant-Mixed Bituminous Pavement, Materials"

2. MnDOT 2331.3, "Plant-Mixed Bituminous Pavement, Construction Requirements"
   Subpart C - "Equipment"
   Subpart E - "Mixture Proportions"
   Subpart F - "Plant Operation"
   Subpart G - "Spreading Operations"
   Subpart H - "Compacting Operations"

3. MnDOT 2341.2, "Plant-Mixed Bituminous Surface, Materials"

4. MnDOT 2341.3, "Plant-Mixed Bituminous Surface, Construction Requirements"

5. MnDOT 2356, "Bituminous Seal Coat"

6. MnDOT 2357.2, "Bituminous Tack Coat, Materials"

7. MnDOT 2357.3, "Bituminous Tack Coat, Construction Requirements"

1.03 SUBMITTALS

A. Submit signed certification that materials furnished for this Work have been tested and conform to the applicable requirements of these Specifications. Indicate source of materials, name and address of testing laboratory, and dates of tests.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Only materials meeting requirements at time of placement (temperature, etc.) will be accepted.

B. Immediately remove from Site all materials not meeting requirements.

1.05 SEQUENCING AND SCHEDULING

A. Do not proceed until testing of subgrade has been completed by Engineer or Owner.

B. Do not proceed until grading has been completed in accordance with Section 02220. Touch up or regrade as necessary to provide surface free of ruts, rills, bird baths, and other undesirable features.

C. Do not proceed until necessary traffic controls, warning signs, flagmen, and other temporary controls are in place.

D. Do not proceed with paving under this Section until all valve boxes, manhole castings, and other penetrations (either previously existing or included in this Work) are set at proper height in accordance with the Drawings or these Specifications.

E. Do not proceed until all piped utilities described under Section 02600 have been installed and tested and all trenches backfilled.

F. Do not proceed until Work covered under Section 02510 is completed and has cured sufficiently to withstand forces and impacts from Work under this Section.

1.06 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 BITUMINOUS BASE COURSE

Bituminous base course shall meet the material requirements of MnDOT 2331.2. Aggregate shall meet the requirements of MnDOT 3139 for mixture BA-2. Bituminous material shall meet the requirements of MnDOT 3151 for asphalt cement with penetration 85/100. Bituminous base course shall be plant mixed and transported in accordance with MnDOT 2331.3, C, E, and F.

2.02 BITUMINOUS WEARING COURSE

Bituminous wearing course shall meet the material requirements of MnDOT 2341.2. Bituminous material shall meet the requirements of MnDOT 3151 for asphalt cement with penetration 85/100. Bituminous wearing course shall be plant mixed and transported in accordance with MnDOT 2341.3.

2.03 BITUMINOUS TACK COAT

Bituminous tack coat shall conform to the requirements of MnDOT 2357.2 for medium curing liquid asphalt grade MC-250 or MC-800.

PART 3: EXECUTION

3.01 Adjust all manhole, valve box, and other access castings so that top of casting is ½-inch below finished grade. Slope manhole castings to match finished grade with full mortar bed under casting. Complete adjustment of all castings at least 24 hours prior to placement of bituminous wearing course.

3.02 Where castings are adjusted following placement of bituminous base course, cutting shall be limited to the smallest area required to accomplish the work.

3.03 All patching of bituminous paving shall be accomplished using plant mixed materials meeting the requirements for the layer being patched. Compaction and other requirements shall be as for the layer being patched. All bituminous and concrete edges shall be liberally coated with bituminous tack coat, as shall all horizontal layers between bituminous materials.

3.04 At least 24 hours prior to placement of final lift of bituminous wear course, all castings shall be covered with a ½-inch thick plywood

cover cut precisely to the outer dimensions of the casting. The cover shall remain in place during placement and initial compaction of the bituminous wearing course. The plywood shall be removed prior to finish rolling of the pavement. Pavement edges around castings shall be hand detailed to provide a compacted chamfered edge between the pavement surface and top of the casting.

3.05 BITUMINOUS BASE COURSE

A. Bituminous base course shall be spread using a self-propelled paving machine in accordance with the requirements of MnDOT 2331.3G, except that Contractor shall be solely responsible for determination of appropriate equipment operating conditions and grade control. When paving widths over 10 feet, screed extensions shall be installed and used according to the instructions of the paving machine manufacturer. The use of the hydraulic gate without screed extensions will not be allowed for pavement widths over 10 feet.

B. Compaction of bituminous base course shall be in accordance with the requirements of MnDOT 2331.3H using the Specified Density Method.

C. Following placement and compaction, the thickness of the placed layer shall be within plus or minus ½-inch of the required thickness, and the finished surface shall be within 0.05 foot of the specified elevation and shall show no variations greater than ½-inch from the edge of a 10-foot straightedge.

3.06 BITUMINOUS TACK COAT

A. Apply in accordance with the requirements of MnDOT 2357.3.

B. Apply to all curb faces, edges of existing pavement, and all manholes, castings and other surfaces to be abutted.

C. Apply immediately prior to placement of bituminous pavement. Recoat areas that have been coated more than 8 hours before placement of pavement.

D. Clean excess from all surfaces not required to be coated.

3.07 BITUMINOUS WEARING COURSE

A. Place and compact bituminous wearing course in accordance with the requirements for bituminous base course.

B. Final rolled surface shall match all curb, slabs, and adjacent surfaces within plus 1/8-inch, minus 0 inch.

C. Following placement and compaction, the thickness of the complete asphalt pavement section shall be within plus or minus ½-inch of the required thickness and the finished surface shall show no variations greater than 1/8-inch from the edge of a 10-foot straightedge. The finished surface shall be free of "bird baths" or other areas of standing water following complete wetting sufficient to generate runoff.

D. The finished surface shall be tight and shall not exhibit a porous or fractured surface capable of trapping or holding moisture. If the surface does not meet this requirement, it shall be sealed in accordance with the requirements of MnDOT 2356, using an aggregate and bituminous material acceptable to Owner.

3.08 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for Work covered under this Section to assure compliance with the Contract requirements, including compaction test results if requested by Engineer or Owner.

END OF SECTION 02513

SECTION 02600

PIPED UTILITIES

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. The Work covered under this Section includes the furnishing of all material, labor, and equipment to construct complete in place all buried yard piping as shown on the Contract Drawings and specified herein. Included shall be all trench excavation, furnishing and placing granular materials for pipe bedding and backfill, furnish and install sheeting and bracing when necessary to safely support all work, remove all water, and restore all subsurface or surface structures directly or indirectly disturbed by the Contractor and all other Work required for a complete installation.

C. Related Sections:

1. Section 02050 - Demolition
2. Section 02220 - Structural Excavating, Filling, and Grading
3. Section 02710 - Foundation Drain System
4. Section 11900 - Process Piping
5. Section 15200 - Site Mechanical Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. AWWA C111/ANSI A21.11, "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings"

2. AWWA C104/ANSI A21.4, "Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water"

3. AWWA C151/ANSI A21.51, "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids"

4. AWWA C110/ANSI A21.10, "Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch, for Water and Other Liquids"

5. ASTM A126, "Specification for Gray-Iron Castings for Valves, Flanges, and Pipe Fittings"

6. ASTM A536, "Specification for Ductile Iron Castings"

7. ANSI B16.22, "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings"

8. ASTM B88, "Specification for Seamless Copper Water Tube"

9. ASTM C76, "Concrete Culvert, Storm Drain and Sewer Pipe"

10. ASTM C443, "Rubber Gaskets"

11. AWWA C502, "Dry-Barrel Fire Hydrants"

12. AWWA C504, "Rubber-Seated Butterfly Valves"

13. AWWA C600, "Installation of Ductile Iron Water Mains and Their Appurtenances"

14. AWWA C651, "Disinfecting Water Mains"

15. AWWA C653, "Disinfection of Water Treatment Plants"

16. AWWA C105/ANSI A21.5, "Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids"

17. ANSI/AWWA C509, "Resilient-Seated Gate Valves for Water and Sewerage Systems"

18. ANSI/AWWA C550, "Protective Epoxy Interior Coatings for Valves and Hydrants"

19. AWWA C500, "Gate Valves for Water and Sewerage Systems"

20. ASTM F714, "Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter"

21. ASTM D1248, "Polyethylene Plastics Molding and Extrusion Materials"

22. ASTM D429, "Adhesion of Vulcanized Rubber to Metal"

23. ASTM A48, "Specification for Gray Iron Castings"

24. ASTM A436, "Specification for Austenitic Gray Iron Castings"

25. ASTM A615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"

26. ASTM C32, "Specification for Sewer and Manhole Brick (Made from Clay or Shale)"

27. ASTM C139, "Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes"

1.03 SUBMITTALS

A. Submit certificate indicating all materials meet requirements of these Specifications. State item, applicable reference specification, class, type, manufacturer, and distributor.

B. The following products require operations and maintenance manuals to be submitted as specified in Division 1:

1. Fire Hydrants
2. Buried Butterfly Valves
3. Buried Gate Valves

1.04 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be inspected by the Contractor at delivery point for loss or damage in transit. It shall be Contractor's responsibility to replace damaged items. Damaged and non-conforming materials shall be removed from Site promptly.

B. Pipe materials shall not be stacked. Each pipe section shall be blocked to prevent rolling. Pipe ends shall be covered to prevent entry of foreign materials.

1.05 JOB CONDITIONS

A. Known existing Underground Facilities and utilities are shown on the Contract Drawings located in accordance with available data, but locations may vary and cannot be guaranteed. The exact locations shall be determined by the Contractor as Work proceeds. Excavation work shall be done carefully so as to avoid damaging existing work, including hand excavation or probing if necessary to spot locate or uncover.

B. Contractor shall provide for protection, temporary removal and replacement, or relocation of obstructions as required for the performance of the Work required in these Contract Documents. No extra payment will be made for this work.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate activities within public street right-of-way to minimize disturbance of traffic.

B. Coordinate removal of existing utilities with installation of new utilities to minimize disruption of utility service.

1.07 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid, except as modified below.

B. Partial payment will not be made for buried pipelines until required testing has been successfully completed.

C. If Engineer or Owner require over excavation to improve pipe foundation in zone shown as granular foundation on Drawings, that work and required additional granular materials will be considered extra work.

D. All backfill required as result of over excavation by Contractor without authorization of Engineer or Owner shall be performed by Contractor at no additional cost.

PART 2: PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe shall conform to the requirements of ANSI A21.51/ AWWA C151, Class 52. Method of joining shall be as shown on the Drawings. If not shown, mechanical joints shall be furnished for pipe conveying potable water under pressure, and push joints will be allowed for gravity pipe conveying sewage or wastewater.

B. Fittings shall be ductile iron and shall conform to the requirements of ANSI A21.10/AWWA C110, Class 250, up to and including 12-inch diameter. Mechanical and push joints shall conform to ANSI A21.11/ AWWA C111.

C. All pipe and fittings shall be furnished with cement mortar lining meeting the requirements of ANSI A21.4/AWWA C104 for standard thickness lining. All exterior surfaces of the pipe and fittings shall have a tar or bituminous seal coating at least 1 mil thick.

Spotty or thin seal coating, or poor coating adhesion, shall be cause for rejection.

D. All pipe joints and fittings shall be furnished with an external copper jumper. Jumpers between sections of pipe shall be not less than 1/16 by 3/4-inch strap bolted to shop welded straps of the same size. Bolts shall be silicone bronze, 5/16-inch diameter. For all locations where shop welded straps are not available, field welds shall be made using the Cadweld method with size 32 cartridge. Each field weld shall be made after preparing the pipe to a clean bare metal surface over the entire area of the weld. Straps bolted to mechanical joint fittings shall be not less than 1/16-inch by 1½-inch. Conducters shall be rated at 600 amps sustained current.

E. All bolts used on mechanical joint fittings shall be "Cor-ten" steel.

2.02 COPPER TUBING

A. Copper tubing shall be Type K water tube conforming to ASTM Specification B88, hard temper where run exposed and soft temper where imbedded in concrete or buried. Fittings shall be stream line, solder-joint, wrought copper, conforming to ANSI Specification B16.22. Dielectric unions, shall be installed between copper water tube and steel pipe, iron pipe, or other dissimilar metals.

2.03 POLYETHYLENE PIPE AND FITTINGS

A. Polyethylene pipe for slip lining and storm drain construction shall be Standard Dimension Ratio (SDR) 32.5 and shall conform to the latest requirements of ASTM F714 for the Iron Pipe Size (IPS) standard outside diameter piping system.

All polyethylene pipe and fittings shall be manufactured from PE3408 polyethylene material in accordance with ASTM D1248 for a Type III or IV, Class C, Category 5, Grade P34 material. Each piece of pipe shall be clearly marked to show this information.

Pipe shall be as manufactured by Plexco or an approved equal.

B. All fabricated fittings shall be constructed to provide a pressure rating equivalent to pipe of the same SDR. All polyethylene pipe and fittings shall be of the same type, grade, class, and category of polyethylene compound and shall be supplied by the same manufacturer.

C. Concrete manhole adapter shall be a slip on large diameter waterstop as manufactured by Fernco, or approved equal.

D. Lap joint flanges shall meet the requirements of AWWA C207, Class "D".

2.04 FIRE HYDRANTS

A. Fire hydrants shall conform to the applicable requirements of AWWA C502.

B. Unless otherwise specified in the Contract Drawings, hydrants shall be Waterous Pacer Model furnished in conformance with the following supplementary requirements:

1. Hydrants shall have a 5-inch (nominal diameter) main valve opening of the type that opens against water pressure.

2. Hydrant barrels shall be two piece, non-jacket type, with a breakaway traffic flange joint above finished grade line and with mechanical joint connection at the hub end for joining a 6-inch ductile iron branch pipe.

3. Hydrant bury length, measured from the bottom of the branch pipe connection to the finished ground line at the hydrant, shall be 8 feet 6 inches.

4. Hydrants shall have two outlet nozzles for 2½-inch (I.D.) hose connection (National Standard Thread) and one outlet nozzle for 4½-inch (I.D.) steamer connection (Minneapolis Thread). All outlet nozzles, threads, and manufacture shall be equal to those presently in use by the Owner. Contractor shall verify the following thread information with Owner prior to procurement:

   a. 2½-inch Hose Nozzles - 7031 threads
   b. 4½-inch Nozzle - 40518 threads

5. Hydrant operating mechanisms shall be provided with "O" ring seals preventing entrance of moisture and shall be lubricated through an opening in the operating nut or bonnet.

6. Operating nut shall be equal to that presently in use by the Owner. Contractor shall verify the following nut information with Owner prior to procurement:

   a. Waterous Nut #5
   b. Counter clockwise to open

7. Hydrant barrel drains shall be plugged with removable plugs.

8. Hydrants placed where groundwater table is less than 8 feet below the ground surface shall have the drain hole plugged and be equipped with a tag stating the need for pumping after use.

2.05 BURIED VALVES

A. Butterfly Valves:

1. All butterfly valves shall be of the tight closing, rubber seat type with rubber seats which are bonded to the valve body. No metal-to-metal sealing surfaces are permitted. Valves shall be bubble tight at 150 psi rated pressures with flow in either direction and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve discs shall rotate 90° from the full open position to the tight shut position. Valves shall meet the full requirements of AWWA Specification C504-70, Class 50-B. The manufacturer shall have manufactured tight closing AWWA rubber seated butterfly valves and buried service operators for a period of at least five years.

2. Bodies shall be constructed of cast iron ASTM A126, Class B and shall have integrally cast mechanical joint ends.

3. Discs shall be constructed of ASTM A436 Ni-Resist, Type 1.

4. Shafts shall be one piece, Class 18/8, Type 304 stainless steel extending full length through the valve disc and bearings; stub shafts are not acceptable.

5. Seats shall be Buna N simultaneously molded in, vulcanized and bonded to the valve body; seat bond must withstand 75 pounds pull under test procedure ASTM D429, Method B; seats affixed to disc not acceptable and ring type rubber seats not permanently affixed to body not acceptable.

6. Bearings shall be sleeve type corrosion resistant and self-lubricating with load not to exceed 2,500 psi.

7. Valve operator shall be designed for buried service and shall be traveling nut type designed to withstand 300 feet pounds of input torque at full open or closed positions without damage to the valve or operator; must be fully gasketed and grease packed and designed to withstand submersion in water to 10 psi; valves shall close with a clockwise rotation of the AWWA nut and shall require a minimum of 30 turns to move from fully open to fully closed.

8. Valves 12 inches or larger shall be furnished with operators with rugged position indicators.

B. Gate Valves:

1. Gate valves for buried service shall be of the resilient wedge type capable of providing drip tight seal in either direction. The valves shall meet all applicable requirements of AWWA C509. Valve shall be rated for 200 psig working pressure minimum.

2. The wedge shall be ductile iron with a bonded Nitrile or Styrene Butadiene elastomeric covering. The bonding process shall meet the test requirements of ASTM D429.

3. The valve shall have an interior and exterior epoxy coating meeting the requirements of AWWA C550 and suitable for potable water contact in accordance with the requirements of the National Sanitation Foundation.

4. Valves 12 inches and larger shall be of the non-rising stem type equipped with approved barrel type rugged gate position indicators.

5. Valves 12 inches and smaller shall be sealed with O-rings replaceable with the valve open and the line pressurized.

6. All gears on gate valves shall be cut tooth steel gears, housed in heavy cast-iron extended type grease cases of approved design.

7. Valve shall be as manufactured by Clow Corporation, Waterous (Series 500), or approved equal.

C. Valve Boxes:

1. Valve boxes shall be round base, three piece cast iron, Mueller H-10357 or equal, suitable for the depth of cover specified.

2. Valve boxes shall be 5½-inch diameter and shall have sufficient length to permit not less than 6 inches adjustment above and below grade when the pipe is laid to the specified depth. Length adjustment shall be screw type.

3. Covers shall have the word "WATER" cast on the top.

D. Corporation Stops:

1. Corporation stops shall be Mueller H-15000, Ford F-600, A.Y. McDonald 4701, or approved equal.

2. Service saddle shall be Smith-Blair Type #313 or approved equal with double stainless steel straps.

E. Curb Stops:

1. Curb stops shall be Mueller Model H-15154, Ford B22, A.Y. McDonald 6104, or approved equal.

2. Curb box shall of the "Minneapolis" pattern base with the inside diameter of the upper section a minimum of 1½ inches for curb stops smaller than 1½ inches and a minimum of 2 inches for curb stops 1½ inches and larger. The cover shall have a single center plug and shall have the word "WATER" cast in raised letters.

2.06 REPAIR COUPLINGS

Repair couplings shall be Rockwell Style 431, Dresser Style 53, or approved equal.

2.07 MANHOLE

A. Manholes shall be constructed according to dimensions and details shown in the Contract Drawings using materials as follows:

Generic Material Reference	Class or Type	Reference Specification	Vendor Requirements
Concrete		See Section 03300	
Reinforcing	Grade 60	ASTM A615 for Billet Steel Bars	
Manhole Steps	Steel Reinforced Plastic, Step "W"	MnDOT Standard Plate 4180H	
Precast Segmental Blocks (where approved)	Radial solid	ASTM C139	

Generic Material Reference	Class or Type	Reference Specification	Vendor Requirements
Manhole Brick (where approved)	Grade MA	ASTM C32	
Mortar	One part Type 1 Portland Cement and three parts clean sharp sand		
Cast Iron Frames and Covers	See Drawings	ASTM A48	Type 1-Neenah R-17 Type 2-Neenah R-4342
Adjusting Rings		MnDOT Standard Plate 4010G	
Eccentric Cone Section		MnDOT Standard Plate 4005K	
Cover Slab		MnDOT Standard Plate 4020E	
Riser Section		MnDOT Standard Plate 4007C	
Bottom Riser with Integral Base and Formed Invert		MnDOT Standard Plate 4007C	
Flexible Water Tight Sleeve		MnDOT Standard Plate 4007C	
Base Slab		MnDOT Standard Plate 4011D	

B. Where vendor requirements are stated, equivalent products will require approval.

2.08 GRANULAR MATERIALS

A. Granular materials furnished for foundation, bedding, encasement, backfill, or other purposes as may be specified shall consist of sound and durable products of any natural or synthetic mineral aggregate such as sand, gravel, crushed rock, crushed stone, or slag, that shall be so graded as to meet the gradation requirements specified herein for each particular use.

B. Granular materials furnished for use in Foundation, Bedding, Encasement, or Backfill construction shall be placed as shown in the Drawings and shall conform to the following requirements:

Percent Passing	Material Use Designation			
Sieve Size	Foundation	Bedding	Encasement	Backfill
3 Inch				
2 Inch				100
1 Inch	100	100	100	
3/4 Inch	85-100	90-100	90-100	
3/8 Inch	30-60	50-90	50-90	
No. 4	0-10	35-80	35-80	35-100
No. 10		20-65	20-65	20-100
No. 40		0-35	0-35	0-35
No. 200		0-10	0-10	0-10

C. Granular materials provided for Foundation, Bedding, Encasement, or Backfill use shall be classified as to use in accordance with the following:

Material Use Designation	Zone Designation
Granular Foundation	Placed below the bottom of pipe grade as replacement for unsuitable or unstable soils, to achieve better foundation support.
Granular Bedding	Placed below the pipe midpoint to a specified depth, prior to pipe installation, to facilitate proper shaping and achieve uniform pipe support.
Granular Encasement	Placed immediately above the top of pipe to a specified depth, after pipe installation, for protection of the pipe and to assure proper filling of voids or thorough consolidation of backfill.
Granular Backfill	Placed below the surface base course, if any, as the second stage of backfill, to minimize trench settlement and provide support for surface improvements.

D. In each case above, unless otherwise indicated, the lower limits of any particular zone shall be the top surface of the next lower course as constructed. The upper limits of each zone are established to define variable needs for material gradation and compaction or void content, taking into consideration the sequence of construction and other conditions. The material use and zone designations described above shall only serve to fulfill the objectives and shall not be construed to restrict the use of any particular material in other zones where the gradation requirements are met.

2.09 THRUST RESTRAINT MATERIALS

A. Tie Rods - Tie rods shall be minimum 3/4-inch diameter (or as shown on Drawings) threaded steel rod meeting the material requirements of ASTM A307, Grade A or better. Tie rods shall be suitably protected against corrosion by hot dip galvanizing or bituminous coating meeting the requirements of AASHTO M190 for Type A.

B. Mechanical Joint Thrust Restraint - Mechanical joint thrust restraint, where permitted, shall be "Mega Lug" as manufactured by Ebba Iron Sales, Inc. or approved equal. Use of standard set screw retainer glands will not be permitted.

C. Concrete - Concrete for use in cast-in-place thrust blocking shall meet the requirements of Section 03300 of these Specifications. The use of wood or pre-cast concrete thrust blocks will not be permitted.

2.10 SOURCE QUALITY CONTROL

A. Products supplied as specified under the specific paragraphs of this Section shall be of the same manufacturer and be identical and interchangeable with products of the same specification and size. Products of the same type, but of different diameter or size, shall be supplied by the same manufacturer.

B. Contractor shall be responsible for ensuring that the products meeting the requirements of this Section are supplied. Contractor shall maintain records to establish that products supplied meet or exceed referenced standards as specified in this Section.

PART 3: EXECUTION

3.01 LOCATION OF WORK

A. The Work shall be located as shown on the Contract Drawings.

B. It may be necessary for the Engineer to shift lines a reasonable amount to avoid an obstruction to the construction work or to reduce right-of-way difficulties. The Contractor will not be allowed any additional compensation due to minor shift of lines. Additional compensation will be allowed only for lengthening of lines.

C. All pipes to be used for the conveyance of potable water shall be placed a minimum of 7 feet 6 inches below the proposed finished grade to the top of pipe. Where pipes cross at the same grade, the smaller pipe shall be rerouted below the larger using 45 degree bends. No additional compensation will be provided for making such crossings.

3.02 EXCAVATION

A. Excavation of every description and of whatever materials encountered shall be made to the alignment and depth shown on the Drawings, or as specified herein. Excavation shall be made by open cut. The trench shall be so sloped, braced, sheeted, and drained that workmen may work safely and efficiently therein in accordance with Laws and Regulations. The trenches shall be sufficiently straight between designated angle points to permit the pipe to be laid true to line in the approximate center of the trench.

B. The trench width may vary with and depend upon the depth of trench, the diameter of pipe to be laid and the nature of the material to be excavated; but in any case shall be of ample width to permit the pipe to be laid and joined properly and the backfill to be placed and compacted properly. The minimum bottom width of unsheeted trench shall be 18 inches. The maximum clear width of trench at the top of the pipe shall be not more than 32 inches greater than the outside diameter of the pipe for pipes 33 inches and larger, or 16 inches greater for pipe under 33 inches except by consent of the Engineer.

C. The pipe shall be laid upon soil cut true and even, so that the barrel of the pipe will have a bearing for its full length. Bell holes shall be excavated to insure the pipe resting for its entire length upon the bottom of the trench.

D. Whenever wet, soft or unstable soil, incapable of properly supporting the pipe, manholes or other structures encountered in the trench, a further depth and/or width shall be excavated and refilled to trench bottom grade with Granular Foundation material, thoroughly compacted to assure a firm foundation for the pipe as directed by Engineer.

3.03 SHORING AND SHEETING

A. Shoring, sheeting, bracing, etc. shall be put in place and maintained by the Contractor at his own expense, as may be required to support the side of the excavation and to prevent any movement which may in any way endanger personnel or injure or delay the work or endanger adjacent buildings or other structures. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted in a minimum of two passes with hand operated vibratory compaction equipment to a depth of 1 foot over the top of the pipe. The sheeting and bracing shall be removed in such manner as not to endanger the constructed pipe or other structures, utilities or property, whether public or private. It shall be the Contractor's responsibility to be familiar with Laws and Regulations relating to this type of work and assume the responsibility for compliance therewith.

3.04 PIPE BEDDING

A. All pipe shall be bedded as indicated on the Drawings and as described below. Labor, equipment, and materials necessary for specified bedding shall be included in the lump sum Contract Price bid.

B. If the Contractor encounters soil not suitable for bedding of pipe or for trench backfill, where native soil is permitted for those purposes by the bedding class, Contractor shall notify the Engineer. All unstable material shall be removed and replaced with Granular Foundation material herein specified as may be ordered by the Engineer.

3.05 PIPE LAYING

A. The type, kind and class of pipe to be used shall be as shown on the Contract Drawings or as specified herein. All pipe shall be laid and maintained to the required line and grade.

B. All gravity pipe shall be laid using approved grade boards, furnished and set by the Contractor at no additional cost to the Owner, or laser beam control. No gravity line shall be laid unless there is a minimum of three grade boards set to check the proper grade and alignment ahead and the laser beam checked into the grades ahead. The Contractor shall provide and use a suitable grade rod to insure the proper grade of the pipe.

C. At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support of the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than would be adequate. No pipe material shall be laid in water nor when the trench or bedding conditions are otherwise unsuitable or improper. Unless otherwise permitted by the Engineer, bell and spigot pipe shall be laid with the bell ends facing upgrade and the laying shall start at the downgrade end and proceed upgrade.

D. Before being lowered into laying position, the Contractor shall make a thorough visual inspection of each pipe section and appurtenant units to detect damage or unsound conditions that may need corrective action or be cause for rejection. The Contractor shall inform the Engineer of any defects discovered.

E. Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.

F. Any defective or damaged pipe, or gravity pipe which has had its grade or joint disturbed after laying, shall be replaced.

G. As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted around the pipe. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is effected.

H. At all times when pipe laying is not in progress, including noon hour and overnight periods, all open ends of the pipe line shall be closed by watertight plugs or other means approved by the Engineer. If water is present in the trench, the seals shall remain in place until the trench is pumped completely dry.

3.06 BACKFILLING IN PIPE ZONE

A. Place encasement and backfill material as shown in the Drawings, free from rocks, boulders, or frozen material. Deposit in the trench simultaneously on both sides of the pipe for the full width of the trench to a minimum height of twelve (12) inches above the top of the pipe. The material shall be shovel placed and hand tamped to fill completely all spaces under adjacent to the pipe. If the pipe size

is larger than 12 inches, the encasement and backfill from the bottom of the trench to 12 inches above the top of the pipe shall be placed by either hand or mechanical methods in two lifts. The first lift, from the trench bottom to the pipe spring line and the second lift shall be compacted with a minimum of two passes with an approved type of mechanical tamping compactor.

B. If suitable material for this portion of the backfill is not available from the trench excavation as determined by the Engineer, the Contractor shall provide and place an approved material as described in these Specifications.

C. All plastic pipe shall be backfilled with granular material, approved for the bedding class, up to the spring line and compacted by hand or mechanical tamping to a minimum of 90 percent Standard Proctor. Take care to ensure that sufficient material has been worked under the haunch of the pipe to provide adequate side support. Place the remaining granular encasement in two lifts, one to top of the pipe and the other to a point at least nine (9) inches over top of pipe. Compact each stage of backfilling by hand or mechanical tamping to a minimum of 90 percent of maximum Standard Proctor density (ASTM D698).

3.07 BACKFILLING ABOVE PIPE ZONE

A. Succeeding layers of backfill from twelve (12) inches above the pipe to the surface may contain coarse materials, but shall be free from large pieces of rock, frozen materials, concrete, blacktop, wood, roots, stumps, sod, rubbish and other similar articles whose presence in the backfill, in the opinion of the Engineer, would cause excessive settlement of the trench or damage to the pipe.

B. If, in the opinion of the Engineer, the native trench material does not meet the requirements for Granular Materials specified herein, it shall be considered surplus material and disposed. The Contractor, during the excavation operations, shall make a reasonable attempt to segregate all undesirable materials encountered from suitable materials. Any additional material needed for backfilling shall be furnished and installed by the Contractor.

C. All trench areas beyond existing or proposed roadbeds and driveways shall be compacted to achieve a minimum of 85 percent maximum Modified Proctor density (ASTM D1557). Compaction shall occur in maximum loose lift thicknesses of 8 inches.

D. It shall be the Contractor's responsibility to determine the proper compacting equipment and methods required to achieve the required density.

E. In those areas where the pipe lines are constructed in existing or proposed roadways, parking lots, driveways, or other areas where settlement may cause structural damage to other utilities, the backfill shall be compacted as follows: Compaction requirements shall be 95 percent maximum Modified Proctor density (ASTM D1557) from the pipe zone to 3 feet below finished grade, and 100 percent maximum Modified Proctor density (ASTM D1557) in the upper 3 feet of the trench.

F. Tests to determine the compacted density of the backfill may be performed by the Engineer.

3.08 THRUST RESTRAINTS - ALL FLUID PRESSURE SYSTEMS

A. Provide all crosses, tees, dead-ends, and bends with suitable means of overcoming thrust. Concrete reaction blocking or mechanical joint thrust restraint or suitable metal tie rods may be used except where use of a specific method or combination is shown in the Drawings.

B. Concrete reaction blocking shall be placed so that all pipe and fitting joints are accessible for repair, and in such a manner as to provide bearing against undisturbed ground. Pressure testing shall not proceed until concrete thrust blocks have attained their design strength. High early strength concrete may be used.

C. Based upon a test pressure of 150 psi, the following table shows the minimum length of pipe to be restrained where tied joints are used and the minimum bearing area of concrete against undisturbed earth where thrust blocks are used. The table reflects conditions for horizontal and downward vertical thrust only.

Nominal Pipe Diameter	THRUST BLOCK AREA - SQUARE FEET (Restrained Pipe Length) - Feet			
	Tees and Dead Ends	90° Bend	45° Bend	22½° Bend
6	4.2 (28)	5.9 (32)	3.2 (13)	1.6 (6)
8	7.2 (38)	10.2 (42)	5.5 (17)	2.8 (8)
10	10.9 (47)	15.4 (51)	8.3 (21)	4.3 (10)

Nominal Pipe Diameter	Tees and Dead Ends	THRUST BLOCK AREA - SQUARE FEET (Restrained Pipe Length) - Feet 90° Bend	45° Bend	22½° Bend
12	15.4 (56)	21.8 (60)	11.8 (25)	6.0 (12)
16	26.8 (75)	37.8 (77)	20.5 (32)	10.4 (15)
24	58.8 (110)	83.2 (73)	45.0 (30)	23.0 (15)

D. For upward vertical thrust provide mechanical joint thrust restraint, tied joints, or gravity thrust block in manner to be approved by Engineer.

E. The cost of providing thrust restraints shall be considered as incidental to the cost of the pipe installation.

3.09 MANHOLES

A. Manhole construction shall conform to the following requirements unless modified by the Contract Drawings.

B. Manhole bases shall be placed on undisturbed earth where possible. Where not possible to place on undisturbed earth, provide granular base in accordance with Section 02220.

C. Precast manhole riser sections shall be subject to rejection on account of failure to conform to any of the specification requirements. Individual sections of manholes may be rejected because of any of the following:

1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.

2. Defects that indicate imperfect proportioning, mixing and molding.

3. Surface defects indicating honeycombed or open texture.

4. Damaged ends, where such damage would prevent making a satisfactory joint.

D. Where shown on the Contract Drawings, the Contractor shall install a stub connection with the bell end of the pipe projecting from the

structure at the proper elevation. Close the open end of the stub with a stopper or plug.

E. Set the frame or ring casting to the designated elevation using adjusting rings set in a full mortar bed.

F. Seal precast concrete manhole joints using resilient rubber gaskets or approved equal.

G. Inverts in manholes shall be formed by laying the sewer main through the manholes and using the required fittings or field cut pipe to accomplish crosses and wye branches. The top half of all mains in the manholes shall be removed in a workmanlike manner and all spaces outside the piping shall be filled with concrete and sloped from the manhole wall toward the pipes.

3.10 HYDRANTS

A. Support hydrants upon a concrete base 18 inches square and a minimum of six (6) inches thick. Each hydrant shall be blocked against the far end of the trench with concrete suitably anchored and/or tied to the fitting at the main with tie rods, or as otherwise approved by the Engineer. Install hydrant of sufficient length to provide the required ground cover over the centerline of the lead pipe. The lowest outlet nozzle on the hydrant shall be not less than 19 inches nor more than 24 inches above the finished ground line or the final curb line in the case of a new street.

B. Wherever a hydrant is set in pervious soil, provide drainage at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand, from the bottom of the trench to at least 6 inches above waste openings in the hydrant and to a distance of 1 foot around the base elbow.

C. Wherever a hydrant is set in clay or other impervious soil, dig a drainage pit 2 feet in diameter and 3 feet deep below each hydrant base and fill it completely with pea rock or crushed stone and coarse sand, under and around the elbow and concrete base to level of 6 inches above the waste opening.

D. Cover all material placed for drainage with a minimum of one 10 mil thickness of polyethylene. No drainage system shall be connected to a sewer.

E. Hydrants must maintain their position and must not be knocked out of plumb during backfilling.

F. Hydrants placed where the groundwater table is less than 8 feet below the ground surface shall have the drain hole plugged and be equipped with a tag stating the need for pumping after use.

3.11 VALVES AND FITTINGS

A. Unless otherwise specified or shown on the Drawings, install cast iron valve boxes with all gate valves 12 inches or smaller and on all direct burial butterfly valves. Valve boxes shall be firmly supported to maintain centered and plumb alignment over the wrench nut with cover flush with the surface of the finished pavement or at such other level as may be directed by the Engineer.

3.12 TESTING PRESSURE MAINS

A. After the line has been backfilled in accordance with these Specifications, test all newly laid pipe, or any valved section by applying a hydrostatic pressure in accordance to that specified in AWWA C600 except that the minimum test pressure shall be 150 pounds per square inch measured at the lowest point of elevation. The duration of each such test shall be at least 2 hours. The test shall determine the leakage, which shall not exceed the limits specified in Table 6 of AWWA C600. The apparatus for conducting the test shall consist of a pressure gauge with pump and appurtenances and shall be furnished and attached to the mains by the Contractor. Slowly fill each valved section of pipe with water and apply the specified test pressure, measured at the lowest point of elevation, by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges and all necessary apparatus shall be furnished by the Contractor.

Before applying the specified test pressure, expel all air from the pipe. Any cracked or defective pipes, joints, fittings, valves, or hydrants discovered in consequence of this pressure test shall be removed and replaced by the Contractor with sound material and the test shall be repeated until satisfactory results are obtained.

The pressure gauge used for the test shall be an Ashcroft Model 1082 with a 4½-inch diameter dial face marked with one (1) psi increments, or approved equal. The gauge shall show proof of being calibrated by an independent testing company within the 90-day period prior to the date of testing. A calibration sticker on the gauge itself with proper identification or letter from the testing company, showing date of calibration and by whom, is required.

B. After the hydrostatic test has been completed, a conductivity test shall be conducted:

The system (pipeline and hydrants) shall be tested for electrical continuity and current capacity. The electrical test shall be made after the hydrostatic pressure test. Backfilling shall have been completed. The line may be tested in sections of convenient length as approved by the Engineer.

1. Direct current of 350 amperes, plus or minus 10 percent, shall be passed through the pipeline for 5 minutes. Current flow through the pipe shall be measured continuously on a suitable ammeter and shall remain steady without interruption or excessive fluctuation throughout the 5-minute test period.

2. Insufficient current or intermittent current or arcing, indicated by large fluctuation of the ammeter needle, shall be evidence of defective electrical contact in the pipeline. The cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested as a unit and shall meet the requirements.

3. Sources of D.C. current for these tests may be motor generators, batteries, arc welding machines, etc.

4. Cables from the power source to the section of the system under test should be of sufficient size to carry the test current without overheating or excessive voltage drop.

5. Connections for the test shall be made at hydrants and other connections as approved. The hydrants shall be in the open position with the caps on during the test. The cable shall be clamped to the top operating nut. Note: After the test, the hydrant shall be shut off and a cap loosened to allow hydrant drainage. Tighten cap after drainage.

6. A hook-on type D.C. ammeter placed on one of the cables leading to the hydrant may be used for measuring current.

7. In using arc welding machines, the current control should be set at a minimum before starting. After starting the machine, advance the control until the current indicated on the ammeter is at the desired test value.

3.13 DISINFECTION OF WATER DISTRIBUTION PIPELINES

A. Before being placed in service, all new water distribution systems, or extensions to existing systems, or any valved section of such extension or any replacement in the existing distribution system shall be disinfected.

1. Materials: Dry Calcium Hypochlorite (comparable to commercial products known as "HTH", "Perchloron", and "Maxochlor") or Dry Chlorinated Lime (frequently called chloride of lime and known to industry as bleaching powder) may be used.

2. Dosage: The dosage of calcium hypochlorite powder containing 70 percent available chlorine shall be one pound for each 1,680 gallons of water pipe capacity treated; chlorine-yielding compounds other than calcium hypochlorite powder may, on approval of the Engineer, be used in amounts proportional to their available chlorine content. This dosage is equivalent to a treatment of 50 parts per million available chlorine. In like manner, one pound of calcium hypochlorite powder will treat 2,100 gallons of water to 40 parts per million chlorine.

3. Point of Application: A predetermined dose shall be shaken into the pipe at the first joint attached to the existing water pipe, and the dosage shall be repeated at frequent predetermined intervals, preferably at each pipe joint as the pipe laying progresses, or as may be directed by the Engineer.

B. When treated with dry calcium hypochlorite or with dry chlorinated lime, all newly laid pipe shall be filled very slowly to avoid washing the powder to the extremity of the pipeline.

C. Water main shall be disinfected for at least 24 hours. Prior to flushing, the chlorine residual shall be at least 10 ppm. If not, Contractor shall repeat disinfection procedure at no additional cost to Owner.

D. Contractor shall be completely responsible for arranging for disposition of chlorinated water in accordance with Laws and Regulations.

3.14 TESTING GRAVITY PIPELINES

A. General:

All sanitary sewer lines shall be watertight and shall be tested for excessive leakage upon completion and before service connections are made.

Each test section of the sewer shall be subjected to infiltration testing, either by hydrostatic or air test method as described below. The requirements set forth for maximum leakage shall be met as a condition for acceptance of the sewer section represented by the test.

If the groundwater level is greater than 3 feet above the invert elevation of the upper manhole and the Engineer so approves, infiltration testing may be allowed in lieu of the exfiltration testing, in which case the allowable leakage shall be the same as would be allowed for the Hydrostatic Test.

All testing shall be performed by the Contractor at his expense without any direct compensation being made therefore, and he shall furnish all necessary equipment and materials, including plugs and standpipes as required.

B. Air Test Method:

The sewer pipe section under test shall be clean at the time of testing but the pipe may be wetted. Pneumatic balls shall be used to plug the pipe ends at manholes. Low pressure air shall be introduced into the plugged line until the internal air pressure reaches 4.0 psi greater than the average back pressure of any groundwater pressure that may submerge the pipe. At least 2 minutes shall be allowed for the air temperature to stabilize before readings are taken and the timing started.

The sewer section under test will be accepted as having passed the air leakage test if it does not lose air at a rate to cause the pressure to drop from 3.6 to 3.0 psi in less time than ½ minute per inch in diameter of the pipe tested.

C. Hydrostatic Test Method:

After bulkheading the test section, the pipe shall be subjected to a hydrostatic pressure produced by a head of water at a depth of 3 feet above the invert elevation of the sewer at the manhole of the test section. In areas where groundwater exists, this head of water shall be 3 feet above the existing water table.

The water head shall be maintained for a period of 1 hour during which time it will be presumed that full absorption of the pipe body has taken place, and thereafter for an extended period of 1 hour the water head shall be maintained as the test period. During the 1-hour test period, the measured water loss within the test section, including service stubs, shall not exceed the Maximum Allowable Volumes (in gallons per hour per 100 feet of pipe) given below for the applicable main sewer diameter.

Main Sewer Diameter (in inches)	Maximum Allowable Loss* (in gallons per hour per 100 feet)
6	0.5
8	0.6
10	0.8
12	1.0
15	1.2
18	1.4
21	1.7
24 and larger	1.9

*Based on 100 gallons per day per inch per mile

If measurements indicate exfiltration within a test action section is not greater than the allowable maximum, the section will be accepted as passing the test.

D. Test Failure and Remedy:

In the event of test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements. Introduction of sealant substances by means of the test water will not be permitted. Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance. All repair and replacement work shall be at the Contractor's expense.

E. Deflection Test:

The testing of plastic pipe (including PVC and PEP) by the mandrel test shall be conducted after a 30-day dead load period (trench backfilled), on the pipe placed, has been destained (ASTM D3034). This testing shall be conducted with the use of a mandrel, maximum 5 percent deflection. Mandrel shall be stamped showing percent of deflection.

3.15 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for Work under this Section to assure compliance with Contract Documents. Maintain records of all pressure testing, mandrel testing, compaction tests, location of buried fittings, and methods of thrust restraint.

END OF SECTION 02600

SECTION 02710

FOUNDATION DRAIN SYSTEM

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to construct a system for collection and discharge of subsurface moisture adjacent to structure foundations, as shown on the Drawings.

C. Related Sections:

1. Section 02220 - Structural Excavating, Filling and Grading
2. Section 02600 - Piped Utilities

D. Products Installed But Not Furnished Under This Section:

1. Furnished Under Section 02220 - Coarse Granular Drainage Material

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. AASHTO M-252, "Standard Specification for Corrugated Polyethylene Drainage Tubing"

1.03 SUBMITTALS

A. Submit signed certificate indicating materials meet requirements of these Specifications and stating name of material manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store covered with opaque tarpaulin to prevent exposure to sunlight.

B. Prevent mechanical damage by crushing, etc. Immediately remove damaged materials from Site.

C. Deliver coarse granular material at time of installation. Do not stockpile on Site. Unload and transfer on Site in manner to prevent segregation.

1.05 SEQUENCING AND SCHEDULING

A. Proceed with Work under this Section prior to backfilling adjacent to structures. Do not re-excavate for installation.

1.06 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 FOUNDATION DRAIN PIPE

Pipe for the foundation drain system shall be perforated circular corrugated polyethylene drainage tubing, 6-inch nominal diameter, as manufactured by Advanced Drainage Systems, Inc. or an approved equivalent tubing meeting the requirements of AASHTO M252. Furnish all tees, wyes, bends, and other fittings and appurtenances by the same manufacturer and of the same material. Septic or leach field tubing will not be allowed.

2.02 FABRIC FILTER WRAP

Fabric filter wrap shall be ADS SOCK by Advanced Drainage Systems, Inc. or approved equal.

2.03 GRANULAR MATERIALS

Granular materials for bedding and encasing the drain pipe shall be as shown on the Drawings and specified under Section 02220 of these Specifications.

PART 3: EXECUTION

3.01 PREPARATION

A. Construct starting from outlet and proceeding up slope. Prepare subgrade to required lines and grades through entire length before placing pipe.

B. Identify any obstructions that would interfere with installation or maintenance of positive slope from highest elevation to outlet.

3.02 INSTALLATION

A. Place fabric filter wrap over pipe prior to placement. Secure with corrosion resistant ties. Overlap fabric at least 12 inches at joints. Repair all rips, tears, or punctures prior to placement of coarse granular drainage material.

B. Place uniform layer of coarse granular drainage material and hand excavate for shape of pipe.

C. Place pipe to lines and grades shown on Drawings. Horizontal centerline alignment shall not vary more than 0.10 foot in either direction from a straight string line established along straight pipe runs. The vertical grade shall be within 0.02 foot of the required grade at any point and the top of the pipe shall not vary more than ½-inch from the edge of a 10-foot straightedge placed on the top of the pipe. The pipe shall not contain any areas with backfall or lacking positive drainage. If the slope is not shown, a minimum slope of ½-inch per foot shall be maintained.

D. Cap or plug all pipe ends except outlet and secure all fittings with manufacturer's recommended couplings or clamps.

E. Place coarse granular drainage material to the springline of the pipe and compact using a mechanical tamper. Assure complete filling around underside of pipe.

F. Place coarse granular drainage material above the pipe to provide a minimum of 6-inch thickness around the entire perimeter of the pipe.

G. Proceed with backfilling as shown on Drawings and described in Section 02220. Carefully place initial lifts to prevent mixing with coarse granular drainage material and displacement of pipe.

H. Immediately install outlet protection as shown on the Drawings to prevent entrance of foreign materials.

3.03 FIELD QUALITY CONTROL

A. Contractor shall establish and maintain quality control for Work under this Section to assure compliance with the Contract Documents and maintain records of Contractor's quality for all operations, including, but not limited to, the following:

1. record locations of all fittings and changes in alignment of buried pipes,

2. location of all damage to waterproofing or insulation caused or discovered during installation.

END OF SECTION 02710

SECTION 02930

LAWNS AND GRASSES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Related Work specified elsewhere:

1. Section 02200 - Structural Excavating, Filling, and Grading.

2. Section 02950 - Trees, Shrubs, and Ground Cover.

1.02 QUALITY ASSURANCE

A. American Sod Producers Association (ASPA) Guide Specifications.

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Growers Certification: Indicate grass species and type of soils grown in. Show compliance with state and federal restrictions.

2. Manufacturer's certification of fertilizer and herbicide composition.

3. Current seed tests.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Tag sod with botanical, common name of each grass species.

B. Sod: Sufficiently moist to withstand exposure, handling during transplanting. If necessary, water before cutting.

C. Protect sod root system from exposure to wind and sun.

D. Protect sod against dehydration, contamination, heating during transportation and delivery.

E. Do not deliver more sod than can be installed within 24 hours.

F. Keep stored sod moist, under shade, or covered with moist burlap.

G. Do not tear, stretch or drop sod.

H. Seed, Fertilizer: Keep dry, protected from the elements.

1.05 JOB CONDITIONS

A. Begin seeding, sodding after preceding related work is accepted.

B. Environmental Requirements

1. Do not place sod when ground is frozen or will freeze within two weeks from time of installation.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 SOD

A. Grass Species: Bluegrass 75% to 100%, Fine Fescue 0% to 25%.

B. ASPA Grade: Nursery grown, 3/4" minimum soil thickness, two year sod. Free of stones, debris. 1½" uniformly mowed height when harvested. Maximum 1" uncompressed thatch.

C. Sod: Inspected, found free of diseases, nematodes, pests, and pest larvae, by entomologist of State Department of Agriculture.

D. Sod: Free of Bermuda grass, quack grass, Johnson grass, poison ivy, nut sedge, nimble will, Canada Thistle, bindweed, bent grass, wild garlic, ground ivy, perennial sorrel, brome grass, other noxious weeds; containing less than five jimsonweed, mustard, lamb's quarter, chickweed, cress, or crab grass plants per 100 square feet.

E. Sod: Uniform in color, leaf texture, density; not grown on peat, highland variety grown on loam soil.

2.02 WATER

A. Free of substances harmful to plant growth, supplied by the Contractor.

2.03 FERTILIZER

A. FS O-F-241, Type 1 - solid form, Grade - B granular (16% N, 8% K2 4% P2 O5) by total weight.

2.04 STAKES FOR SOD

A. Wood, 3/4" square, 8" length.

2.05 SEED

A. Species, purity, germination, and rate.

1. %	Species	Purity	Germination
75-100	Kentucky Blue	95%	95%
0-25	Perennial Rye	95%	95%

B. Packaged Seed: Sealed, stitch sewn, heavy weight bags; seed tag attached indicating suppliers name, total weight, seed analysis including percent by weight, species, purity, germination date tested, name of independent testing laboratory.

2.06 GROUND COVER

A. Ground Cover: Seed Mixture No. 11 per MnDOT Standard Specifications, Standard 3876.

B. Purity and germination percentages noted shall be considered as absolute minimum.

C. Erosion Mat: Jute fiber per MnDOT Standard 3883.

2.07 MULCH

A. Type, Condition: Straw or hay, delivered and stored to be kept dry, free of noxious weeds, crabgrass, goosegrass, other similar objectionable weed seed.

2.08 TOPSOIL

A. Per MnDOT Standard Specification 3877, "select".

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that rough grading work per Section 02220 has been completed.

3.02 PREPARATION

A. Areas to be seeded or sodded shall have topsoil cover to a minimum depth of 6". In the event that the topsoil cover has been disturbed or is not of acceptable depth prior to the application of sod or seed, the Contractor shall be required to supplement the topsoil in the area to bring

it up to the above specified depth. All areas receiving seed or sod shall be worked by the Contractor until the soil is completely fined and in a mellow condition, to smooth even finish grade. All holes, depressions and revulets shall be filled in to ensure no disruption of established drainage patterns. All rubble, sticks, branches or stones and extraneous material over 3/4" diameter on the surface, which will interfere with the sod shall be picked up and removed.

B. Immediately prior to seed or sodding, Contractor shall loosen topsoil to a depth of 3" on all areas except slopes steeper than 2 horizontally to 1 vertically using discs, harrows, tiller rakes to produce fine grade. On slopes steeper than 2:1, use cultivating equipment in general direction at right angles to the direction of surface drainage wherever practical.

C. Prepare ground so top of new seeded area of sod shall be laid flush with adjacent walks, permanent surfacing, and any existing turfed areas.

D. Seed

1. Fertilize seeded areas only (one pound per 100 sq. ft.).

2. Scarify, disk, or harrow fertilizer into the top 2" to 3" of soil.

E. Sod

1. Scarify areas to receive sod to a 2" depth.

2. Final drag surface to smooth pulverized finish grade condition.

3.03 REFERTILIZING

A. Refertilize areas which are not seeded within 14 days after initial application.

3.04 SODDING

A. Transplant sod within 36 hours after harvesting. Sod showing visible signs of heating shall not be incorporated in the Project.

B. Begin sodding at bottom of slopes.

C. Lay first row of sod in straight line with long dimension of rolls parallel to slope contours.

D. Butt side, end joints tightly to eliminate visual joints.

E. Stagger end joints in adjacent rows, a minimum of one foot. Do not stretch or overlap sod.

F. Peg sod on slope ratio of one in three or greater with minimum of two stakes per square yard, 1" exposed.

G. Water sod immediately after transplanting.

H. Roll sod, except on pegged areas, with roller weighing 100-150 pounds per foot of roller width.

I. Water sod, soil to provide thorough soaking within four hours after rolling.

3.05 SEEDING

A. Seed between April 15 and June 1 or August 15 and September 15.

B. Apply with a brillion seeder. Hydro seeding acceptable only upon approval of Engineer.

C. Seed only on still days. Wind velocity 10 MPH or less.

D. Apply seed in 1/3 volume per pass by covering the ground and crossing in three directions.

E. Use of mechanical seeder may be waived for small, inaccessible areas.

3.06 GROUND COVER

A. In strict accordance with MnDOT Standard 2575, applicable portions thereto, including erosion mat placement.

3.07 MULCHING

A. Apply to all seeded areas at the rate of 10 pounds per 100 sq. ft. Distribute uniformly to obtain 40-60% coverage of ground surface. Cut mulch into soil with disk, 1" penetration.

3.08 PROTECTION

A. Erect temporary barricades, warning signs against pedestrian, vehicular traffic.

3.09 LAWN ESTABLISHMENT AND REPLACEMENT

A. Watering:

1. Keep turf areas moist after planting until areas have been accepted.

B. Mowing:

1. Mow when grass reaches 3" in height, mow to 1½" in height. Do not cut off more than 50% of grass leaf in single mowing. Remove grass clippings.

C. Resod areas failing to become established after one month (above freezing temperatures) from installation.

D. Seeded areas which fail to show an adequate stand of grass (11-15 seedling per square inch within four weeks) shall be raked, refertilized, reseeded, remulched. Reseeding shall continue until an adequate stand of grass overall is achieved.

E. Maintain turf areas until Substantial Completion.

F. Remove sod stakes after turf is established.

END OF SECTION 02930

SECTION 02950

TREES, SHRUBS AND GROUND COVER

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Related Work specified elsewhere:

1. Section 02220 - Structural Excavating, Filling, and Grading.

2. Section 02930 - Lawns and Grass.

1.02 SOURCE, QUALITY CONTROL

A. Plant Material Standard: American Standards for Nursery Stock, ANSI Z60.1.

B. Inspection

1. Plant Material: Inspected at the growing site, tagged or otherwise approved for delivery.

2. Inspection at growing site does not preclude right of rejection at site.

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Provide one gallon container each of planting soil, mulch to Engineer for approval prior to planting operation.

2. Provide plant material suppliers list, growing locations to Engineer for approval prior to ordering material.

3. Prior to end of the planting, before the maintenance period, furnish three copies of written maintenance instructions to Contractor for maintenance, care of installed plants through their full growing season.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Preparation for Delivery

1. Balled and Burlapped (B&B) Plants

a. Dig, prepare for shipment in manner that will not damage roots, branches, shape, future development after replanting.

b. Ball of natural earth in which they are growing: Not broken, artificially formed by mudding-in.

c. Wrap ball firmly with burlap or strong cloth and tie: ANSI Z60.1.

d. Ball sizes, ratios: ANSI Z60.1.

2. Bare-root (BR) Plants

a. Dig with entire root system intact, earth carefully removed.

b. Cover roots with thick coating by puddling after plants are dug. Mulch with wet straw while in transit.

B. Delivery

1. Deliver fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state law.

2. Deliver plants tagged with individual waterproof legible identification labels stating correct plant name, size direct from nursery.

3. Protect during delivery to prevent damage to root ball or dessication of leaves.

4. Notify Engineer of delivery schedule in advance so plant material may be inspected upon arrival at job site.

5. Remove unacceptable plant material immediately from job site.

C. Storage

1. Heel-in, mulch, water immediately upon delivery if not to be planted within four hours.

2. Protect roots of plant material from drying or other possible injury.

3. Store plants in shade, protect from weather.

D. Handling

1. Do not drop plants.

2. Do not pick up container or balled plants by stems or trunks.

1.05 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

A. Well-formed, shaped, true to type, free from disease, insects, defects such as knots, sun-scald, windburn, injuries, abrasion, disfigurement.

B. True to botanical common name, variety per American Joint Committee on Horticultural Nomenclature, Standardized Plant Names, latest edition.

C. Nursery grown per ANSI Z60.1 - 1973, unless otherwise specified.

1. Grown under climatic conditions similar to those in locality of project.

2. Container grown stock: Growing in container for minimum 90 days before delivery, not root-bound, with root system hardened-off.

3. Bare root stock: Roots well-branched, fibrous.

4. Ground Cover Plants: Well-established in removable containers, integral containers, formed homogenous soil sections.

5. All material: Have been transplanted or rootpruned in the three year period immediately preceding the current season of growth.

2.02 PLANTING SOIL

A. Mixture: Prepared mixture of two parts topsoil, one part cattle manure or of five parts topsoil, five pounds commercial fertilizer per cubic yard of topsoil and one part peat moss; thoroughly mix.

2.03 FERTILIZER

A. Chemical Type L Commercial fertilizer (10% N, 6% K2 4% P2 O5), uniform in composition to state, federal laws, suitable for application with equipment designed for that purpose.

B. Organic Type: Poultry guano granular form, free from dust and feathers.

2.04 MULCH

A. Wood Chip Mulch: Clean oak wood chips free of branches, bark, dirt, etc.; chip size 1" to 4" long x ½" thick..

B. Rock Mulch: Rip-rap, 3/8" - 6" size, Bryan Red Rock or equal.

2.05 WRAPPING MATERIAL

A. Two thicknesses of crepe paper cemented together with bituminous material, 4" to 6" wide. Tie with 1" masking tape.

2.06 GUYING AND STAKING MATERIAL

A. Brace stakes, guy stakes for tree support: 2" x 2" nominal fir, pine, pointed at one end. Provide 2' long for guy stakes, 9' long for brace stakes.

B. Guying wire: Annealed, galvanized steel 12 gauge wire for trees up to 4" diameter, 9 gauge for over 4" diameter.

C. Hose: New reinforced rubber, 3/4".

2.07 WEED BARRIER

A. Black poly woven material.

2.08 BED EDGING

A. Heavy-duty black vinyl edging, 6" high.

2.09 WATER

A. Quality: Potable.

2.10 SPLASH BLOCKS

A. Concrete Splash Blocks: 12" wide x 36" long x 5"± thick with top contoured to drain toward one end. Minimum 4000 psi, 6% air entrained concrete.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify final grades have been established, topsoil has been placed prior to beginning planting operations.

B. Inspect trees, shrubs, ground cover plants for injury, insect infestation, and trees, shrubs for improper pruning.

C. Do not begin planting, wrapping of trees until deficiencies are corrected, plants replaced.

3.02 PREPARATION

A. Stake out location for plants, outline of planting beds on ground, verify locations of underground utilities, structures.

B. Do not begin excavation until stake out of plant locations, plant beds are prepared.

3.03 EXCAVATION FOR PLANTING

A. Pits and trenches:

1. Shape: Vertical sides, flat bottoms, square or circular.

2. Size:

a. Depth: Minimum 2' for trees, 16" for shrubs from finish grade, increased as necessary to accommodate ball or roots, at least 6" compacted topsoil below ball, roots.

b. Width or diameter: 1' greater than diameter of ball, or spread of root if bare-rooted.

B. Planting Beds

1. Planting beds shall have planting soil to a depth of 6".

2. Bring beds to smooth, even surface conforming to established grades after full settlement has occurred.

C. Obstructions Below Ground

1. Contractor shall review subsoil conditions and submit a bid to include rock excavation.

2. If large obstructions are encountered, planting pockets may be moved a few feet at the direction of the Engineer. No additional compensation will be allowed for new pit or backfilling unusable pits.

3.04 PLANTING

A. General

1. Center plant in pit or trench. Face for best effect.

2. Set plant plumb, hold rigidly in position until soil has been tamped firmly around ball, roots. Use only planting soil for backfill.

3. Place sufficient planting soil under plant to bring top of root ball 1" below finish grade or surrounding area.

4. Backfill pit or trench, water thoroughly to settle soil. After soil settles, fill pit with planting soil, water, leave pit surface even with finish grade of surrounding ground.

5. Watering basin: Topsoil berm 2" above finish grade, outside of the planting pit, forming a watering basin with a level bottom around each plant at the planting pit.

B. Balled Plants

1. Place in pit on planting soil material that has been hand tamped prior to placing plant.

2. Place with burlap intact so location of ground line at top of ball is same as at nursery.

3. Remove binding holding burlap at top of ball.

4. Do not pull wrapping from under ball.

5. Do not plant if ball is cracked or broken before or during planting process.

C. Bare-root Plants

1. Cut off clean, broken, frayed root. Spread roots out in pit. Carefully work soil among roots.

D. Container-grown Plants

1. Can removal

   a. Cut cans on two sides with an acceptable can cutter (not with axe or spade). Do not injure root ball.

   b. Do not cut sides on knockout cans.

   c. Carefully remove plants without injury or damage to root ball. Superficially cut edge roots with knife on three sides.

2. Box Removal

   a. Remove bottom of plant boxes before planting.

   b. Remove sides of box without damage to root ball after positioning plant and partially backfilling.

3. Dig planting holes to accommodate root balls.

4. Hand place plants which are in containers less than one gallon in size. Hand backfill, hand tamp leaving slight depression around bases of plants. Cover root ball with maximum 1" of planting soil.

3.05 MULCHING

A. Mulch planting pits, trenches, bed areas within 2 days after planting.

B. Cover tree watering basin, entire shrub bed evenly with 2" of mulch material.

C. Water thoroughly immediately after mulching.

D. Hose down planting area with fine spray to wash leaves of plants.

3.06 GUYING AND BRACE STAKING OF TREES

A. Brace stake deciduous trees up to 2" caliper.

1. Stakes: Driven perpendicularly, 3' into ground 6" outside of planting pit. Three equally spaced stakes around each tree.

B. Guy stake all deciduous trees over 3" caliper and all evergreen trees.

1. Stakes: Driven into ground to a depth which leaves 8" exposed, at 45°angle between stake and ground. Space three stakes on equal spacing around tree.

2. Drive stakes outside the planting pit a distance which allows the guy wire to be perpendicular to the stake.

C. Guy wires and hose collars.

1. Place hose collars around guy wires to protect trees from wire contact.

3.07 PRUNING

A. Deciduous Trees

1. Prune minimum necessary to remove injured twigs, branches, deadwood, suckers.

2. Make all cuts with clean sharp tools flush with trunk or branch to eliminate stubs. Do not pole, top trees.

3. Paint all cuts over 1" with waterproof antiseptic tree paint.

B. Shrubs

1. Use clean sharp tools to remove broken or badly bruised branches in accordance with best standard practices.

2. Prune to preserve natural form or character.

3. Cuts over 1" shall be painted with waterproof antiseptic tree paint.

3.08 WRAPPING

A. Spirally wrap all deciduous plant trunk material from bottom to first branches promptly after planting.

B. Overlap wrapping approximately 2".

C. Tie wrapping securely in place at bottom and top.

3.09 TRANSPLANTING

A. Plantings scheduled to be transplanted shall be removed and replanted immediately with a tree spade.

3.10 MAINTENANCE

A. Contractor: Perform all plant material maintenance until Substantial Completion.

B. Owner accepts the responsibility for replacement of improperly maintained plant material after date of Substantial Completion.

3.11 INSPECTION AND ACCEPTANCE

A. Engineer will inspect plantings upon receipt of Contractor completion notification letter.

B. Owner will be notified by the Contractor upon completion of project to start maintenance procedures.

END OF SECTION 02950

DIVISION 3 - CONCRETE

03100 CONCRETE FORMWORK

03200 CONCRETE REINFORCEMENT

03300 CAST-IN-PLACE CONCRETE

03410 STRUCTURAL PRECAST CONCRETE

03600 GROUT

SECTION 03100

CONCRETE FORMWORK

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this section shall be done in accordance with the following sections as well as the general specifications as outlined in Division 1.

B. Work covered under this section shall include providing formwork and shoring necessary for the placement of all cast-in-place concrete and any embedments or items to be cast into the concrete.

C. Concrete, reinforcing steel and embedments are not included in this section.

D. Related Sections:

1. Section 03300 - Cast-In-Place Concrete
2. Section 03410 - Structural Precast Concrete

1.02 REFERENCES

A. Work covered under this Section shall be in accordance with the latest available version of the following references unless otherwise noted

1. ACI 117, "Standard Tolerances for Concrete Construction and Materials, Chapter 2"

2. ACI 301, "Specifications for Structural Concrete for Buildings, Chapter 4"

3. ACI 318, "Building Code Requirements for Reinforced Concrete"

4. ACI 347, "Recommended Practice for Concrete Formwork"

1.03 SUBMITTALS

A. No submittals are necessary for materials and supplies covered under this section which comply with the applicable specifications.

1.04 SEQUENCING AND SCHEDULING

A. The erection and removal of formwork shall be scheduled and sequenced to provide for the minimum curing and form removal requirements as set forth in Section 03300 of the Specifications. The Contractor shall be responsible for sequencing form erection and removal to match any concrete pours, curing, and any other adjacent or related work which may affect the placement, removal or availability of concrete any formwork.

1.05 WARRANTIES AND GUARANTEES

A. The Contractor shall be responsible for the stability, performance and structural integrity of all formwork.

1.06 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Forms shall be constructed of wood, metal, or other material subject to review by the Engineer. Forms shall provide a smooth continuous surface.

B. Chamfer strips shall be constructed of wood, metal, or other material subject to review by the Engineer.

C. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be a commercially manufactured type. Wire is not acceptable. Ties shall be a type which leave no metal closer than one inch from the surface of the finished concrete.

D. Form coating or release agent shall be a non-staining form release which prevents adhesion of concrete to formwork, and shall be compatible with the type of form materials used. Acceptable agents include North Central Form Release, Eucoslip Form Release, Nox-Crete form coating and Crembeton 103.

2.02 MANUFACTURE

A. Forms may be either premanufactured or constructed on site by the Contractor.

B. The design and engineering of the formwork, as well as the construction, shall be the responsibility of the Contractor. The formwork shall be designed for loadings, lateral pressures and allowable stresses in accordance with Chapter 1 of ACI 387. Forms shall also be designed in accordance with ACI SP-4.

C. Forms shall be manufactured so as to provide smooth continuous surfaces in contact with concrete, as recommended in ACI 301 and 347.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Forms shall be protected from deterioration, weather and shrinkage prior to concreting by proper storage, oiling, wetting, or other appropriate methods.

B. Forms shall be free of rust, rot, or other detrimental forms of deterioration.

3.02 ERECTION

A. Forms shall conform to the shape, lines and dimensions of the components shown on the drawings, true to line, plumb and level as required to conform to ACI 117.

B. Forms shall be adequately designed, erected, supported and maintained to safely support all vertical loads that might be applied, including construction loads and loads resulting from the placement and vibration of concrete.

C. Forms for exposed concrete shall be constructed with particular care to avoid appreciable deflection in order to eliminate bulges, offsets, or other unsightly features in the finished surfaces.

D. Forms shall be sufficiently tight to prevent leakage of grout or cement paste.

E. Forms shall be provided for all openings in concrete except pipe sleeves. The location, number, and details of such items as openings, chases, recesses, construction joints, control joints, expansion joints, and inserts shall be carefully coordinated.

F. Forms shall be designed so they may be removed in proper sequence and without damage to the concrete. Hammering or prying against concrete surfaces shall be avoided to prevent damage to concrete.

G. Formwork supported on ground shall have satisfactory foundations to carry the loads imposed during and after construction without appreciable settlement.

H. Where necessary to maintain the specified tolerances the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the plastic concrete and construction loads. Positive means of adjustment (e.g. wedges, jacks, shores and struts) shall be provided and all settlement taken up during concrete placing operations.

I. Forms for exposed concrete shall be treated with a non-staining form oil. Care shall be taken to avoid placement of form oil on reinforcing steel, embedded anchorages, anchor bolts, bearing plates, or other items which require bonding to concrete. Care shall be taken to avoid excess accumulation of form oil in form work.

J. Forms shall be thoroughly cleaned of all dirt, mortar, sawdust and other foreign matter prior to use, and the bottoms of forms inaccessible from within shall be provided with access panels to permit removal of extraneous materials before placing concrete.

3.03 ATTACHMENTS

A. Openings in formwork shall be provided to accommodate any conduits, fixtures, or other appurtenances extending through the formwork.

B. Items which will be directly embedded into concrete shall be accurately located, securely supported, level, plumb and straight. This shall include items such as anchors, bearing plates, bolts, sleeves, conduits, pipes, and other inserts.

3.04 INSPECTION AND ACCEPTANCE

A. The Contractor shall make formwork accessible for inspection of reinforcing, embedments and any other necessary portions of the concrete work required by the Engineer.

B. The Contractor shall make inspection holes as requested by the Engineer to verify consolidation of concrete.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with contract requirements. The Contractor shall maintain records, available to the Owner and Engineer, regarding quality control measures.

END OF SECTION 03100

SECTION 03200

CONCRETE REINFORCEMENT

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this section shall be done in accordance with the following sections as well as the general specifications as outlined in Division 1.

B. Work covered under this section shall include fabrication, supply and placement of reinforcing steel and prestressing tendons, including bars, welded wire fabric, dowels, wire strand, ties supports, and other reinforcement accessories.

C. Anchor plates, anchor bolts, form ties, and other embedments are not included in this section.

D. Related Sections

1. Section 03100 - Concrete Formwork
2. Section 03300 - Cast-In-Place Concrete
3. Section 03410 - Structural Precast Concrete
4. Section 05550 - Steel and Iron Fabrications

1.02 REFERENCES

A. Work covered under this Section shall be in accordance with the latest available version of the following references unless otherwise noted:

1. ACI SP-66, "Detailing Manual - 1988"

2. ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures"

3. ACI 318, "Building Code Requirements for Reinforced Concrete"

4. AWS D1.4, "Structural Welding Code - Reinforcing Steel"

5. CRSI, "Manual of Standard Practice"

6. CRSI, "Placing Reinforcing Bars"

7. ASTM Designation A185, "Specification for Steel Welded Steel Wire Fabric for Concrete Reinforcement"

8. ASTM Designation A416, "Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete"

9. ASTM Designation A615/A616M, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcing"

10. ASTM Designation A616/A616M, "Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement"

11. ASTM Designation A617/A617M, "Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement"

12. ASTM Designation A706, "Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement"

1.03 SUBMITTALS

A. Shop Drawings: Shop Drawings are not required for submittal if in accordance with the Contract Drawings and Specifications.

B. In accordance with Section 01300, the manufacturer's certificates giving properties of the steel (i.e. mill tests) furnished under this section of the Specifications shall be submitted.

1.04 SEQUENCING AND SCHEDULING

A. Placement and securing of reinforcing steel and formwork and review of reinforcing shall be scheduled so that reinforcing work may be reviewed by the Engineer before it becomes inaccessible, as required in Part 3.04 of this section.

1.05 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Reinforcing bars shall conform to the latest ASTM Designation A615, A616, A617 or A706, Grade 60.

B. Welded wire fabric shall conform to the latest ASTM Designation A185.

C. Prestressing tendons shall conform to the latest ASTM Designation A416.

D. All bar supports resting on or within 2 inches of a formed surface, free surface, ground, or any other location in which corrosion of the bar or support could occur shall conform to requirements set forth in the CRSI Manual of Standard Practice for Type C plastic-protected or Type E stainless steel protected bar supports. Precast concrete block bar supports conforming to requirements set forth in the CRSI Manual of Standard Practice may be used for concrete placed against the ground.

E. Tie wire shall be No. 16 annealed wire.

2.02 MANUFACTURE

A. All reinforcing bars shall be bent cold to the dimensions required before placing. Diameter of hooks and bends shall be as set forth in ACI 315. Bars with kinks or bends not shown on the drawings shall not be incorporated into the Work. Bar lengths, depths, and bends exceeding specified fabrication tolerances shall not be permitted in the work.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Steel reinforcement shall be stored above the surface of the ground on platforms, skids or other supports, and shall be reasonably protected from injury and surface deterioration caused by exposure to conditions producing rust. When placed in the Work, reinforcement shall be free of injurious seams, flaws, cracks, scale, excess rust or other foreign materials.

3.02 ERECTION

A. All reinforcing shall be accurately placed to the dimensions shown on the Drawings, and securely held in place by bar supports, chairs, spacers or wire and tied with wire at all cross points in a manner that will provide the required concrete covering.

B. Reinforcing shall be placed within 1 inch of the locations shown on the Drawings and in no case shall the total number of reinforcing bars be less than the number of bars indicated on the Drawings.

C. Unless otherwise specified, the clear distance between the reinforcing steel and concrete surfaces shall be 2 inches ± 1/4". When concrete is placed against soil, the clear distance between the reinforcing and the soil shall be 3 inches ± 1/4". Care shall be taken to prevent sagging between reinforcement supports which would reduce clear cover distances below the above values.

D. Reinforcing shall NOT be tack welded.

E. Adequate chairs, ties, etc., shall be placed at such intervals as to prevent bars or welded wire fabric from sagging or deflecting and to hold the reinforcement rigidly against displacement of the concrete.

F. Reinforcing steel shall be placed strictly in accordance with the details shown on the Drawings.

G. Control and construction joints shall be located only in the locations shown on the Drawings, and shall be constructed strictly in accordance with joint details shown on the Drawings.

H. All lap splices shall conform to the requirements set forth in ACI 318. Deformed reinforcing splices shall be Class C.

I. All welded splices shall conform with AWS D1.4.

J. Reinforcement shall be free of loose rust and mill scale, earth, ice, cement, mortar and other materials prior to placement of new concrete which reduce or prevent complete bond with concrete.

3.03 INSPECTION AND ACCEPTANCE

A. Concrete shall not be placed until the reinforcing steel has been directly observed and accepted by the Engineer. Formwork which makes the reinforcing inaccessible for observation shall not be placed until the reinforcing area in question has been observed and accepted by the Engineer.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with contract requirements. The Contractor shall maintain records, available to the Owner and Engineer, regarding quality control measures. Records shall be kept of the grades, size and location of reinforcing the type of supports provided for reinforcing, and the class and dimension of reinforcing splices.

END OF SECTION 03200

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this section shall be done in accordance with the following sections as well as the general specifications as outlined in Division 1.

B. Work covered under this section shall include providing all of the materials, equipment and labor to complete all of the cast-in-place concrete work as shown on the Drawings.

C. Reinforcing steel, embedments and formwork are not included in this section.

D. Related Sections:

1. Section 02220 - Structural Excavating, Filling and Grading
2. Section 03100 - Concrete Formwork
3. Section 03200 - Concrete Reinforcement
4. Section 05550 - Steel and Iron Fabrications
5. Section 07900 - Joint Sealers

1.02 REFERENCES

A. Work covered under this Section shall be in accordance with the latest available version of the following references unless otherwise noted:

1. ACI 117, "Standard Tolerances for Concrete"

2. ACI 211, "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete"

3. ACI 214, "Recommended Practice for Evaluation of Strength Test Results of Concrete"

4. ACI 301, "Specifications for Structural Concrete for Buildings"

5. ACI 302.1R, "Guide for Concrete Floor and Slab Construction"

6. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"

7. ACI 305, "Hot Weather Concreting"

8. ACI 306, "Cold Weather Concreting"

9. ACI 308, "Standard Practice for Curing Concrete"

10. ACI 309, "Recommended Practice for Consolidation of Concrete"

11. ACI 318, "Building Code Requirements for Reinforced Concrete"

12. ACI 347, "Recommended Practice for Concrete Formwork"

13. ACI 614, "Recommended Practice for Measurement, Mixing and Placing Concrete"

14. ACI SP-46-8, "A Method of Proportioning Structural Concrete Mixes with Fly Ash and Other Pozzolans"

15. ASTM Designation C31, "Test Methods of Making and Curing Concrete Test Specimens in the Field"

16. ASTM Designation C33, "Standard Specifications for Concrete Aggregate"

17. ASTM Designation C39, "Test Method for Compressive Strength of Cylindrical Concrete Specimens"

18. ASTM Designation C40, "Test Method for Organic Impurities in Fine Aggregate for Concrete"

19. ASTM Designation C88, "Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate"

20. ASTM Designation C94, "Specification for Ready-Mixed Concrete"

21. ASTM Designation C117, "Test Method for Material Finer Than 75 um (No. 200) Sieve in Mineral Aggregates by Washing"

22. ASTM Designation C123, "Test Method for Lightweight Pieces in Aggregate"

23. ASTM Designation C127, "Test Method for Specific Gravity and Absorption of Coarse Aggregate"

24. ASTM Designation C128, "Test Method for Specific Gravity and Absorption of Fine Aggregate"

25. ASTM Designation C136, "Method for Sieve Analysis for Fine and Coarse Aggregates"

26. ASTM Designation C142, "Test Method for Clay Lumps and Friable Particles and Aggregates"

27. ASTM Designation C150, "Specification for Portland Cement"

28. ASTM Designation C131, "Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"

29. ASTM Designation C171, "Specifications for Sheet Materials for Curing Concrete"

30. ASTM Designation C260, "Specifications for Air Entraining Admixtures for Concrete"

31. ASTM Designation C309, "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete"

32. ASTM Designation C494, "Specifications for Chemical Admixtures for Concrete"

33. ASTM Designation C618, "Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete"

34. ASTM Designation C881, "Specification for Epoxy-Resin-Base Bonding Systems for Concrete"

35. ASTM Designation D994, "Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)"

36. AASHTO Designation T26, "Quality of Water to be Used in Concrete"

37. MNDOT (Standard Specifications for Construction) Designation 3728 "Bituminous Mastic Joint Sealer for Pipe"

1.03 SUBMITTALS

A. In accordance with Section 01300, prior to the start of work, Manufacturer's data and product information shall be submitted for

concrete material products including admixtures, bonding agents, grouts, and others as requested by the Engineer.

B. Prior to the start of work, Certificates of material properties signed by the material producer or processor and the Contractor verifying compliance with Contract material specifications shall be submitted for review. Certification shall include project name and number, date of report, name of contractor, source of material, manufacturer or processor, and brand name for proprietary products.

C. Prior to the start of work the concrete suppliers standard mix design shall be submitted for each concrete designation to be used.

D. If concrete production facility records are utilized as the basis for proportioning the mix, all concrete strength test data shall be submitted for each concrete designation to be used.

E. The Contractor shall submit a schedule for all product, material and testing submittals and concrete placement.

F. If a sprayed on membrane is used for curing, the manufacturer's certification shall be submitted, verifying that the material furnished has been tested and conforms to the required tests as described in the appropriate sections below.

1.04 SEQUENCING AND SCHEDULING

A. The Contractor shall provide a schedule for all product, material and testing submittals and concrete placement.

1.05 QUALITY ASSURANCE PROGRAM

A. The Contractor shall provide a quality assurance program for the products and material sources and for the concrete construction as set forth in Parts 2 and 3 of this section.

B. The Contractor shall provide access and make materials available to the Engineer for testing as required.

C. Any required testing not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be conducted at the Contractor's expense.

1.06 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Form Materials - See Section 03100

B. Reinforcing Materials - See Section 03200

C. Concrete Materials

1. Cement: All cement shall be Portland Cement conforming to ASTM Designation C-150. Type I cement shall be used in all concrete mixes included in this section unless otherwise specifically authorized by the Engineer in writing. One brand of cement shall be utilized throughout the Project, unless reviewed and approved by the Engineer.

2. Fine Aggregate: Fine Aggregate material shall consist of clean, hard, dense, durable uncoated rock fragments.

The fine aggregate , as batched, shall be well graded, and when tested by means of standard screens (ASTM Designation C136), shall conform to the grading requirements set forth in ASTM Designation C33. The maximum percentages of deleterious substances in the fine aggregate, as delivered to the mixer, shall not exceed the following values:

	Percent by Weight
Material passing No. 200 screen (ASTM Designation C117)	3
Lightweight material (ASTM Designation C123)	2
Clay Lumps (ASTM Designation C142)	1
Total of other deleterious substances (such as alkali, mica, coated grains, soft flaky particles and loam)	2

The sum of the percentages of all deleterious substances shall not exceed 5 percent, by weight. Fine aggregate producing a color darker than the standard in the colorimetric test for organic impurities (ASTM Designation C40) will be rejected. Fine aggregate having a specific gravity (ASTM Designation C128) of less than 2.60 will be rejected. The fine aggregate will be rejected if the portion retained in a No. 50 screen when subjected to five cycles of the sodium sulfate test (ASTM Designation C88) shows a weighted average loss of more than 8 percent, by weight.

3. Coarse Aggregate: The term "coarse aggregate" is used to designate aggregate graded from 3/16 inch to 6 inches in diameter or any size or range of sizes within such limits. The coarse aggregate shall be reasonably well graded within the nominal size ranges specified below. Coarse aggregate for concrete shall consist of natural gravel or crushed rock or a mixture of natural gravel and crushed rock.

   The coarse aggregate shall consist of clean, hard, dense, durable, uncoated rock fragments. The percentages of deleterious substances for any size of coarse aggregate, as delivered by the mixer, shall not exceed the following values:

	Percent by Weight
Material passing No. 200 screen (ASTM Designation C117)	1
Lightweight material (ASTM Designation C123)	2
Clay Lumps (ASTM Designation C142)	1/2
Total of other deleterious substances (such as alkali, mica, coated grains, soft flaky particles and loam)	1

   The sum of the percentages of all deleterious substances in any size of aggregate, as delivered to the mixer, shall not exceed 3 percent, by weight.

   Coarse aggregate shall be rejected if it fails to meet the following test requirements:

Los Angeles Rattler Test (ASTM Designation C131) - If the loss, using grade A, exceed 10 percent, by weight, at 100 revolutions or 40 percent, by weight, at 500 revolutions.

Sodium Sulfate Test for Soundness (ASTM Designation C88) - If the weighted average loss after five cycles is more than 10 percent by weight.

Specific Gravity (ASTM Designation C127) - If specific gravity (saturated surface dry basis) is less than 2.60.

The coarse aggregate shall be separated into nominal sizes and shall be graded in accordance with the requirements set forth in the latest ASTM Designation C33.

4. Water: Water shall be reasonably clean and free from injurious amounts of oil, acid, salt, alkali, organic matter or other deleterious substances. If the Contractor intends to use water from some source other than domestic water supply, the Contractor shall obtain and furnish to the Engineer the results of such tests as are required to demonstrate that the water conforms to these Specifications. The quality of questionable water shall be determined in accordance with the lasted AASHTO Designation T26.

5. Air Entraining Admixtures: Unless otherwise directed, all concrete to be embodied in the work shall be air-entrained. The method of obtaining air-entrainment shall be by the addition of air-entraining agent in the mixing water of the batch. The use of air-entraining cement will not be permitted. The air-entraining admixture shall meet the requirements of the latest ASTM Designation C260. The air-entraining solution shall be batched by means of a mechanical batcher capable of accurate measurement throughout the batch during the specified mixing. Since the quantity of air-entraining admixture required will vary with changing atmospheric conditions, the quantity used shall be commensurate with prevailing conditions. In mixes which include the addition of a water-reducing admixture, the amount of air-entraining admixture shall be adjusted to compensate for any increased air-entraining due to the water-reducing admixture.

6. Water Reducing Admixture: The water reducing admixture shall be lignin based or hydroxylated-polymer based admixture and shall meet the requirements of the latest ASTM Designation C494. The water-entraining solution shall be batched by means of a mechanical batcher capable of accurate measurement throughout

the batch during the specified mixing. The use of water-reducing admixtures which accelerate the setting time of the mix will not be allowed.

7. Pozzolans: Pozzolans shall be fly ash or natural pozzolans meeting the requirements of the latest ASTM Designation C618, and shall have a loss on ignition of less than five percent.

D. Curing Materials: Impervious sheet type curing materials shall conform to the latest ASTM Designation C171. The type of sheet shall be optional, except that polyethylene film, if used, shall be white opaque.

Membrane forming curing compound shall conform to the latest ASTM Designation C309, Type 1-D (clear or translucent with fugitive dye) or Type 2 (white pigmented), Compound shall be non-permanent type and shall deteriorate within 60 days of application.

Water, if used for curing, shall be fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter or other deleterious substances.

E. Joint Sealers: See Section 07900

F. Bonding Agents and Grouts

1. Bonding Agent: Epoxy bonding agent shall conform to requirements set for Type 2, Grade 2, Class A, B or C epoxy as set forth in ASTM C881. The epoxy class shall be based on the ambient temperature during placement in accordance with the following:

Class	Ambient Temperature
A	below 40 degrees F
B	40 to 60 degrees F
C	above 60 degrees F

Manufactured epoxy agents considered acceptable include Sikadur-Highmod as manufactured by Sika Chemical Corporation and Number 463 epoxy as manufactured by the Euclid Chemical Company.

2. Non-Shrink Grout: See Section 03600

G. Bituminous Joint Filler: Bituminous joint filler shall be a preformed bituminous material such as Sealtight Asphalt Expansion

Joint Filler as manufactured by W. R. Meadows, and shall conform to the latest ASTM Designation D994.

H. Concrete Sealer: Concrete sealer shall be SIKAGARD 70 as manufactured by Sika Chemical Corporation or equal.

I. Waterstop: Waterstop shall be Servicised/Durajoint PVC Waterstop Type 4 (6-inch wide serrated type with center bulb). All waterstop joints shall be a melted butt splice formed with the manufacturer's electrical splicer designed for use with the waterstop. All splicing shall be performed in accordance with the manufacturer's recommendations.

2.02 MANUFACTURE

A. General Mix Requirements: Concrete shall be composed of Portland cement, air-entraining admixture, coarse aggregate, fine aggregate, and water. Water reducing admixture shall be incorporated as specified elsewhere. Pozzolan may be incorporated into the concrete mix in accordance with these Specifications.

The concrete mixes shall be designed with the intention of producing the quality specified, and proportioned and mixed in accordance with the requirements as set forth herein. Ready-mixed concrete shall be batched in an approved plant in accordance with ASTM C94.

The Contractor shall submit to the Engineer mix designs as required in the Submittals section.

B. Proportioning: The concrete mix to be furnished under this contract shall be either Mix 2 or 2P. The concrete mix shall have the following characteristics:

STRUCTURAL CONCRETE	Mix No. 2	Mix No. 2P
Specified 28-day Compressive Strength f'c (psi)	4,000	4,400
Maximum Nominal Aggregate Size (inches)	3/4	3/4
Maximum Slump (inches)	6	6
Minimum Slump (inches)	3	3
Air Content (percent)	6±1	6±1

STRUCTURAL CONCRETE	Mix No. 2	Mix No. 2P
Minimum Cement Content (lb/c.y.)	611	517
Minimum Pozzolan Content (lb/c.y.)	---	141
Maximum Water Cement Ratio	0.45	---
Water Reducing Admixture	Req'd	Req'd

C. Design and Testing

Design and testing for the concrete mix to be used under this contract shall be made using the cement, aggregates and pozzolans and other admixtures which will be used for the project. The mix shall be designed in accordance with ACI 211 and Chapter 4 of the "Building Code Requirements for Reinforced Concrete", ACI 318-83 to attain the required strengths and slumps, using the required aggregate sizes and admixtures. Proportioning by use of the water-cement ratio limits will not be permitted. Concrete containing pozzolans shall be designed in accordance with ACI SP-46-8.

If concrete production facility records are utilized as the basis for proportioning the mix, all concrete strength test data shall be submitted to the Engineer as required under the Submittals portions of this Specification.

In the design of concrete mixes requiring a water reducing admixture, the specified slump shall be obtained by maximizing the amount of water-reducing admixture used in the mix and minimizing the water-cement ratio.

2.03 SOURCE QUALITY CONTROL

A. The manufacture shall maintain a source quality control program to insure that materials conform to the Specifications. Each type of material shall be provided from one source to the fullest extent practical. The records shall be maintained regarding the source of all materials and submitted to the Owner.

PART 3: EXECUTION

3.01 MIXING AND TRANSPORTATION

A. Concrete shall be produced, transported and handled in accordance with "Design and Control of Concrete Mixes" and ACI 614. Ready-mixed concrete shall be batched in an approved plant and transported to the job site in accordance to ASTM C94 and ACI 304.

3.02 PLACEMENT

A. General

Before concrete is placed, all equipment for mixing and transportation of concrete shall be cleaned, all debris and ice shall be removed from the spaces to be occupied by the concrete, and all forms shall be thoroughly cleaned of debris, ice and other coatings. Before placing concrete, all required embedded items, including reinforcing steel, anchors, inserts, bolt cans, sleeves, and all other items specified under this and other sections of the Specifications are required to be in their final position at the time the concrete is placed, and shall be properly located, accurately positioned, and built into the construction and maintained securely in place.

Screeds shall be placed on proper supports to maintain required thickness of slabs, and bulkheads shall as required to limit each pour to the distinct predetermined construction joints, if any.

No concrete which has started to set, nor any retempered concrete, shall be used.

B. Placement

Subgrades for placing concrete shall be prepared as specified in Section 02220 of these Specifications. Subgrades shall be damp but not wet before the concrete is placed. Subgrades shall contain no frozen materials at or below the surface.

Concrete shall be transferred from the mixer to the place of final deposit by methods which prevent the separation of aggregate from mortar, and prevent the loss of ingredients. Methods of deposit shall be such as to prevent spattering mortar on reinforcing steel or forms before the actual placement of concrete against these surfaces. Concrete may be conveyed in buckets, buggies, chutes, or other approved means. All concrete shall be placed in continuous approximately horizontal layers.

Concrete shall not be dropped through space any distance more than necessary and in no case more than 4 feet. All concrete for walls or vertical surfaces shall be placed through temporary openings in the forms spaced at frequent intervals or through drop chutes equipped with suitable hopper heads. Drop chutes shall be of variable lengths and sufficient number to ensure the concrete of being kept level at all times. Concrete shall be deposited in the forms as nearly as practicable in its final position. All concrete shall be placed in lifts not to exceed 20 inches in depth.

Special care shall be taken to prevent splashing of the forms or reinforcement with concrete. Any such splashes or accumulations of hardened concrete on the forms or on any items to be embedded in the concrete above the general level of the concrete already in place shall be removed before the work proceeds.

Concrete shall not be deposited in or through water unless the procedures for placement have been reviewed by the Engineer and approved by the Owner. The placement procedures shall include provisions to prevent segregation or dilution of cement paste.

Walls and footings shall be poured full height in one pour, unless otherwise shown on the Contract Drawings or approved by the Engineer. Walls and footings shall be poured no less than 8 hours before slabs are poured over them.

C. Placement Time Limitations

Concrete containing a water reducing admixture which does not retard the setting time of the mix shall be placed within 1 hour after mixing. If the water reducing admixture incorporated into the mix retards the setting time of the concrete, the concrete shall be placed within 1-1/2 hours after mixing. The use of additional water reducer beyond the normal recommended amount by the manufacturer shall not be used to retard the concrete.

D. Consolidation

Concrete shall be consolidated in accordance with ACI 309. Consolidation shall include ramming, spading and agitating the concrete with suitable tools during and immediately after deposition, in such a manner as to produce a thoroughly consolidated concrete of maximum density. The consolidated concrete shall present a smooth, finished, unbroken mortar surface without exposed stone when the forms are removed, and the concrete should make complete contact and good bond with reinforcing steel and other embedded items. The use of suitable power-driven vibrators in conjunction with hand tamping and

spading is required. Care shall be taken to avoid over-vibration of the concrete. Vibrators shall not be used to transport concrete within the forms. Temporary openings may be provided in the formwork to facilitate compaction of the concrete. No more than four cubic yards of concrete may be deposited prior to consolidation.

E. Construction Joints

Joints shall be constructed as shown on the Contract Drawings unless otherwise approved by the Engineer. Concrete work shall continue uninterrupted until the completion of the pour, even if overtime work is required for such completion, so that in no place will concrete be deposited in contact with concrete that has attained its initial set, except at construction joints.

Where a joint is made, before depositing new concrete on or against concrete that has set, the surface should be prepared and form oil (Section 03100) or bitumen meeting the requirements of MnDOT 3728 should be applied.

Care shall be taken to vibrate and compact the first lift to ensure a tight bond with previously placed concrete. The same care shall be used to compact all concrete in contact with all cold joints.

F. Control Joints

Control joints shall be located only in the locations shown on the Drawings, and shall be constructed strictly in accordance with joint details shown on the Drawings.

Where indicated on the Drawings, the control joint shall be sealed with a material which meets the requirements of Section 07900 of these Specifications.

G. Curing and Protection

1. General: All concrete shall be cured a minimum of 7 days following the completion of the placement thereof. All concrete shall be protected against physical damage from any cause until the completion of work.

2. Removal of Forms: Forms shall be removed in a manner to ensure complete safety of the structure.

   The periods of time specified in this section represent cumulative periods of time (not necessarily consecutive) during

which the temperature of the concrete is above 50 degrees fahrenheit.

Where the formwork as a whole is supported on shores the beam and column sides may be removed after 24 hours if the mix design does not contain a retarding admixture, and after 48 hours if the mix contains an admixture, provided the concrete has cured sufficiently so as to not be damaged thereby.

Wall forms and forms for the tops of sloping surfaces shall not be removed until the concrete has attained adequate strength, and in no case less than 48 hours.

Beam and slab bottom forms shall remain in place for a period of 14 days. However, beams and slabs having forms removed before 28 days shall be shored until the concrete has reached the age of 28 days. If the Contractor wishes to reduce the period of time that the beam and slab bottom forms are left in place, he may request the Engineer to take additional cylinders of each slab or beam pour. When a cylinder made from the same concrete that is used in a beam or slab pour reaches 75 percent of the specified 28 day compressive strength the forms may be removed. The Contractor shall notify the Engineer in advance as to the number of cylinders desired and the times at which they should be tested. The Engineer shall make the cylinders and arrange for testing. The Contractor shall pay the cost of the cylinder molds, any additional transportation or handling cost for delivering the cylinders to the testing laboratory, and the cost of testing the cylinders.

In no case shall forms, shoring or reshoring be removed until the members have acquired sufficient strength to safely support the weight and the loads thereon.

Procedures for reshoring shall follow the recommendations outlined in ACI 347 Section 3.7.

3. Curing: Curing may be by any of the following methods, as applicable. The details of each method are subject to approval by the Engineer. Concrete shall be adequately cured for at least 7 days.

   a. Forms left in place will be considered adequate curing provided other means of curing are used on the unformed surfaces of each respective section of the concrete.

b. Unformed surfaces, or surfaces from which forms have been removed, may be cured by keeping the surface continuously wet by spraying, ponding or applying wet sand, wet burlap or similar materials and keeping these materials continuously wet. Materials and procedures shall be such that the concrete will not be stained.

c. Only when other methods of curing are not reasonably practicable, concrete surfaces may be cured by wetting thoroughly and covering with suitable film and/or paper to retain the moisture. Paper shall comply with ASTM Designation C171. Film shall be 4 mil thick, "Visqueen" or equal. Membrane material shall be suitably held in place by weighting or other means, and joints shall be taped or otherwise sealed so as to retain the moisture. Film and/or paper shall be checked daily and concrete beneath shall be inspected to make sure it is damp, and if any drying is found, corrective measures shall be taken immediately.

d. Concrete may be cured with sprayed-on membrane curing compound applied as specified and in accordance with the manufacturer's directions, except that membrane compound shall not be used on surfaces to receive cement finish or surfaces of construction joints. Membrane shall conform to ASTM Designation C308, Type 1-D or 2, except that the moisture retention test shall show a loss of not more than 0.030 gram per square centimeter. Manufacturer's testing certifications shall be submitted by the Contractor as required in the Submittals division of this section.

   Sprayed-on curing membrane shall be applied in two passes, the second at right angles to the first, to give a uniform appearance and adequate film. The material shall be at least equal in thickness to that tested. Rough surfaces will require heavier application. Particular care shall be taken to obtain good coverage on corners and edges. Concrete shall be wetted before application of the curing membrane and shall be damp at the time sprayed. The film shall be protected from physical damage which may occur during the curing period. Any damage to the film shall be repaired immediately. Trowelled and floated surfaces shall have curing compound applied as soon as practicable following the finishing operations.

4. Shock and Vibration: Pile driving, blasting, use of wrecking balls and other operations which cause shocks or vibrations to be transmitted to the concrete shall not be permitted within 100

feet of concrete less than 7 days old unless otherwise authorized by the Engineer.

H. Cold Weather Protection

When the ambient air temperature is below 40 degrees Fahrenheit, or when there is a probability that such temperature will occur during the 24 hour period after placing, special provision shall be taken to protect the concrete. Except as otherwise specified herein, the mixing, placing and protection shall be in accordance with ACI 306.

Calcium chloride shall not be used.

Frozen concrete shall be immediately removed upon direction of the Engineer and replaced with new work and materials at no expense to the Owner. In order to maintain the temperature specified, the work shall be entirely enclosed, and all fuel and suitable heating equipment and the necessary labor and supervision shall be furnished. Non-vented heaters shall not be used within enclosures where concrete slabs are being water cured so as to prevent the unfavorable reaction between carbon dioxide and fresh concrete.

During cold weather, temperature records shall be kept by the Contractor and furnished to the Engineer daily, showing the temperature at 4-hour intervals of the outside air, of the air in the coldest part of the enclosure near the concrete, of the concrete as it is placed, and of the concrete in place at such points as the Engineer may direct. During freezing weather, such temperature records shall be kept night and day.

I. Hot Weather Protection

Care shall be taken during hot weather to keep concrete temperatures and mixing and placing times to a minimum.

Transport trucks shall be dispatched to avoid delays and the work shall be organized to use the concrete promptly to prevent unnecessary additional mixing at the job site.

When necessary, arrangements for installation of windbreaks, shading, spraying, sprinkling, or wet covering of a light color shall be made in advance of placement, and such protective measures shall be undertaken as quickly as concrete hardening and finishing operations will allow.

Production, delivery, placement and protection of concrete during hot weather shall comply with ACI 305.

J. Special Provisions for Concrete Containing Pozzolans

The Contractor may use, at his option, a concrete mix containing pozzolan, provided it meets the requirements of these Specifications. All pozzolan used in concrete supplied under this contract shall be from the same source.

Concrete with pozzolan tends to lose air entrainment faster than normal concrete. Therefore, the Engineer will perform one air test every 20 minutes during the placement of each load of concrete. Additional air-entraining admixture may be added at the site to compensate for loss of air-entrainment provided the concrete is then rotated in the mixer or ready mix truck a minimum of 30 revolutions and is retested for air and slump.

K. Concrete Finishes

1. General: A superior quality of concrete finish is expected on all exposed concrete surfaces. All exposed edges shall be chamfered 1 inch unless otherwise specified.

2. Formed Surfaces: After forms are removed, all metal devices shall be removed to a depth of not less than 1 inch from the surface of the concrete, and all fins at joints in the forms or form lining shall be removed. All cavities produced by the removal of form ties, together with all sand pockets, honeycombed areas, and other holes shall be carefully cleaned out, saturated with water, and filled with mortar compacted into place with sufficient pressure to ensure filling all voids. This mortar shall be mixed as dry as it is possible to use, in the proportions of one part cement to two parts sand, allowed to stand about 1 hour, and then remixed before being used.

   On all exposed surfaces that are not to be given special architectural treatment, the Contractor shall apply, using a rubber float or approved equal, a latex or acrylic based bonding agent mixed with a standard or commercial packaged mortar. The color of the finished surface after drying shall be uniform and of approximately the same color as the original concrete.

3. Unformed Surfaces: All finishing operations for unformed concrete surfaces shall be performed before and after the bleed or other water is on the concrete surface. No finishing operations shall be performed while any water is on the concrete surface. The extent of finishing operation described below will depend on the type and use of the structure.

Before any bleed water comes to the surface, the concrete shall be screeded or struck off to the specified grade or elevation and floated to embed the aggregate, level any ridges, and fill any voids. The surface shall be floated with a bull float, darby, or other approved equipment on all large areas and a hand float along the edges and other small areas. After all water has left the surface, the concrete shall be floated a second time, trowelled to a smooth dense surface, and hair brushed to a non-slip surface.

The finishing operations for the various types of structures shall be continued through the following stages unless otherwise designated:

a. Screeding - All surfaces scheduled to be overlayed with concrete.

b. First Floating - Tops of walls, footings and vertical surfaces and other unexposed or buried surfaces.

c. Second Floating - All exposed surfaces not subject to vehicle or pedestrian traffic.

d. Trowelling - All interior surfaces subject to vehicle or pedestrian traffic.

e. Hair Brushing - All exterior surfaces.

L. Tolerances: All concrete structures shall be constructed in accordance with the tolerances set forth in ACI 117.

M. Surface Sealer: All interior and exterior slabs, sidewalls and stairways shall have a surface sealer installed in accordance with the manufacture's recommendations.

N. Slabs and Floors: Unless otherwise designated in the Plans and Specifications, slabs and floors shall conform with recommendations set forth in ACI 302.1R.

O. Concrete Surface Protection: Contractor shall be responsible from the elements of construction including, but not limited to: painting, stains, and traffic. If damage to a concrete surface occurs, Contractor at his own expense, shall repair or clean surface to Engineer's satisfaction.

3.03 INSPECTION AND ACCEPTANCE

A. General: The Contractor shall notify the Engineer of scheduled concreting operations at least 24 hours prior to the time such operations are initiated. Proper facilities shall be provided by the Contractor for the Engineer to inspect the ingredients and the proportioning process. The Engineer may take, without charge, samples of the ingredients and of the concrete to determine if the concrete conforms to the requirements set forth in the Specifications.

The Engineer may take samples for any of the following tests from any portion of the batch. All tests will be made in accordance with the appropriate ASTM specification.

B. Slump: Prior to the placement of any concrete, the Engineer may take a slump test. When the slump is greater than the allowable, the Engineer will reject the concrete and the Contractor shall remove the concrete from the site. Addition of water to compensate for stiffening of the concrete before placing will not be allowed.

C. Air Content: Air content determinations will be made by the Engineer. If the measured air content falls outside of the specified limits, the placing of concrete shall immediately be stopped, and the Engineer will immediately make another air content determination from the same batch. In the event of a second failure, the concrete shall be considered to have failed to comply with the Specifications and the Contractor shall remove all of the concrete of that batch from the site.

D. Strength: The concrete strengths will be evaluated and accepted in accordance with subsection 4.7 of ACI 318-83 unless otherwise specified. The Engineer will make sets of test cylinders in accordance with the frequency recommended by ACI. Each set of cylinders shall consist of three cylinders made from the same batch of concrete, one cylinder shall be tested at seven days, and another at 28 days. The third cylinder will be tested after the 28-day test if requested by the Owner, Engineer, or Contractor. The method of making, curing and testing the cylinders shall be in accordance with the requirements of the latest ASTM Designation C31 and C39, unless otherwise specified by these Specifications. Test cylinders will be placed in the vicinity of and subjected to the same curing conditions as the pour from which they were taken for the first 24 hours. The testing of the cylinders will be made by an independent testing laboratory. The cost of testing all cylinders that fail to meet the requirements of the Specifications shall be paid by the Contractor. All testing that meets requirements of the Specifications will be paid by the Owner.

If any test cylinders show a strength at 28 days which fails to meet the specified strength, the concrete represented by such test cylinders shall be further tested in accordance with subsection 4.7.4 of ACI 318-83. Such additional tests shall be paid for by the Contractor. If such tests indicate that the concrete does not meet the compressive strength requirements established by this Specification, the Owner will either reject the concrete or require such reinforcement or modification of the structure as is necessary to satisfy the design requirements. All rejected concrete shall be removed and replaced with new concrete of the specified strength at the expense of the Contractor. All reinforcement or modification of a structure required as a result of concrete which does not comply with the specified requirements shall be subject to review by the Engineer and approval by the Owner. All costs associated with reinforcement or modification shall be at the expense of the Contractor and shall not be limited to the costs of design, inspection, and construction of the work.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with contract requirements. The Contractor shall maintain records, available to the Owner and Engineer, regarding quality control measures. Records shall be kept of the location, dimensions and the volume of concrete placed for each pour. Concrete strength test results shall be evaluated in accordance with ACI 214.

END OF SECTION 03300

SECTION 03410

STRUCTURAL PRECAST CONCRETE (PLANT CAST)

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this section shall be done in accordance with the following sections as well as the general specifications as outlined in Division 1.

B. The work covered under this section shall include precast and precast-prestressed structural construction, including product design not shown on Contract Drawings, manufacture, transportation, erection and other related items such as anchorage, bearing pads, inserts, storage and protection of precast concrete.

C. Products furnished but not installed under this section.

1. Placement of anchorage and connection devices on foundations.

D. Not included in this section are the special provisions for the architectural precast concrete.

E. Related Sections:

1. Section 03100 - Concrete Formwork
2. Section 03200 - Reinforcing
3. Section 03300 - Cast-In-Place Concrete
4. Section 03600 - Grout
5. Section 04150 - Masonry Accessories
6. Section 05500 - Steel and Iron Fabricating
7. Section 07900 - Joint Sealers

1.02 REFERENCES

A. Work covered under this Section shall be in accordance with the following references of the latest available version unless otherwise noted:

1. American Concrete Institute (ACI) 301, "Structural Concrete for Building"

2. ACI 318, "Building Code Requirements for Reinforced Concrete"

3. American Welding Society (AWS) D1.1, "Structural Welding Code-Steel"

4. AWS D1.4, "Structural Welding Code-Reinforced Steel"

5. Prestressed Concrete Institute (PCI) MNL-116, "Manual for Quality Control for Plants and Production for Precast and Prestressed Concrete Products"

6. American Institute of Steel Construction (AISC) Steel Construction Manual

7. PCI Design Handbook, Precast and Prestressed Concrete, 3rd edition, 1985

8. PCI Committee on Tolerances, "Tolerances for Precast and Prestressed Concrete", PCI Journal, January-February, 1985, V. 30, No. 1

9. PCI MNL-120, Design Handbook-Precast and Prestressed Concrete"

10. PCI MNL-123, "Manual on Design of Connections for Precast Prestressed Concrete"

11. PCI MNL-124, "PCI Design for Fire Resistance of Precast Prestressed Concrete"

12. ASTM A36, "Structural Steel"

13. ASTM A153, "Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

14. ASTM A416, "Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete"

15. Minnesota Rules, Section 1305, "Amendments to the Uniform building code"

16. Uniform Building Code (UBC) Chapter 23, "General Design Requirements"

1.03 SUBMITTALS

A. Shop Drawings: Production and erection drawings shall be prepared and submitted for the Engineer's approval. Drawings shall indicate member sizes, sections, assembly methods, connections, stud layout, openings and other necessary data for fabrication and installation. Drawings shall also indicate and number each facing unit and each

unit delivered to the job shall bear the corresponding number clearly marked on the panel. The following items shall be included in the shop drawings:

1. Plans and/or elevations locating and defining all material furnished by the manufacturer.

2. Sections and details showing connections, cast-in items and their relation to the work.

3. Description of all loose, cast-in and field hardware.

4. Field installed anchor location drawings.

5. All dead, live and other applicable loads used in the design.

6. Criteria of deflections and cambers, bearing requirements, and special conditions used in the design.

B. Product Design Criteria: Product design criteria utilized by the Manufacturer in the manufacturing of components included in this section shall be submitted for reviewal upon request.

C. Test Reports: Reports of tests on concrete and other materials use in the manufacturing of components included in this section are to be submitted upon request.

D. Plant Quality Control: Outline of plant quality control program.

1.04 SEQUENCING AND SCHEDULING

The Contractor shall provide a schedule for designing, casting, curing, transporting and erecting the precast concrete and drawing and table indicating the erection sequence.

1.05 WARRANTIES AND GUARANTEES

A. The Contractor shall be responsible for providing precast products free from chipping, cracking, spalling or any other unsightly blemishes.

B. The precast concrete Manufacturer shall guarantee for a period of twelve months from the date of acceptance of installation the workmanship, material and satisfactory performance of all members provided. This shall include spalling, visible cracking, or excessive deflection due to inferior materials or workmanship.

1.06 QUALITY ASSURANCE

A qualified precast concrete manufacturer shall provide the structural precast concrete and direct the installation. The manufacturer shall demonstrate the capability to produce the components and quality specified. The manufacturer must show experienced personnel, physical facilities, established quality control procedures and management capabilities. When requested by the Engineer, the manufacturer shall submit written evidence of the above.

1.07 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Form Materials - See Section 03100

B. Reinforcing Materials - See Section 03200

C. Strand: Strand used for prestressing of precast members shall consist of uncoated, 7-wire, low-relaxation strand which meets the requirements of ASTM A416 Grade 270K.

D. Concrete - See Section 03300, with the exception that the 28-day compressive strength shall be at least 5,000 psi.

E. Anchors and Inserts: ASTM A36 carbon steel plates, angles, items cast into concrete, and inserts shall be confined to PCI MNL-123 and should be hot dipped galvanized in accordance with ASTM A153 except surfaces requiring field welding.

F. Grout - See Section 03600

G. Bearing Pads: Bearing pads shall be 1/4-inch thick high density plastic or Neoprene (chloroprene) and smooth both sides as set forth in the Contract Drawings. Neoprene shall conform to Division II, Section 25 of AASHTO Standard Specifications for Highway Bridges. High density plastic pads with multi-monomer plastic strips shall be nonleaching and support construction loads with no visible overall expansion.

H. Structural Steel: Structural steel shall conform to Section 05550. All exposed steel shall be hot dipped galvanized.

I. Welded Studs: Welded studs shall be in accordance with AWS D1.1.

2.02 SOURCE QUALITY CONTROL

The manufacturer shall maintain a source quality control program to insure that materials conform to the Specifications. Each type of material shall be provided from one source to the fullest extent practical. The records shall be maintained regarding the source of all materials and submitted to the Owner.

2.03 MANUFACTURE

A. Design Standards and Methods: Design of all concrete components included in this section shall be in accordance with ACI 318. The design method and procedures set forth in the PCI Design Handbook, PCI MNL-120, PCI MNL-123, and PCI MNL-124 shall be used where appropriate. Design of all welded connections shall be in accordance with AWS D1.1 and D1.4. Design of all structural steel shall be in accordance with the AISC Steel Construction Manual and specifications.

B. Loadings for Design: All structural precast and precast, prestressed construction components shall be designed for the following loading conditions:

1. Initial handling and erection stresses.

2. All dead loads.

3. All live loads (wind, snow, etc) as set forth in Chapter 23 UBC and Minnesota (Section 1305) Rules.

4. All other loads specified for members where they are applicable.

C. Design: Design calculations of products not completed on the Contract Drawings shall be performed by a registered engineer experienced in precast, prestressed concrete design and submitted for approval upon request.

D. Permissible Design Deviations

1. Design deviations will be permitted only with the Owner's approval and after the Engineer's review of the Manufacturer's

proposed design, supported by complete design calculations and drawings.

2. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the Owner.

E. Manufacturing Procedures: Manufacturing procedures shall be in general compliance with PCI MNL-116. Items which must be prestressed include roof plank, floor plank, beams, interior wall panels and exterior wall panels.

F. Manufacturing Tolerances: Manufacturing tolerances shall comply with PCI MNL-116 and the PCI Committee on Tolerances, Chapter 2 - Product Tolerances. Specific applicable products are building beams and spandrels, columns, hollow core slabs, insulated wall panels and architectural panels (window panels).

G. Finishes: The PCI specifications for finishes shall be used. Components manufactured under this section of the Specifications shall be provided with a Commercial Finish. All faces shall have true, well defined surfaces. Any exposed ragged edges shall be corrected by rubbing and grinding.

The top surfaces of roof plank shall be screened to true surfaces free from high and low areas and then floated to relatively smooth surfaces free from projecting gravel, footprints or other defects to provide a finish suitable for application of membrane and insulation.

Strands shall be recessed at the exposed vertical ends, and the ends of the member shall receive a sacked finish.

The top surface of the floor plank shall be intentionally roughened to a full amplitude of approximately 1/4 inch or greater.

H. Openings: The Manufacturer shall provide for those openings 12 inch round or square or larger as shown on the Contract Drawings. Other openings shall be located and field drilled or cut by the trade requiring them after the precast, prestressed products have been erected. All openings shall be approved by the Engineer and the precast Manufacturer before forming, drilling or cutting.

I. Patching: Patching will be acceptable providing the structural adequacy of the member and the appearance are not impaired.

J. Fasteners: The Manufacturer shall cast in structural inserts, bolts, dovetail slots, plates, and any other items as detailed by the Contract Drawings.

K. Plant Quality Control: The precast concrete manufacturer shall have an established quality control program in effect prior to letting of the contract. An outline of this program shall be submitted.

Prior to start of production, certified test reports of materials shall be submitted.

Plant records of production and quality control shall be kept in accordance with PCI MNL 116. Such records shall be available to the Engineer upon request.

The quality control program and records shall include:

1. Qualified personnel including a trained concrete technician. Such personnel should report to Management or Engineering and be independent of Production.

   If the manufacturer has contracted for his plant quality control to be performed by an outside concrete laboratory, that laboratory should be accredited by the Cement and Concrete Reference Laboratory of the National Bureau of Standards, or otherwise be able to prove its capability.

2. Plant records of component materials, concrete and production operation as follows:

   a) **COMPONENT MATERIALS**

      AGGREGATES

      Suppliers test reports including abrasion (or petrographic analysis), absorption, gradation and specific gravity.

      Plant tests for organic impurities and sieve analysis as follows:

         Fine aggregates (back-up mixes) - every two weeks or for each 200 cubic yards of aggregate.

         Coarse aggregates (back-up mixes) - every two weeks or for each 400 cubic yards of aggregate.

      CEMENT - Certified test reports or special arrangement with supplier. Age of cement in storage.

      WATER - Analysis and strength test not older than six months for non-potable water.

REINFORCING STEEL - Certified test reports for each grade, size and shipment.

HARDWARE - Certified test report for grades; weld certification, if structural, and product information of inserts.

ADMIXTURES - Product information and/or certified test reports.

ALL OTHER MATERIALS - Product information.

b) CONCRETE

Date of cast.

Mix proportions by weight.

Mixing water corrections and/or aggregates corrections due to surface moisture.

Yardage, anticipated and actual yield.

Identification of casting area, mold or unit.

Cylinder identification.

Concrete temperature.

Air temperature, weather conditions, and any measures taken for cold or hot weather concreting.

Slump - daily if more than 2 inches.

Air content - daily.

Continuous inspection of batching, mixing, conveying, placement, consolidation and finishing of concrete.

Method and duration of curing. Temperature charts for accelerated curing.

Twenty-eight day strength - daily, per mix design.

Unit weight, dry and fresh - weekly for normal weight; daily for light weight.

Strengths at release or stripping, if required for structural reasons.

Determination of absorption on architectural concrete exposed to weathering.

Detailed information on architectural concrete mixes.

c) **OTHER PRODUCTION OPERATIONS**

Marking of all units with date cast and identification number; alternatively consecutive numbering for date identification as part of production records.

Inspection of molds prior to concreting.

Checking on dimensions of units, position and amount of reinforcement, other incorporated materials, openings, block-outs, etc.

Inspection of stripping from mold, handling and storage.

General observation of plant, equipment, working conditions, weather and other items affecting production.

Test of concrete coverage over steel for a minimum 5 percent of production.

Final inspection of finished products and subsequent marking of them to this effect.

Inspection of architectural finish to ensure that the product matches the approved project sample.

Final inspection of product during loading for proper procedures and possible defects developed during storage.

Inspection of products following any repair.

Calibration of testing equipment every 6 months to 1 percent accuracy.

Calibration of batching scales every 4 months to 1 percent accuracy.

Records should be kept for a minimum of 2 years after final acceptance.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: Precast concrete members shall be lifted and supported during manufacturing, stockpiling, transporting and erection only at the lifting or supporting points, or both, as shown on the Contract and Shop Drawings, and with approved lifting devices. All lifting devices shall have a minimum safety factor of 4. Embedded strand which cause surface spalling when utilized to handle the precast members shall not be used on wall panels or window panels.

Transportation, site handling and erection shall be performed with acceptable equipment and methods, and by qualified personnel.

B. Storage: All precast members shall be stored above the ground surface. Members shall be stored so that identification marks are easily discernable. Stacked members shall be separated by battens across the full width of each bearing point. Members shall be stacked so that lifting devices are accessible and undamaged. The upper member of stacked tiers shall not be used as storage area for shorter members or heavy equipment.

3.02 ERECTION

A. General: Precast, prestressed concrete members shall be erected a minimum of 28 days after manufacture and connected in accordance with approved shop drawings.

B. Site Access: Suitable access to the building, proper drainage and firm, level bearing for the hauling and erection equipment to operate under their own power shall be provided.

C. Preparation: The Contractor shall:

1. Provide true, level bearing surfaces on all bearing walls and other field placed supporting walls.

2. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.

3. Provide all shoring required for composite beams and slabs. Shoring shall have a minimum load factor of 1.5 x (dead load plus construction loads).

D. Erection: Erection shall be defined as including:

1. Placing, aligning and leveling the members in final positions in the structure on the designated supporting faces.

2. Connection of precast members to each other, or to supporting structural members, as shown on the Shop Drawings.

3. Removal of lifting hooks, if necessary.

4. Cleaning and sealing all precast to precast joints.

E. Installation: Installation of precast, prestressed concrete members shall be performed by the Manufacturer or a competent erector. Members shall be lifted by means of suitable lifting devices at points provided by the Manufacturer. Temporary shoring and bracing, if necessary, shall comply with the Manufacturer's recommendations.

F. Alignment: Members shall be properly aligned and leveled as required by the approved Shop Drawings. Variations between adjacent members shall be reasonably levelled out by jacking, loading, or other feasible methods as recommended by the Manufacturer and approved by the Engineer.

All precast concrete members shall be erected level, plumb, square and true within the allowable tolerances. They must be positioned so that dimensional error does not accumulate. Horizontal and vertical joints shall be correctly aligned and uniform joint width shall be maintained as erection progresses. Saw cutting which produces a square and smooth edge along the precast plank will be allowed for aligning planks in field. Planks which are saw cut longitudinally shall not be less than one-half the standard manufacturer's width as indicated on the Drawings. In no case will breaking or chipping plank edges be allowed as a method of alignment.

G. Joints: If the space between flanges of adjacent roof plank exceeds 3/4 inch, it shall be covered with a minimum three inch wide 20 gage galvanized sheet metal cover adhered on each side with plastic flashing cement. Cement shall not run into joints.

H. Field Welding: Field welding is to be done by qualified welders as set forth in AWS D1.1 using equipment and materials compatible to the base material.

I. Erection Tolerances: The overall tolerance for the erected components shall conform to the requirements set forth in Chapter 3 of the PCI Committee on Tolerances for Precast and Prestressed

Concrete. The applicable components are the beams, floor and roof members, structural wall panels, and architectural wall panels.

3.03 ATTACHMENTS

A. General: Subject to the approval of the Engineer, precast, prestressed concrete products may be drilled or "shot" provided no contact is made with the prestressing steel. Any spalling which occurs shall be repaired.

3.04 PAINTING

A. General: The completed erected precast concrete components shall be painted as set forth in Section 09800.

3.05 INSPECTION AND ACCEPTANCE

A. General: Final inspection and acceptance of erected precast, prestressed concrete members shall be made by the Engineer to verify conformance with Contract Drawings and Specifications.

3.06 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with contract requirements. The Contractor shall maintain records, available to the Owner and Engineer, regarding quality control measures.

END OF SECTION 03410

SECTION 03600

GROUT

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this section shall be done in accordance with the following sections as well as the general specifications as outlined in Division 1.

B. The work covered under this section shall include all materials, labor, and equipment necessary to grout anchors, pins, dowels and rebars in concrete and to seat base plates as shown on the Contract Drawings.

C. Miscellaneous attached hardware items, as well as cast-in-place concrete, are not included in this section.

D. Related sections:

1. Section 03300 - Cast-In-Place Concrete
2. Section 03410 - Structural Precast Concrete
3. Section 05500 - Metal Fabrications

1.02 REFERENCES

Work covered under this section shall be in accordance with the latest available version of the following references, unless otherwise noted:

1. CRD C-621, "Corps of Engineers Specification for Non-Shrink Grout"

2. ASTM C-191, "Test Method for Time of Setting of Hydraulic Cement by Vicat Needle"

3. ASTM C-309, "Specification for Liquid Membrane-Forming Compounds for Curing Concrete"

4. ASTM C-580, "Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings"

5. ASTM C-827, "Test Methods for Early Volume Change of Cementations Mixtures"

6. ASTM C-882, "Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete"

1.03 SUBMITTALS

In accordance with Section 01300, the Contractor shall submit manufacturer's data on the materials to be used under this section of the Specifications.

1.04 SEQUENCING AND SCHEDULING

A. Sequencing and scheduling of the work included in this section shall coincide with the related work and adjacent work areas to correspond with required set and cure times of grout material, material surfaces to which grout is applied, and to correspond with the erection schedule of attached and adjacent hardware items.

1.05 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. General: Grout material shall be a non-shrink grout consisting of a non-metallic Portland cement grout, durable in wetting and drying, freezing and thawing conditions, and shall conform with the requirements set forth in CRD C-621. The grout shall not contain gypsum.

Materials for forming, if required, shall be approved by the Engineer. Curing compound conforming to ASTM C309, as required for the designated work, shall be approved by the Engineer.

2.02 MANUFACTURE

PERFORMANCE CRITERIA

A. Mixed portland cement grout shall meet the following requirements:

1. Time of Set (ASTM C191)

   a. Initial Set: 3.0 hours min.
   b. Final Set: 6.5 hours max.

2. Flow (CRD C-621): 100-124%.

3. Color: concrete gray.

4. The grout shall not exhibit bleeding.

5. The grout shall not segregate.

6. The grout shall be pumpable through standard grout pumping equipment.

B. Cured portland cement grout shall meet the following requirements:

1. Compressive Strength (CRD C-621)

   a. 1 day: 3,000 psi min.
   b. 28 day: 6,000 psi min.

2. Splitting Tensile Strength (ASTM C496) at 28 days: 500 psi min.

3. Flexural Strength (ASTM C580) at 28 days: 1,200 psi min.

4. Bond Strength (ASTM C882 Modified) Plastic grout to hardened concrete at 28 days (moist cure): 1,950 psi min.

5. Expansion (CRD C-621) at 28 days: +0.015% min.

6. The grout shall not produce a vapor barrier.

7. The grout shall exhibit positive expansion when tested in accordance to ASTM C827.

8. The grout shall conform to United States Army Corps of Engineers Specification CRD C-621.

9. The grout shall be approved by the United States Department of Agriculture.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

Grout products shall be delivered in original, unopened containers with the manufacturer's name, labels, product identification and batch numbers. Products shall be stored and conditioned as recommended by the manufacturer.

3.02 APPLICATION

A. Surface Preparation: Before grout is placed, all debris, standing water, ice and any loose or deleterious materials shall be removed from the surfaces where grout is to be applied.

B. Environmental Conditions: Grout shall not be applied if it is raining or snowing, or if rain or snow appears imminent and the area of application is not adequately protected.

C. Mixing Equipment: All equipment used to mix and apply the grout material shall be clean and free from oil, ice or other deleterious substances.

D. Protection: Precautions should be taken to avoid damage to any surface near the work area due to the mixing, handling and application of grout material.

E. Workmanship: Grout shall be applied to the designated areas in a neat and orderly fashion.

3.03 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with contract requirements. The Contractor shall maintain records, available to the Owner and Engineer, regarding quality control measures. Records shall be kept of the location, dimensions and the volume of concrete placed for each pour.

END OF SECTION 03600

DIVISION 4 - MASONRY

04100 MORTAR

04125 MASONRY GROUT

04150 MASONRY ACCESSORIES

04200 UNIT MASONRY

SECTION 04100

MORTAR

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this Section shall be done in accordance with the following sections as well as the general requirements as set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor necessary to provide mortar material for project masonry work.

Masonry grout, masonry accessories and unit masonry are not included in this Section.

C. Related Sections:

1. Section 03300 - Cast-In-Place Concrete
2. Section 04125 - Masonry Grout
3. Section 04150 - Masonry Accessories
4. Section 04200 - Unit Masonry

1.02 REFERENCES

The following are complete titles of references cited in this Section:

1. ASTM Designation C91, "Specification for Masonry Cement"

2. ASTM Designation C144, "Specification for Aggregate for Masonry Mortar"

3. ASTM Designation C150, "Specification for Portland Cement"

4. ASTM Designation C207, "Specification for Hydrated Lime for Masonry Purposes"

5. ASTM Designation C270, "Specification for Mortar for Unit Masonry"

6. ASTM Designation C780, "Specification for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Masonry"

1.03 SUBMITTALS

A. Submit design mix, indicate proportion or property method used and required environmental conditions.

B. Submit field method of measuring volumes of materials to be used for design mix.

C. Submit test reports on mortar indicating conformance to ASTM C270.

D. The Contractor shall submit samples of available colored mortar for use with face brick. Samples shall demonstrate color (hue and tone) and texture. Engineer shall select color to use from these available samples.

1.04 DELIVERY, STORAGE AND HANDLING

The Contractor shall protect mortar materials from the elements and other damage during delivery. Cement and lime shall be stored in watertight enclosures with elevated floors. Sand shall be protected from rainfall.

1.05 SEQUENCING AND SCHEDULING

A. Production of mortar material shall be scheduled to coincide with masonry erection work.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Follow recommended practices set forth in Section 04200 of these Specifications.

1.07 BASIS FOR COMPENSATION

A. Compensation for all work covered by this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Mortar materials shall conform to the following specifications:

Portland Cement:	ASTM C150, Type 1, Gray Color
Hydrated Lime:	ASTM C207, Type S
Sand:	ASTM C144
Water:	Clear, potable and free of deleterious amounts of acid, alkaline and organic materials.
Coloring at Face Brick:	ASTM C979, Pigments for integrally colored, concrete, finely milled (95 to 99% minus 325 mesh) inert, stable to atmospheric conditions, weather resistant, alkali resistant and free of fillers and extenders.

B. General: Mortar for unit masonry shall use only those materials specified in this section of the Specifications. Type M mortar shall be used for all unit masonry mortar below or in contact with ground on this project. Type S or Type M may be used at all other locations. No admixtures, calcium chloride, salts or anti-freeze compounds shall be used, except for acceptable coloring additive.

C. Reinforced Concrete Masonry: Mortar for use in reinforced concrete masonry shall conform to ASTM Designation C270.

D. Mortar for repointing defective mortar joints in unit masonry shall be the same type as originally used to lay up the work.

2.02 TESTING MORTAR

A. Determine the water retentivity and compressive strength of mortar in accordance with the test procedures described in ASTM C91.

B. Mix mortar for testing in the laboratory from representative samples of mortar materials and proportions to be used in the construction.

C. Testing for mortar composition and mortar properties shall conform to ASTM C780.

PART 3: EXECUTION

3.01 APPLICATION

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.

B. Mixing: The Contractor shall accurately measure mortar materials such that the specified proportions are controlled and accurately maintained. Sand, lime and cement shall be mixed dry to a uniform color, with water being added to bring the mortar to proper consistency for use. Workability or consistency of mortar on the board shall be such that mortar is sufficiently wet to be worked under trowel. The mortar shall be mixed for at least 3 minutes after the water is added in a drum-type mechanical mixer. The mixer shall be thoroughly cleaned after discharging each batch. Mixing shall be performed to assure uniform color throughout exterior.

C. Placement: Mortar shall be used within 2 1/2 hours of initial mixing, and mortar not used within this time shall be discarded. Mortar may be retempered by adding water and remixing at any time within 2 hours after initial mixing to restore its workability.

Before any masonry units are laid, the top surface of the concrete foundation or wall shall be cleaned. If the concrete surface is soiled and not clean, at the Engineer's discretion, sandblasting, chipping or scarifying may be required, at the Contractor's expense, to ensure a good bond of the masonry and concrete.

D. Mortar Bedding and Joints: Hollow units shall be laid with full mortar coverage on horizontal and vertical face shells, except that webs shall also be bedded in the starting course on footings and solid foundation walls, and where adjacent to cores to be reinforced and/or filled with grout or concrete. Mortar bedding for the first course of blocks to be grouted shall not fill the area under the block cores; grout shall come into direct contact with the concrete foundation or wall.

Solid units shall be laid with full head and bed joints.

Horizontal and vertical face joints shall be uniform in width and 3/8-inch thick unless otherwise indicated.

Horizontal joints shall be tooled before vertical joints.

All exposed masonry joints shall be compressed with a jointing tool to form a dense, smooth, concave joint. All non-exposed masonry

joints shall be compressed, with the mason's trowel to form a struck joint.

Mortar shall be cleaned from exposed faces immediately and the faces kept free from droppings.

Mortar protrusions extending into cavities or cells to be reinforced and grouted shall be removed.

At cavity walls or cells to be reinforced, mortar shall be spread so that it is back 1/2-inch from the edge or the mortar may be troweled forming a beveled bed to prevent the mortar from protruding or falling into the grout space or cavity.

When patching or pointing must be done after the mortar has hardened, the joint shall be chiseled out to a depth of 1/2-inch, thoroughly wetted, and repointed with fresh mortar.

The method of measuring materials for mortar shall be such that proportions of the materials can be controlled.

3.02 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with contract documents and maintain records of Contractor's quality for all operations including, but not limited to the following:

1. a copy of design mix on-site
2. a copy of method of measuring materials be kept on-site.

END OF SECTION 04100

SECTION 04125

MASONRY GROUT

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this Section shall be done in accordance with the following sections as well as the general requirements as set forth in Division 1 of these Specifications.

B. The work covered under this Section includes providing all materials, labor, and equipment necessary to grout masonry work, including: bond beams, lintels, wall cores with reinforcing, and cavity walls.

Mortar, unit masonry and masonry accessories are not included in this Section.

C. Related Sections:

1. Section 04100 - Mortar
2. Section 04150 - Masonry Accessories
3. Section 04200 - Unit Masonry

1.02 REFERENCES

The following are complete titles of references cited in this Section:

1. ASTM Designation C39, "Specification for Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens"

2. ASTM Designation C94, "Specification for Ready-Mix Concrete"

3. ASTM Designation C143, "Standard Method of Test For Slump of Portland Cement Concrete"

4. ASTM Designation C144, "Specification for Aggregate for Masonry Mortars"

5. ASTM Designation C150, "Specification for Portland Cement"

6. ASTM Designation C404, "Specification for Coarse Aggregate"

7. ASTM Designation C476, "Specification for Grout for Masonry"

8. ASTM Designation C1019, "Specification for Sampling and Testing Grout"

1.03 SUBMITTALS

A. In accordance with Section 01300, the Contractor shall submit manufacturer's data on the materials to be used under this section of the Specifications.

B. Submit design mix, indicating proportions used, required environmental conditions and admixture limitations.

C. For grout batched on-site, submit field method of measuring volumes of materials to be used for the design mix.

1.04 DELIVERY, STORAGE AND HANDLING

The Contractor shall protect grout material not mixed and delivered by a ready-mixed plant from the elements and other damage during construction. Cement shall be stored in a watertight enclosure with an elevated floor. Aggregate shall be protected from rainfall.

1.05 SEQUENCING AND SCHEDULING

A. Sequencing and scheduling of the work included in this Section shall coincide with the related work and adjacent work areas to correspond with required set and cure times of grout material, material surfaces to which grout is applied, and to correspond with the erection schedule of attached and adjacent hardware items.

1.06 ENVIRONMENTAL REQUIREMENTS

A. General: Follow recommended practices set forth in Section 04200 of these Specifications.

1.07 BASIS FOR COMPENSATION

A. Compensation for all work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Masonry grout shall conform to the following specifications:

Portland Cement:	ASTM C150, Type 1, Gray Color
Fine Aggregate:	ASTM C144
Coarse Aggregate:	ASTM C404
Water:	Clear, potable and free of deleterious amounts of acid, alkaline and organic materials

B. General: Grout fill required at all bond beams, lintels and wall locations as shown on the Drawings shall be proportioned according to Table 1 of ASTM C476 for fine grout. If the minimum horizontal dimension of the space to be grouted is 4 inches, coarse grout may be used.

Grout may be mixed and delivered in accordance with the requirements for ready-mix concrete under ASTM C94 or mixed on-site in quantities needed for immediate use in accordance with ASTM C476 for fine grout.

All grout shall be of fluid consistency but only fluid enough to pour or pump without segregation.

C. In no case will mortar be accepted as a substitute for grout, except where indicated on the Contract Drawings.

2.02 TESTING GROUT

A. The consistency of grout shall be measured using a slump test in accordance with ASTM C143.

B. Testing of grout mix shall be done in accordance with ASTM C1019.

C. Compressive strength test shall be performed in a damp condition in accordance with ASTM C39.

D. Performance: Grout shall have a minimum 28-day compressive strength of 2,000 psi with a slump of 7 to 8 inches.

PART 3: EXECUTION

3.01 APPLICATION

A. Surface Preparation: Before grout is placed, all debris, standing water, excess mortar, ice and any loose or deleterious materials shall be removed from the surfaces where grout is to be applied.

B. Environmental Conditions: Grout shall not be applied if it is raining or snowing, or if rain or snow appears imminent and the area of application is not adequately protected.

C. Mixing Equipment: When a batch mixer is used on the job site, all materials should be thoroughly mixed for a minimum of 5 minutes. Grout not placed within 1-1/2 hours after water is first added to the batch shall be discarded. The method of measuring materials for grout shall be such that proportions of the materials can be controlled.

All equipment used to mix and apply the grout material shall be clean and free from oil, ice or other deleterious substances.

D. Protection: Precautions should be taken to avoid damage to any surface near the work area due to the mixing, handling and application of grout material.

E. Workmanship: Grout shall be applied to the designated areas in a neat and orderly fashion, free from voids and spillage, Level Finish, with reinforcement, inserts, and accessories firmly supported during placement.

F. Placement: Grout shall be placed by low lift grouting methods only.

For low lift grouting, the wall shall not be built to a height exceeding 5 feet before grout is pumped or poured into the cores. Grout shall not be dropped through space any distance more than necessary and in no case more than 4 feet. Grout shall be consolidated in accordance with Section 03300 of these Specifications. The level of grout shall be stopped at least ½ inch from the top of masonry at intermediate pours. The steel reinforcing shall project a sufficient height to provide a lap splice as indicated in Section 04150 of these Specifications.

Do not displace reinforcement while placing grout. Spaces containing grout shall be mechanically vibrated or rodded during placement to ensure complete filling of the grout spaces.

Metal lath may be used under bond beams or other blocks to confine the grout to flow in the required cores only.

The grouting of any section of wall shall be completed in one day with no interruptions greater than one hour.

3.02 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section to assure compliance with the Contract Documents and maintain records of Contractor's quality for all operations including, but not limited to, the following:

1. a copy of design mix on-site
2. record of grout pours: locations, dimensions and volume of pours.

END OF SECTION 04125

SECTION 04150

MASONRY ACCESSORIES

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this Section shall be done in accordance with the following sections as well as the general requirements as set forth in Division 1 of these Specifications.

B. The work covered under this Section includes providing all materials, labor and equipment required to provide metal ties, steel reinforcement, control joints, weep holes and plastic flashing for concrete masonry work.

Mortar, grout, and unit masonry are not included in this Section.

C. Related Sections:

1. Section 04100 - Mortar
2. Section 04125 - Masonry Grout
3. Section 04200 - Unit Masonry
4. Section 07900 - Joint Sealers

D. Products Installed But Not Furnished Under This Section:

1. Furnished under Section 05500 - Termination Bar

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. ASTM Designation A82, "Specification for Steel Wire, Plain, for Concrete Reinforcement"

2. ASTM Designation A116, "Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric"

3. ASTM Designation A153, "Specification for Zinc-Coated (Hot Dip) on Iron and Steel Hardware"

4. ASTM Designation A185, "Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement"

5. ASTM Designation A615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"

6. ASTM Designation A616, "Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement"

7. ASTM Designation A617, "Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement"

8. ASTM Designation B227, "Specification for Hard-Drawn Copper-Clad Steel Wire"

1.03 SUBMITTALS

A. No submittals are necessary for materials and supplies covered under this Section which comply with the applicable specifications.

1.04 DELIVERY, STORAGE AND HANDLING

Steel reinforcing and metal ties shall be stored above the surface of the ground on platforms, skids or other supports, and shall be reasonably protected from injury and surface deterioration caused by exposure to conditions producing rust. When placed in the Work, reinforcement shall be free of injurious seams, flaws, cracks, scale, rust or other foreign materials.

1.05 SEQUENCING AND SCHEDULING

A. Installation of masonry accessories shall be scheduled to coincide with masonry erection work.

1.06 BASIS FOR COMPENSATION

A. Compensation for all work covered under this section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Metal Ties: Metal ties and anchors shall be made of material having a minimum tensile stress of 30,000 psi.

Wire which serves as lateral ties in multi-wythe masonry walls shall be of corrosion-resistant metal (ASTM A82) or shall be coated with a

corrosion-resistant metal, such as copper, zinc, or other metal having equivalent or better corrosion-resistant qualities. Coatings for multi-wythe reinforcement shall meet or exceed the coatings listed for single wythe reinforcement listed later in this Section.

Lateral metal ties shall not be less than No. 9 gage thickness, or be crimped. They shall be adjustable and part of a prefabricated joint reinforcement which includes lateral and longitudinal ties. Only ladder or truss type joint reinforcement, with ties spaced at 16 inches o.c., will be allowed. Ties shall not restrain transverse movement of the two wythes. Furnished joint material shall be AA wire product AA525 or AA625 or an approved equal.

Continuous ladder or truss type joint reinforcement shall be used for single wythe construction. Furnished joint material shall be AA wire product AA500 or AA600 or an approved equal. Material shall be coated by one of the following:

1. Zinc coatings on iron or steel shall conform to Class B-1, B-2, or B-3 of ASTM A153-73.
2. Zinc coating on wire shall conform to Class 2 or Class 3 of ASTM A116-73.
3. Copper-coated wire shall conform to Grade 30HS of ASTM B227-70(76).

Dovetail anchor slots shall be AA wire product AA100 or an approved equal.

Dovetail anchors shall be AA wire product AA200 (3/16-inch wire tie, galvanized) or an approved equal.

Adjustable ties shall be AA wire product AA302 or an approved equal.

B. Steel Reinforcing Bars: Reinforcement shall conform to the following applicable standards: ASTM A82-76; ASTM A185-73; ASTM A615-76A; ASTM A616-76; ASTM A617-76.

C. Control Joint: Control joints shall be of the type indicated on the Drawings and shall be sealed with a material which meets the specifications under Section 07900 and matches the color of the concrete mortar.

1. Concrete masonry unit control joints shall consist of either a control block unit or a Michigan type control joint as shown on the Drawings, using 30-pound asphalt saturated felt building paper.

2. Brick face veneer shall have a control joint consisting of a backing rod and waterproof seal as shown on the Drawing with material properties as specified under Section 07900.

3. Provide horizontal slip plane, on at least one end of the lintel or both ends of lintel if indicated on drawings, where reinforced lintel beam terminates at a control joint. Plastic flashing or bituminous sheets may be used for a slip plane.

4. All bond beams shall be continuous across control joints, a dummy groove shall be provided to control location of anticipated crack.

D. Weep Holes: Weep holes shall consist of 3/8-inch diameter nylon rope or sash cord which can be left in place to act as a wick.

E. Plastic Flashing: 30 mil thick where not exposed, 62 mil where detail exposes part or all of flashing; B.F. Goodrich vinyl water barrier, "Nevastral" or "Nu-Flex" by Sandell Mfg. Co. Use for through wall flashing applications, and elsewhere where flashing is built into concealed masonry.

F. Metal Tie Bars: Corrosion resistant rigid steel anchors shall have a minimum section of 1½ inches by ½ inch by 30 inches with 3-inch right angle bends at each end.

PART 3: EXECUTION

3.01 ERECTION

A. General: All reinforcement shall be accurately cut to length and bent by such methods as will prevent injury to the material. All kinks or bends in the bars caused by handling incident to delivery shall be straightened out without injury to the material before placing it in the masonry. Wall ties connecting the facing veneer wythe with the backup wythe shall consist of prefabricated joint reinforcement.

B. Metal Ties in Cavity Wall and Single Wythe Construction:

1. Prefabricated joint reinforcement shall be placed in horizontal mortar joints so that longitudinal wires are located over face-shell mortar beds and are fully embedded in mortar for their entire length with minimum mortar cover of 5/8 inch on exterior side of walls and 1/2 inch at other locations. Reinforcement shall not be continuous through a control joint. Vertical

spacing of the reinforcement shall not exceed 16 inches. Ties in alternate courses must be staggered. Reinforcement shall be lapped 6 inches or more. Factory fabricated sections shall be installed at all corners.

For cavity wall construction, there shall be one cross wire serving as a tie for not more than each 2 square feet of wall area. Additional ties shall be provided at all openings as indicated on the Drawings.

Dovetail anchor slots shall be embedded horizontally at 16 inches o.c. in concrete retaining walls and where shown on Drawings for precast members. Dovetail anchors shall be attached at 16 inches c.c. vertically.

C. Steel Reinforcing Bars: Position reinforcement bars accurately at locations shown on the Drawings. Support and secure vertical and horizontal bars against displacement prior to grouting by wire positioners or other suitable devices at intervals not exceeding 200 bar diameters nor 10 feet. Provide required cover and bar lap as indicated in these Specifications.

Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall provide sufficient lap to transfer the working stress of the reinforcement by bond and shear. Minimum lap shall be 48 bar diameters, but not less than 24 inches. If welded or mechanical connections are used, they shall develop the strength of the reinforcement.

Place reinforcement bars prior to grouting.

Completely grout cells containing vertical or horizontal reinforcement bars or dowels in accordance with Section 04125 of these Specifications.

Tolerances for the placement of steel bars in walls and flexural elements shall be, plus or minus 1/2 inch for "d" equal to 8 inches or less, plus or minutes 1 inch for "d" equal to 24 inches or less but greater than 8 inches, and plus or minus 1-1/4 inches for "d" greater than 24 inches. Where "d" is equal to the distance from the top of the grouted masonry beam or face of masonry unit to the center of the steel.

Tolerance for longitudinal location of reinforcement shall be plus or minus 2 inches.

D. Protection for Reinforcement: All bars and joint reinforcing shall be completely embedded in mortar or grout. All reinforcement shall have a coverage of masonry not less than the following:

3 inch for bottom of footings.

2 inch on vertical members where masonry is exposed to action of weather or soil for bars larger than 5/8 inch and 1-1/2 inches for bars 5/8 inch or less.

3/4 inch from the faces of all walls not exposed to action of weather or soil.

1-bar diameter over all bars, but not less than 3/4 inch at the upper faces on any member, except where exposed to weather or soil in which cases the minimum coverage shall be 2 inches or 3 inches, respectively.

Reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have not less than 5/8 inch mortar coverage at exposed face of wall.

The thickness of grout or mortar between masonry units and reinforcement shall be not less than 1/4 inch and No. 6 gage or smaller wires may be laid in 3/8 inch horizontal joints.

E. Control Joints: Control joints shall not be through bond beams, unless indicated on Drawings. Control joints shall be raked out 3/4 inch and left ready for sealing.

F. Weep Holes: Weep holes shall be placed in a head joint of the outer wythe immediately above the flashing and spaced 16 inches on center with rope or sash cord extending out 1/2-inch beyond the exterior face.

G. Plastic Flashing: Extend flexible flashing 1/2-inch beyond outside of shelf angle or masonry veneer wythe to from a drip. Flashing shall be cut leaving an exposed uniform line of flashing.

Where flashing is to be continuous, all lapped joints at the end of sections must be thoroughly sealed with the proper adhesive per manufacturer's recommendation. At heads of masonry openings, carry head flashing at least 6 inches beyond ends of shelf angle and turn up ends 4 inches minimum to form an end-dam at the masonry head joint, with corners folded, not cut.

Penetration of the flashing, either unintentionally or to accommodate a shelf angle bolt, nut, or metal tie, shall be resealed per manufacturer's recommendation, to prevent water passage.

Flashing shall be attached to masonry with an aluminum termination bar as covered in Section 07135.

H. Steel Anchor Bars: Steel anchors shall be provided at 4-foot o.c. vertically at wall intersections.

3.02 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work covered under this section of the Specifications to assure compliance with Contract documents and maintain records of Contractor's quality for all operations.

END OF SECTION 04150

SECTION 04200

UNIT MASONRY

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this Section shall be done in accordance with the following sections as well as the general requirements as set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, labor and equipment necessary to install the unit masonry and the cavity wall masonry system for the project as shown on the Contract Drawings.

Mortar, grout, and masonry accessories are not included in this Section.

C. Related Sections:

1. Section 03410 - Structural Precast Concrete: Anchors
2. Section 04100 - Mortar
3. Section 04125 - Masonry Grout
4. Section 04150 - Masonry Accessories
5. Section 05500 - Steel and Iron Fabrication: Anchor Bolts and Shelf Angles for Masonry
6. Section 06100 - Rough Carpentry
7. Section 07212 - Board Insulation: Insulation for Cavity System
8. Section 07900 - Joint Sealers

D. Products installed but not furnished under this Section:

1. Furnished under Section 05550 - Anchor Bolts
2. Furnished under Section 07212 - Board Insulation

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. ASTM Designation C33, "Specifications for Concrete Aggregate"

2. ASTM Designation C90, "Specification for Hollow Load Bearing Concrete Units"

3. ASTM Designation C140, "Specification for Sampling and Testing Concrete Masonry Units"

4. ASTM Designation C216, "Facing Brick (Solid Masonry Units Made from Clay or Shale)"

5. ASTM Designation E447-84, "Compressive Strength of Masonry Prisms"

6. U.B.C., Uniform Building Code 1988 Edition, Standard No. 24-7 and Chapter 24 "Masonry"

7. OSHA U.S. Occupational Safety and Health Administration, Section 1926.700(a)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300:

1. Product Data: Manufacturer's specifications and product information for each type of concrete masonry and brick veneer unit proposed, prior to start of masonry work. Include manufacturer's test data indicating the net area compressive strength of concrete masonry units as determined in accordance with U.B.C. Standard No. 24-7.

1.04 DELIVERY, STORAGE AND HANDLING

Concrete masonry units and clay brick shall be protected against the elements, wetting and other damage prior to use. Concrete block and clay brick shall be stockpiled on supports free from contact with the ground and covered with a waterproof covering. Masonry units shall be free from soil, ice and frost when laid in the wall.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Follow recommended practice set forth by the U.B.C. Section 2404, Part C, "Cold Weather Construction".

1.06 BASIS FOR COMPENSATION

A. Compensation for all work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Concrete Block: Concrete block shall be of the size shown on the Contract Drawings and be normal weight, with sand and gravel aggregate, conforming to the latest ASTM Designation C33. Hollow concrete block shall conform to the latest ASTM Designation C90, Grade N (exposed to moisture penetration or weather), Type 1 (moisture controlled units). The specified compressive strength of masonry f'm shall be greater or equal than 1,750 psi as interpolated from Table No. 24-C of the U.B.C.

Each unit shall be produced by the same manufacturer and shall be of uniform size, shape, color and texture for each continuous area and visually related areas. Do not utilize irregular, unsound or broken units.

Size: Manufacturer's standard units with nominal face dimensions of 16 inches long x 8 inches high (15-5/8 inches by 7-5/8 inches actual), with a nominal width as indicated on the Drawings.

Special Shapes: Provide where indicated and where required for bond beams, lintels, corners, jambs, control joints, and other special conditions. Utilize corner blocks and other standard shapes as necessary so that walls will be smooth and free of voids and depressions. Where horizontally reinforced masonry beams, bond beams and lintels are indicated on Drawings, provide special formed U-shaped masonry units or knock-out bond beams as required. Units shall provide for reinforcement at the indicated locations and continuous grout fill of indicated depth.

Curing: Cure units in an autoclave at normal pressure and temperature.

Weight Classification: Normal weight units unless otherwise indicated, oven dry weight of concrete of 125 pounds per cubic foot or more.

B. Face Brick: Clay brick shall conform to the latest ASTM Designation C216, Grade SW, Type FBX. Color shall be golden rose, with antique texture, as manufactured by Sioux City Brick and Tile Company.

Size: Manufacturer's standard units shall be modular. Special units and solid units shall have nominal face dimensions of 8 inches long by 8 inches high by 3-3/4 inches wide.

C. Mortar - See Section 04100

D. Grout - See Section 04125

E. Masonry Accessories - See Section 04150

PART 3: EXECUTION

3.01 ERECTION

A. General: Concrete masonry units and clay brick shall be dry when laid. All masonry shall be laid in running bond unless otherwise indicated on the Drawings. Each unit shall be adjusted to final position in the wall while mortar is still soft and plastic. Any unit disturbed after mortar has stiffened shall be removed and relaid with fresh mortar. Vertical cells to be filled with grout shall be aligned to provide a continuous unobstructed opening of the dimensions shown. Chases shall be built in and not cut in. Chases shall be plumb and shall be minimum one-unit length from jambs of openings. Anchor bolts, weep holes, accessories and other items to be built-in shall be installed as the masonry work progresses.

Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and properly located openings, movement-type joints, returns and offsets. Do not use units of less-than-half-size unit length except as may be required at wall corners and openings provided the masonry unit coursing was accurately installed.

Cut units as required to provide pattern indicated on Drawings and to fit adjoining work neatly. Utilize full units without cutting wherever possible. Cut masonry units with saw designed to cut masonry to provide clean, sharp, unchipped edges.

In exposed work, do not utilize masonry units with chips, cracks, voids, discolorations, or other defects which may be visible or cause staining in the finished work.

Masonry bond beams shall be supported by shoring or an adequate bracing system for a minimum of 7 days after grouting.

Do not remove forms and shores until reinforced masonry members have cured sufficiently to carry their own weight and other loads that may be placed on them during construction.

Wall Intersections: Steel tie bar shall be placed in accordance with Section 04150 of these Specifications; or joint reinforcement, strips of metal lath, or 1/4-inch mesh galvanized hardware cloth shall be placed across the joint between the two walls in alternating courses. The appropriate cores shall be filled with mortar or grout to embed the tie bar or selected reinforcement type. Metal lath may be placed under the cores to support the filling.

Stopping and Resuming Work: Rake back 1/2 masonry unit length in each course. Clean exposed surfaces of set masonry and remove loose masonry units and mortar prior to laying fresh masonry.

B. Mortar: See Section 04100

C. Masonry Grout: See Section 04125

D. Tolerances for Concrete Masonry Construction Based on Actual Dimensions:

Variation from the Plumb:

1. In the lines and surfaces of columns, walls and arises: in 10 feet - 1/4 inch; in any story or 20 feet maximum - 3/8 inch, in 40 feet or more - 1/2 inch.

2. For external corners, control joints and other conspicuous lines: in any story or 20 feet maximum - 1/4 inch; in 40 feet or more -1/2 inch.

Variation from the Level or the Grades Indicated on the Drawings:

1. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: in any bay or 20 feet maximum - 1/4 inch; in 40 feet or more - 1/2 inch.

Variation of the Linear Building Lines from Established Position in Plan and Related Portion of Columns, Walls and Partitions:

1. In any bay or 20 feet maximum - 1/2 inch; in 40 feet or more - 3/4 inch.

Variation in Cross-Sectional Dimensions of Columns and in the Thickness of Walls:

1. Minus 1/4 inch; plus 1/2 inch.

E. Anchorage: Precast planks (Section 03410), steel shelf angles (Section 05500), and wood nailers (Section 06100) shall be anchored to the concrete masonry walls as shown on the Contract Drawings.

Anchor bolts embedded in masonry shall be located as indicated on the Drawings and meet the requirements of Section 05500. Masonry blocks which require anchor bolts to pass through face shells shall be field drilled to the corresponding bolt diameter plus 1/8-inch. Rigid templates shall be used to hold the anchor bolts at the required spacing and location shown on the Contract Drawings during grouting. Templates shall be in place and rigidly attached prior to the grout pour. Expansion anchors shall not be used in any masonry.

F. Protection of Masonry: When rain or snow is imminent and work is discontinued, the tops of exposed masonry walls shall be covered with a well secured, nonstaining, waterproof cover. Extend membrane at least 2 feet down both sides of wall and anchor securely in place. Contractor shall be responsible for following applicable OSHA standards for providing temporary shoring and bracing for masonry walls until the designed lateral strength is reached, to prevent collapse due to wind or other force. Where necessary, foundation walls shall be temporarily braced to prevent damage from backfilling operations.

G. Embedments and Accessories: All anchors, ties, steel reinforcement, anchor bolts, metal frames and other similar items shall be installed as the work progresses. Door frames shall be filled solidly with mortar as the laying of block progresses. The Contractor shall place sealant around all door frames and where noted on the Contract Drawings according to Section 07900 of these Specifications.

H. Reinforcing Bars: See Section 04150

I. Building Insulation: At cavity wall locations, board insulation meeting the requirements of Section 07210 shall be firmly attached, according to Section 07210, to the masonry backup wall as shown on the Contract Drawings.

J. Built-In Work: As work progresses, built-in items indicated on the Drawings and items in this and other sections of Contract Documents.

Cut units as required to build in conduits, switch boxes, grounds, anchors, nailing strips, plumbing fixtures, mechanical and electrical systems, pipes, brackets, and accessories. Form chases, slots, cut outs, and patch masonry work as required by other trades. Set bucks, blocking and anchoring as required for accurate installation.

Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core to fill voids.

Fill space between hollow metal frames and masonry solidly with mortar.

Fill cores with grout three (3) courses, or 24 inches, under bearing plates, beams, lintels, posts, and similar conditions unless otherwise indicated on Drawings.

K. Finish: At completion of the Work, the Contractor shall point all holes and defective mortar joints where necessary as covered in Section 04100 of these Specifications.

Thoroughly clean exposed masonry. Before applying any cleaning agent to entire wall, apply to sample wall area of approximately 20 s.f. in approved location. Do not proceed with cleaning work until sample area is approved. Use approved cleaning material, method on remaining wall area.

If stiff brushes, water do not suffice clean the surface on which no green efflorescence appears with Sure-Klean Vana-Trol as manufactured by Pro So Co., Inc.

Remove "problem" stains as follows with the as specified formulations of Pro So Co., Inc.:

1. Green Efflorescence - "No. 800 Stain Remover."
2. Tar, Asphalt - "Asphalt and Tar Remover."
3. Ferrous Stains - "Ferrous Stain Remover."
4. Do not use acid solutions for cleaning masonry units unless specifically approved by Architect.
5. Clean off loose mortar, remove stains from concrete masonry units.

3.02 FIELD QUALITY CONTROL

A. Masonry Testing: If requested by the Owner, the Contractor shall build, at the Contractor's expense, three sets of prisms, in accordance with ASTM E447-84, Part 5, Test Specimen, to be tested in a laboratory at the Owner's expense. The prisms shall be constructed during construction of the masonry work. The prisms shall be cured for 28 days and tested in accordance with the latest ASTM Designation C140. The compressive strength as calculated by dividing the test load by the net cross sectional area of the prism shall be at least 1,750 psi.

B. The Contractor shall establish and maintain quality control for work covered under this Section to assure compliance with the Contract Documents and maintain records of Contractor's quality for all operations including, but not limited to, the following:

1. records of the location, dimensions and the quantity of block placed.

END OF SECTION 04200

DIVISION 5 - METALS

05120 STRUCTURAL STEEL

05500 METAL FABRICATIONS

05550 METAL STAIRS, HANDRAILS, RAILINGS, GRATING, AND FLOOR PLATES

SECTION 05120

STRUCTURAL STEEL

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this section shall be done in accordance with the following sections as well as the general requirements as set forth in Division 1.

B. Work covered under this section includes all materials, equipment, and labor for the structural steel framing, anchor bolts, base plates, bearing plates, structural frame accessories, embedded channels and plates, shelf angles, and other miscellaneous steel components shown in the Contract Drawings, but not including the steel piping.

C. Related Sections

1. Section 03300 - Cast-in-Place Concrete
2. Section 03600 - Grout
3. Section 04200 - Unit Masonry
4. Section 05500 - Metal Fabrication
5. Section 05550 - Metal Stairs, Handrails, Railings, Grating, and Floor Plates
6. Section 09800 - Special Coating

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. American Society for Testing and Materials (ASTM) A36, "Specification for Structural Steel"

2. ASTM A108, "Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality"

3. ASTM A123, "Specification for Zinc (Hot Dipped Galvanized) Coating on Iron and Steel Products"

4. ASTM A153, "Specification for Zinc Coating (Hop Dip) on Iron and Steel Hardware"

5. ASTM A240, "Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels"

6. ASTM A307, "Specification for Carbon Steel Externally Threaded Standard Fasteners"

7. ASTM A325, "Specification for High Strength Bolts for Structural Steel Joints"

8. ASTM A500, "Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes"

9. ASTM A501, "Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing"

10. ASTM A525, "Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process"

11. American Welding Society (AWS) A2.0, "Standard Welding Symbols"

12. AWS D1.1, "Structural Welding Code - Steel"

13. American Institute of Steel Construction (AISC), "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings"

14. AISC, "Specification for Architectural Exposed Structural Steel"

15. Military Specifications MIL-P-21035, "Specification for Paint, High Zinc Dust Content Galvanizing Repair"

16. Military Specification MIL-C-18480, "Specification for Coating Compounds, Bituminous, Solvent, Coal-Tar Base"

17. Federal Specification TT-P-645, "Specification for Primer, Paint, Zinc-Chromate, Alkyd Type"

18. Federal Specification TT-P-320, "Specification for Pigment, Aluminum: Powder and Paste for Paint"

19. Federal Specification TT-V-119, "Specification for Varnish, Spar, Phenolic Resin"

1.03 SUBMITTALS

A. Shop Drawings: Shop drawings are not required for submittal if in accordance with the Contract Drawings and Specifications.

B. Manufacturer's Mill Certificate: The certification of the structural steel shall meet or exceed the specified requirements.

C. Welder's Certificates: Submit Manufacturer's Certificates have met welders employed on the Work, verifying AWS qualifications within the previous 12 months.

1.04 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC, "Specification for Design, Fabrication, and Erection of Structural Steel for Buildings".

B. Perform Work in accordance with AISC, "Specification for Architectural Exposed Structural Steel".

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to the Project site and fully identified with name, brand, type and grade.

B. Care shall be utilized throughout the delivery, storage, and handling so as to not scratch, bend, warp or otherwise damage components.

C. Metal cords, cable or straps likely to damage the galvanized or painted coating shall not be used.

D. All components shall be stored above ground on level timbers or other materials in a dry ventilated space and protected from rusting and other damage.

1.06 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Structural Steel Shapes and Plates: All steel shapes and plates shall be the size and shape shown on the Contract Drawings, shall conform to the latest ASTM Designation A36. Pipe supports shall be painted as set forth in Section 09800. Other components not designated as painted shall be dipped galvanized.

B. Bolts: All bolts shall be the size and shape shown on the Contract Drawings and shall meet or exceed the latest ASTM Designation A325, except as specified on the Contract Drawings, and shall be hot dipped galvanized.

C. Anchor Bolts and Threaded Rods: All anchor bolts and threaded rods shall be the size and shape shown on the Contract Drawings and shall meet or exceed the latest ASTM Designation A304 and shall not be hot dipped galvanized.

D. Nuts: Nuts shall conform to the latest ASTM Designation A563, heavy hex, Grade C and shall be hot dipped galvanized.

E. Washers: Washers shall conform to the latest ASTM Designation F436, plain and shall be hot dipped galvanized.

2.02 FABRICATION

A. General: All structural steel shall be fabricated in accordance with the Contract Drawings, Shop Drawings and in a neat workmanship manner.

B. Structural Steel: All structural steel components shall be fabricated and erected in accordance with the applicable requirements set forth by the American Institute of Steel Construction (AISC) publications "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", Section 1.23 entitled "Fabrication", and "Code of Standard Practice for Steel Buildings and Bridges", Section 6 entitled "Fabrication and Delivery".

All members shall be straight with no bends or kinks. Steel shall be accurately cut with shears, mechanically guided torches capable of forming smooth cut or hand guided torches. Hand guided cuts or other rough surfaces which are exposed or visible shall be ground smooth. All exposed sharp edges and corners shall be machine filleted or chamfered. All bolt holes shall be accurately located, orientated

normal to the bolting surfaces and drilled to the diameters indicated on the Drawings.

C. Stainless Steel: All stainless steel components shall be fabricated and erected in accordance with applicable requirements set forth by the American Iron and Steel Institute (AISI) publication "Stainless and Heat Resisting Steels".

D. Welds: All welds for the structural components shall conform to the applicable standard specifications set forth by the American Welding Society (AWS) publication "Structural Welding". All welds shall be of the type and size shown on the Contract Drawings or on approved Shop Drawings. If no type and size is shown, Contractor shall determine the weld appropriate in accordance with AWS.

E. Bolted Connections: All bolted connections shall be tightened to produce a snug fit where no daylight shall be seen between connected members.

F. Galvanized Coating: Base plates, bolts, rods, nuts, washers, shelf angles and plates not stainless or scheduled for painting shall be hot dipped galvanized as set forth in ASTM A123 after cut and fabricated.

G. Protection of Aluminum: Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of bituminous paint conforming to Mil. Spec. MIL-C-18480 or a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. The zinc-chromate primer shall conform to Fed. Spec. TT-P-645. The aluminum paint shall consist of an aluminum paste conforming to Fed. Spec. TT-P-320, spar varnish conforming to Fed. Spec. TT-V-119 and thinner compatible with the varnish. The aluminum paint shall be field mixed in proportion of 2 pounds of paste, not more than 1 gallon of spar varnish and not more than 1 pint of thinner.

H. Damage caused to galvanized surfaces by transport, erection, welding, or other operations shall be field repaired using an Engineer approved cold galvanizing process.

I. Quality Control:

1. The manufacturer or fabricator shall maintain a documented quality control program. The quality control program shall

conform to the AISC Specifications and Code of Standard Practice.

2. Welders shall conform to the requirements set forth in AWS 01.1 Section 5 for the work performed. All welds shall be inspected in accordance with AWS D1.1 Section 6. All welds shall be visibly inspected and measured.

3. The Owner may perform additional non-destructive testing of the welded joints. If the welds have crack, lack of fusion, entrapped slag or welding rod, excess porosity or other detrimental defects, the Contractor shall pay for the testing which indicates the defect and shall correct the deficiency at no cost to the Owner.

PART 3: EXECUTION

3.01 ERECTION

A. General: All steel components shall be erected in a neat workmanship like manner. All components shall be plumb, horizontal at the designated slope and square as appropriate. Do not field cut or alter structural members without approval of Engineer.

B. Structural Steel: Structural steel shall be erected in accordance with the AISC Specifications Section 1.25 entitled "Erection", the Code of Standard Practice Section 7 entitled "Erection" and Commentaries. This includes the tolerance requirements.

C. Field Connections: All field connections shall be performed in a neat workmanship like manner. Applicable welding and bolted connection requirements set forth in Part 2 of this Section for fabrication shall also pertain to the erection.

D. Anchor Bolts: Anchor bolts shall be accurately placed and embedded in the concrete or grouted masonry unit when plastic. Templates shall be utilized to match bolt holes spacing for the final components. Placement of anchor bolts in masonry shall also follow the requirements of Section 04200. Grout under base plates shall be in accordance with Section 03600.

3.02 TOUCH UP

A. Welds shall be painted with one coat of galvanizing repair paint, Military Spec. MIL-P-21035 (ships).

3.03 FIELD CONTROL QUALITY

The Contractor shall establish and maintain quality control for work under this Section to assure compliance with Contract requirements and maintain records of his quality control for all construction operations. In addition, the Contractor shall coordinate, verify and check the precast concrete, cast-in-place concrete and other operations which directly affect placement of the steel and iron components. A copy of records of inspections and tests, as well as records of corrective actions shall be provided if requested by Engineer or Owner.

END OF SECTION 05120

SECTION 05500

METAL FABRICATIONS

PART 1: GENERAL

1.01 DESCRIPTION

A. All works included in this section shall be done in accordance with the following sections, as well as the general requirements as set forth in Division 1.

B. The Contractor shall fabricate, furnish and install the metal components in accordance with the dimension and details shown in the Contract Drawings and as set forth in these Specifications.

The miscellaneous metal components includes the following:

- steel pipe supports
- embedded channels and plates
- steel columns, beams, and headers
- stainless steel sump plate
- steel base plates and column caps
- anchor bolts
- expansion anchors
- cast iron floor grating and frame
- manhole covers and frames
- instrument panel enclosure
- other miscellaneous steel and cast iron
- termination bar

C. Related Sections:

1. Section 04150 - Masonry Accessories
2. Section 04200 - Unit Masonry
3. Section 05120 - Aluminum Fabrications
4. Section 05550 - Metal Stairs, Handrails, Railings, Gratings, and Floor Plates
5. Section 09800 - Special Coatings and Painting

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. American Society for Testing and Materials (ASTM) A36, "Specification for Structural Steel"

2. ASTM A123, "Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products"

3. ASTM A194, "Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service"

4. ASTM A240, "Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels"

5. ASTM A307, "Specification for Carbon Steel Externally Threaded Standard Fasteners"

6. ASTM A325, "Specification for High-Strength Bolts for Structural Steel Joints"

7. ASTM A500, "Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"

8. ASTM A563, "Specification for Carbon and Alloy Steel Nuts"

9. ASTM B241, "Specifications for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube"

10. ASTM F436, "Specification for Hardened Steel Washers"

11. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings"

12. AISC "Code of Standard Practice for Steel Buildings and Bridges"

13. American Welding Society (AWS) publication "Structural Welding"

14. "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Structural Connections of Engineering Foundations, August 14, 1980 and endorsed by the AISC and the Industrial Fastener Institute.

15. American Iron and Steel Institute (AISI), "Steel Products Manual, Stainless and Heat Resisting Steels", December, 1974

16. Military Specification MIL-C-18480, "Specification for Coating Compounds, Bituminous, Solvent, Coal-Tar Base"

17. Federal Specification TT-P-645, "Specification for Primer, Paint, Zinc-Chromate, Alkyd Type"

18. Federal Specification TT-P-320, "Specification for Pigment, Aluminum: Powder and Paste for Paint"

19. Federal Specification TT-V-119, "Specification for Varnish, Spar, Phenolic Resin"

1.03 SUBMITTALS

A. Shop Drawings: Shop Drawings are not required for submittal if in accordance with the Contract Drawings and Specifications.

B. Certification of Compliance: Certificates of compliance for materials set forth shall be provided.

1.04 BASIS FOR COMPENSATION

Compensation for all Work covered by this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Structural Steel Shapes and Plates: All steel shapes and plates shall be the size and shape shown on the Contract Drawings, shall conform to the latest ASTM Designation A36. Steel stairs, ladders and platforms, and steel pipe supports shall be painted as set forth in Section 09800. Other components not designated as painted shall be hot dipped galvanized.

B. Structural Tubes: All structural steel tubes shall be the size and shape shown on the Contract Drawings and shall conform to the latest ASTM Designation A500, Grade B and shall be hot dipped galvanized.

C. Stainless Steel and Threaded Rods: All stainless steel and threaded rods shall be the size and shape shown on the Contract Drawings and shall conform to latest ASTM Designation A240 Type 304.

D. Bolts: All bolts shall be the size and shape shown on the Contract Drawings and shall conform to the latest ASTM Designation A325, except as otherwise specified on the Contract Drawings, and shall be hot dipped galvanized.

E. Rods and Studs: All nonheaded rods and studs shall conform to the latest ASTM Designation A687, except as otherwise specified on the Contract Drawings, and shall be hot dipped galvanized.

F. Nuts: Nuts shall conform to the latest ASTM Designation A563, heavy hex, Grade C and shall be hot dipped galvanized.

G. Washers: Washers shall conform to the latest ASTM Designation F436, plain and shall be hot dipped galvanized.

H. Stainless Steel Bolts: All stainless steel bolts shall be the size and shape shown on the Contract Drawings and shall conform to the latest ASTM Designation A194.

I. Stainless Steel Nuts: All stainless steel nuts shall conform to the latest ASTM Designation A194.

J. Cast Iron Grating and Frame: Cast iron grating shall be No. R-4990-HX, Type A with standard frame as manufactured by Neenah Foundry Co. or equal.

K. Manhole Covers and Frames: Manhole cover with support frame of 4 feet by 4 feet manhole shall be Neenah R-6665-2TH or equal. Manhole cover with support frame for 2-foot 6-inch by 3-foot 6-inch manhole shall be Neenah R-6665-1UH with flathead head bolts or equal.

L. Expansion Anchors: Expansion anchors shall be of size and type indicated on Drawings as manufactured by HILTI or approved equal.

M. Unistrut members, fittings and fasteners shall be as manufactured by Unistrut Corporation or approved equal. All members shall be hot dipped galvanized. The following component parts shall be utilized:

Unistrut Designation	Member (see drawing, P.17)
P1000	Base channel, interior horizontal and side
P1026	Interior angle brackets
P1873	Perimeter angle bracket
P2452	Leg bracket
P3301	Interior vertical
P5500	Top and bottom

2.02 FABRICATION

A. General: All structural and architectural metal shall be fabricated in accordance with the Contract Drawings, Shop Drawings and in a neat workmanship manner.

B. Structural Steel: See Section 05120.

C. Stainless Steel: All stainless steel components shall be fabricated and erected in accordance with applicable requirements set forth by the American Iron and Steel Institute (AISI) publication "Stainless and Heat Resisting Steels".

D. Welds: All welds for the structural components shall conform to the applicable standard specifications set forth by the American Welding Society (AWS) publication "Structural Welding". All welds shall be of the type and size shown on the Contract Drawings and the Shop Drawings Submitted.

E. Bolted Connections: All bolted connections shall conform to the requirements set forth in the document entitled "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" except as otherwise specified on the Contract Drawings. The surface condition of the connecting parts which will be inaccessible for painting shall be Class F, G or H (blast cleaned with inorganic zinc rich paint, metallized with zinc or metallized with aluminum). Where two structural steel components are bolted together, oversized holes conforming to the specifications may be utilized.

F. Galvanized Coating: The hanger supports, columns and headers, base plates and column caps, bolts, rods, studs, nuts, washers, Unistrut members, and other miscellaneous angles and plates not stainless or scheduled for painting shall be hot dipped galvanized as set forth in ASTM A123 after cut and fabricated.

G. Instrument Panel Enclosure: The control stand instrument panel enclosure shall be constructed of 12 gage stainless steel with a No. 4 finish as set forth in the American Iron and Steel Institute

publication, "Stainless and Heat Resisting Steel". All bends shall have a minimum radius of twice the material thickness. All welds shall be continuous, ground smooth and brushed to match the surface finish. All cut edges shall be cut straight. All burrs and sharp edges shall be removed. Nameplates shall be of the laminated black and white composite type with black face and with engraving extending into the white to give white letters on a black background. Nameplates shall be fastened with stainless steel screws. The use of adhesives is not acceptable.

H. Damage caused to galvanized surfaces by transport, erection, welding, or other operations shall be field repaired using an Engineer approved cold galvanizing process.

I. Quality Control:

1. The manufacturer or fabricator shall maintain a documented quality control program. The quality control program shall conform to the AISC Specifications and Code of Standard Practice.

2. Welders shall conform to the requirements set forth in AWS 01.1 Section 5 for the work performed. All welds shall be inspected in accordance with AWS D1.1 Section 6. All welds shall be visibly inspected and measured.

3. The Owner may perform additional non-destructive testing of the welded joints. If the welds have crack, lack of fusion, entrapped slag or welding rod, excess porosity or other detrimental defects, the Contractor shall pay for the testing which indicates the defect and shall correct the deficiency at no cost to the Owner.

PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Care shall be utilized throughout the delivery, storage and handling so as to not scratch, bend, warp or otherwise damage the components.

B. Metal chords, cable or straps likely to damage the galvanized or painted coating shall not be used.

C. All components shall be stored above ground on level timbers or other materials.

3.02 ERECTION

A. General: All metal components shall be erected in a neat workmanship like manner. All components shall be plumb, horizontal at the designated slope and square as appropriate.

B. Structural Steel: Structural steel shall be erected in accordance with the AISC Specifications Section 1.25 entitled "Erection", the Code of Standard Practice Section 7 entitled "Erection" and Commentaries. This includes the tolerance requirements.

C. Field Connections: All field connections shall be performed in a neat workmanship like manner. Applicable welding and bolted connection requirements set forth in Part 2 of this section for fabrication shall also pertain to the erection.

D. Anchor Bolts: Anchor bolts shall be accurately placed and embedded in the concrete when plastic. Templates shall be utilized to match bolt holes spacing for the final components. Placement of anchor bolts in masonry shall also follow the requirements of Section 04200. Grout under base plates shall be in accordance with Section 03600.

E. Cast Iron Grate, Manhole Covers, and Their Frames: The cast iron frames shall be accurately placed during the concrete placement to match the finished concrete surface and the grate width or cover size. Installation shall be performed in accordance with manufacturer's recommendations.

3.03 FIELD CONTROL QUALITY

The Contractor shall establish and maintain quality control for work under this Section to assure compliance with contract requirements and maintain records of his quality control for all construction operations. In addition, the Contractor shall coordinate, verify and check the precast concrete, cast-in-place concrete and other operations which directly affect placement of the steel and iron components. A copy of records of inspections and tests, as well as records of corrective actions shall be provided if requested by Engineer or Owner.

END OF SECTION 05500

SECTION 05550

METAL STAIRS, HANDRAILS, RAILINGS, GRATING, AND FLOOR PLATES

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for the stair, ladder, handrails, and aluminum grating for sumps and floor.

C. Related Sections:

1. Section 03300 - Cast-in-Place Concrete
2. Section 03410 - Structural Precast Concrete (Plant Cast)
3. Section 03600 - Grout
4. Section 05500 - Metal Fabrication
5. Section 09800 - Special Coating

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. American Society for Testing and Materials (ASTM) A36, "Specification for Structural Steel"

2. ASTM A53, "Specification for Hot-Dipped, Zinc-Coated Welded and Seamless Steel Pipe"

3. ASTM A153, "Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

4. ASTM A283, "Specification for Carbon Steel Plates, Shapes, and Bars"

5. ASTM A307, "Specification for Carbon Steel Externally Threaded Standard Fasteners"

6. ASTM A500, "Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"

7. ASTM B241, "Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube"

8. American Welding Society (AWS) A2.0, Standard Welding Symbols

9. AWS D1.1, Structural Welding Code

10. Military Specification MIL-C-18480, "Specification for Coating Compounds, Bituminous, Solvent, Coal-Tar Base"

11. Federal Specification TT-P-645, "Specification for Primer, Paint, Zinc-Chromate, Alkyd Type"

12. Federal Specification TT-P-320, "Specification for Pigment, Aluminum: Powder and Paste for Paint"

13. Federal Specification TT-V-119, "Specification for Varnish, Spar, Phenolic Resin"

1.03 SYSTEM DESCRIPTION

A. Stair, Ladder, and Gratings: The star and ladder including stringers, stair treads, and connections to supporting structure shall be capable of resisting a uniformly distributed load of 100 pounds per square foot.

B. Handrail: The handrail including posts, rails, fittings, and connections to supporting structure shall be capable of resisting a lateral or vertical load of 200 pounds per lineal foot.

1.04 SUBMITTALS

A. Shop Drawings: Shop Drawings are not required for submittal if in accordance with the Contract Drawings and Specifications.

B. Certification of Compliance: Certificates of compliance for materials set forth shall be provided.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Care shall be utilized throughout the delivery, storage and handling so as to not scratch, bend, wrap or otherwise damage the components.

B. Metal chokers, cable or straps likely to damage the surface shall not be used.

C. All components shall be stored above ground on level timbers or other material which will not stain, corrode, scratch or otherwise damage the components.

1.06 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Steel Sections: ASTM A36. See Section 05120.

B. Steel Pipe: ASTM A53, Grade B.

C. Plates: ASTM A283.

D. Aluminum Grating: Type KRP 15-4 serrated as manufactured by Klemp Grating or approved equal. Grating shall have 1-1/2-inch by 3/16-inch serrated aluminum bearing bars. Toe plates matching stair treads shall be installed at the top of all stairs.

E. Stair Treads: Type KRP 19-4 serrated as manufactured by Klemp Grating or approved equal. Stair tread shall have aluminum corrugated nosing and eight 1-3/4-inch by 3/16-inch serrated rectangular aluminum bearing bars for 3-foot 8-inch treads and 1-1/4-inch by 3/16-inch for 2-foot 4-inch treads.

F. Saddle Anchors: Type H-3 saddle anchors for aluminum grating as manufactured by Klemp or approved equal.

G. Self Tapping Fasteners: No. 12, very heavy gauge metal fastener with hex washer head and standard coating for aluminum as manufactured by HILTI fastening systems, or No. 12 TEKS/5 with climaseal corrosion-resistant coating as manufactured by Buildex or approved equal.

H. Expansion Anchors: See Section 05500.

I. Handrail: Aluminum pipe conforming to ASTM B241 alloy 6061 Temper T6 schedule 40 for rails, schedule 80 for posts. Pipe shall be 1-1/2-inch nominal diameter.

J. Handrail Fittings: Aluminum fittings including tees, crosses, ells, flanges, plugs and brackets shall be cast as manufactured by Hallaender or approved equal.

2.02 FABRICATION

A. General

1. Fit and shop assemble in largest practical section for delivery to site.

2. Fabricate components with joints tightly fitted and secured.

3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush and hairline. Ease exposed edges to small uniform radius.

4. Accurately form components required for anchorage of stairs, ladders, railings, and grating to each other and to building structure.

B. Grating and Stair Treads: Grating and stair treads shall be fabricated from pre-manufactured grating which is not wrapped, bent, bowed, or otherwise damaged. The widest standard panel width available shall be utilized.

C. Handrail: The handrail shall be fabricated from aluminum pipe and slip-on/bolt-on fittings. All fittings shall be from one manufacture source. All fittings shall be securely fastened to the rails and posts. All handrails shall be fabricated in a neat workmanship like manner. No welding or intermediate splicing or coupling is allowed.

D. Finishes: All steel components of stair, ladder and gratings shall be painted as set forth in Section 09800. Other components not designated as painted shall be hot dipped galvanized.

E. Protection of Aluminum: Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of bituminous paint conforming to Mil. Spec. MIL-C-18480 or a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. The zinc-chromate primer shall conform to Fed. Spec. TT-P-645. The aluminum paint shall consist of an aluminum paste conforming to Fed. Spec. TT-P-320, spar varnish conforming to Fed. Spec. TT-V-119 and thinner compatible with the varnish. The aluminum paint shall be field mixed in

proportion of 2 pounds of paste, not more than 1 gallon of spar varnish and not more than 1 pint of thinner.

PART 3: EXECUTION

3.01 ERECTION

A. Preparation of Surfaces: Prior to placement of any component, the contact surface shall be protected from galvanic or corrosion action. Prior to placement against concrete, a bituminous paint coating shall be placed. The paint coating on the structural steel as set forth in Section 09800 will be considered to be adequate protection if continuous and not scratched, chipped or otherwise damaged. All bolt holes and any damage to the coating shall be repainted.

B. Grating and Stair Treads: The grating and stair treads shall be placed in accordance with the dimensions and details shown on the Contract Drawings. The grating and stair treads shall be firmly bolted and fastened to the structural members so that the grating and stair treads do not move, rattle or rub against the support members. A minimum of two fasteners at each support member for grating and stair treads is required. Intermediate fasteners will be required for wide grating panels.

C. Handrail: Handrail system shall be installed with the posts plumb and the rails horizontal or at the slope required. All fittings shall be securely fastened to each pipe. The handrail shall be installed in strict accordance with manufacturer's recommendations. The posts and rails shall be firmly fastened to the steel, concrete or masonry structure.

3.02 FIELD QUALITY CONTROL

The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements and maintain records of his quality control for all construction operations. In addition, the Contractor shall coordinate, verify and check the precast concrete, cast-in-place concrete and other operations which directly affect placement of the components of stair, handrails, and gratings. A copy of records of inspections and tests, as well as records of corrective actions shall be provided if requested by Engineer or Owner.

END OF SECTION 05550

DIVISION 6 - WOOD AND PLASTICS

06100 ROUGH CARPENTRY

06192 PREFABRICATED WOOD TRUSSES

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Related work specified elsewhere:

1. Section 03100 - Concrete Formwork.

2. Section 06192 - Prefabricated Wood Trusses.

3. Section 07310 - Underlayment for Asphalt Shingles.

1.02 QUALITY ASSURANCE

A. Lumber Grades: Western Wood Products Association "Product Use Manual."

B. Plywood Grades: APA, American Plywood Association "Plywood Commercial / Industrial Construction Guide."

C. Preservative Treated Lumber: American Wood Preservers Bureau, "LP-2 Pressure Treated with Water-Borne Preservatives".

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Furnish certificates for preservative treated lumber.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Immediately upon delivery to job site, place materials in area protected from weather.

B. Store materials a minimum of 6" above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.

C. Do not store seasoned material in wet or damp portions of building.

D. While unloading, protect sheet materials from corners breaking and damaging surfaces.

1.05 JOB CONDITIONS

A. Examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed. Do not proceed with the installation until unsatisfactory conditions have been corrected.

B. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit, verify sizes and locations of related work. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of work.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 ROUGH HARDWARE

A. Nails, spikes, screws, bolts and similar items of size and types to rigidly secure members in place or as otherwise indicated. Non-corrosive type at exterior. Hot-dipped galvanized at treated wood.

2.02 LUMBER

A. S4S, moisture content not to exceed 19%.

1. End jointed lumber not allowed.

B. Framing (all values for single member; use under normal load conditions)

Provide Hem Fir No. 2 or better:

Fb = 1000 psi
Fy = 75 psi
E = 1400000 psi

2.03 PLYWOOD

A. Exterior Plywood - Not Exposed: CC-EXT-APA of thickness indicated on Drawings.

2.04 GYPSUM SHEATHING

A. Sheathing: ASTM C79, Type "X", 5/8" or ½" thick.

2.05 **BUILDING PAPER**

A. Paper: asphalt saturated felt, No. 15 type, ASTM D226.

2.06 **MISCELLANEOUS FIRESTOPPING**

A. Firestopping: mineral fiber batts.

2.07 **SOFFIT VENTS**

A. Brown color, prefinished, .019" continuous louvered ventilation strips, nominal 2" wide by 10'-0" long as manufactured by Air Vent, Inc., or equal.

PART 3 - EXECUTION

3.01 **GENERAL**

A. General Installation:

1. Discard units of material with defects which might impair the quality of the work, and units which are too small to fabricate the work with minimum joints or the optimum joint arrangement.

2. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

3. Securely attach carpentry work to substrates by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

4. Install all items closely fitted, accurately set to required lines, levels, rigidly secured in place.

B. Wood Framing, General:

1. Provide framing members of sizes and on spacing shown, and frame openings as shown, or if not shown, comply with the recommendations of the "Manual for House Framing" of the National Forest Products Association. Do not splice structural members between supports.

2. Anchor and nail as shown, and comply with the "Recommended Nailing Schedule - Table I of the "Manual for Housing Framing" and other recommendations of the NFPA if not shown on structural drawings.

3. Firestop concealed spaces with wood block not less than 2" thick, if not blocked by other framing members. Provide blocking at each building story level and at ends of joist spans. Install per criteria of UBC 2516.f.

4. Provide draft / smoke stop in mansard areas not to exceed a maximum spacing of 60'-0" o.c.

3.02 FRAMING

A. Framing

1. Plates and Stud Members

a. Provide single bottom plate and double top plates for loadbearing partitions, 2" thick by width of studs.

b. All plates against masonry or concrete to be pressure treated wood.

c. Provide studs in continuous lengths without splices.

d. Toenail studs to bottom plate and end nail to lower top plate.

e. Overlap double top plate minimum of 6" at corners and intersections.

f. Face nail upper top plate to lower top plate.

g. Nail bottom plate to wood construction.

h. Anchor bottom plate to masonry or precast construction.

i. Triple studs at corners and partition intersections.

j. Partition parallel with joists: Locate joists directly below studs.

k. Frame openings as shown on structural drawings. If not shown, frame as follows::

(1) Double cripple studs and headers: Openings less than 4 feet.

(2) Triple cripple studs and headers: Openings 4 feet and greater.

2. Headers

a. Continuous headers, same width as studs, depth required to span widest opening as indicated.

b. Toenail headers to studs and opening framing.

c. Stagger joints in individual header members a minimum of three stud spaces, allowing no joints to occur over openings.

d. Lap headers at intersections with bearing partitions or tie with metal straps.

3. Blocking

a. Wedge, align, and anchor blocking with countersunk nails.

b. Locate blocking to facilitate installation of finishing materials, fixtures, specialty items, and trim.

B. Sheathing-Plywood:

1. Comply with recommendations of American Plywood Association (APA), for the installation of plywood.

2. Sheathing: Install as recommended by the APA's "Guide to Plywood Sheathing for Floors, Walls and Roofs" for the spacing of supports or types of substrates involved in the work. APA "Plywood" diaphragm construction. Provide thickness shown on Drawings. Plywood to be continuous across two or more spans and face grain across supports.

C. Joist Framing

1. Install with crown edge up.

2. Support ends of each member minimum 3" of bearing on masonry.

3. Support joists alternately at ends with solid blocking, 2" thick by depth of joists, between members crossing bearing point.

4. Lap members framing from opposite sides of beams, girders, or partitions, minimum 4", or tie opposing members together by toe nailing or metal connectors.

5. Anchor joists bearing on masonry and precast concrete as indicated.

6. Notches

a. Do not notch in middle third of joists.

b. Notches in top or bottom of joists: Maximum of 1/6 depth of member.

c. Notched ends: Maximum of 1/3 depth of member.

7. Bored holes: Maximum 1/3 depth of member, 2" minimum distance to top or bottom of joists.

8. Bridging where indicated.

D. Rafters

1. Notch to fit exterior wall plates and toenail to plates.

2. Double rafters at opening in roof framing to provide headers and trimmers, and support with metal hangers.

3. At ridge, place rafter directly opposite each other and nail to ridge member of support with metal hangers.

4. At ridge, place rafter directly opposite each other and nail to ridge member of support with metal hangers.

5. At valleys, bevel ends of rafters for bearing against hip rafters.

6. At hips, bevel ends of rafters for bearing against hip rafters.

3.03 PLYWOOD

A. Roof Sheathing

1. Run grain of face plies across supports. Stagger panel end joints with respect to each other and all joints with respect to joints. Butt panel ends and edges allowing 1/16" space at panel end joints and 1/8" space at panel edge joints. Nail 6" o.c. at each end support and 12" o.c. at intermediate supports with 8d deformed shank nails.

3.04 GYPSUM SHEATHING/BUILDING PAPER

A. Horizontal Installation: Install panels horizontally and with end joints on supports and staggered two support spacings where possible, but not less than one support spacing or 12". Fasten at each support with four fasteners (spaced approximately 8" o.c.), set back 3/8" minimum from edges. Exterior face gypsum board sheathing on exterior wood framed walls shall be continuously blocked at all joints. Sheathing shall be fastened to wood framing with No. 11 gauge, 1-3/4" long, 7/16" head diamond-point galvanized nails at 4" o.c. or equivalent.

B. Building Paper: Install in shingle fashion, lapping joints 6" minimum. Secure at each framing member with staples 12" o.c.

END OF SECTION 06100

SECTION 06192

PREFABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes all materials, equipment, and labor. Coordinate with Section 06100 - Rough Carpentry.

1.02 QUALITY ASSURANCE

A. All prefabricated wood truss installation to be performed by mechanics thoroughly experienced in techniques required and mechanics familiar with published recommendations of manufacturer whose products are used.

B. All materials and workmanship specified in this section meet requirements as listed below.

C. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:

1. "Design Specification for Metal Plate Connected Wood Trusses."

2. "Design Specification for Metal Plate Connected Parallel Chord Wood Trusses."

3. "Commentary and Recommendations for Handling and Erecting Wood Trusses."

4. "Commentary and Recommendations for Bracing Wood Trusses."

5. "Quality Control Manual."

D. Lumber Standard

1. Comply with PS 20 and with applicable rules of the respective grading inspecting agencies for species and grade of lumber indicated.

E. Connector Plate Manufacturer's Qualifications

1. Provide truss connector plates manufactured by a firm which is a member of TPI and which complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Control Manual."

1.03 PRODUCT HANDLING AND STORAGE

A. Handle prefabricated trusses with care and in accordance with manufacturer's instructions.

B. Stockpile or store trusses as recommended by truss manufacturer. Store trusses 6" off ground and protect trusses from damage.

C. Handle and store trusses with care, and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure.

D. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

1.04 DESIGN

A. All prefabricated wood trusses shall be designed for superimposed dead and live loads, spacing, span conditions, overall depth, and end bearing depth indicated on the Drawings. Any deviation from these parameters will not be permitted without approval of the Engineer.

B. The trusses shall be designed in accordance with the "National Design Specification for Wood Construction 1977" by the National Forests Products Association (NFPA).

C. Light gauge metal connectors used at joint connections and splice connections for prefabricated wood trusses shall be designed in accordance with "Design Specification for Light Metal Plate Connected Wood Trusses, TPI-78" by the Truss Plate Institute.

D. All prefabricated wood trusses shall be designed by a registered Professional Engineer in the State of Minnesota. The engineering certification shall occur on all truss shop drawings and calculations submitted for approval.

E. The maximum vertical live load deflection shall not exceed L/360 for the superimposed live loads indicated.

F. Provide 2 x 4 continuous top and bottom chord horizontal truss bridging.

G. All prefabricated wood trusses shall be connected to roof deck and wall top plates with at least one metal framing anchor of minimum 18 gauge material at each bearing. Nail anchor to top plate and wood truss with minimum four nails each.

1.05 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Shop Drawings: Shop drawings shall be complete and shall include a layout plan, fabrication details, connection and anchorage details, and member identification marks. The identification marks shall appear on the manufactured units to facilitate correct field placement.

2. Calculations: Shop drawings shall be accompanied by a complete structural design analysis prepared and certified by a registered Professional Engineer. The design analysis shall show all design loads, reactions, stresses, and structural characteristics of members and connections.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 LUMBER

A. All lumber used for the truss members shall conform to the published stress ratings for the species and grades as set out in the official grading rules of the appropriate lumber association or as listed in the reference specifications; except wherever notes on the drawings or truss engineering designs calls for lumber which exceeds the minimums set forth therein, the specifications, plans, and/or truss engineering designs shall be applicable.

B. The moisture content of all lumber shall be within the proper limits, as stated in the reference specifications, but shall not, in any case, exceed 19% nor be less than 7% at the time of fabrication.

2.02 CONNECTORS

A. All truss connector plates shall be manufactured from only prime commercial quality galvanized sheet metal of no less than 20 gauge thickness which has a minimum yield of 33,000 PSI and a minimum ultimate tensile strength of 48,000 PSI. The corrosion-resistant coating shall be G-60 ASTM A446, Grade A commercial class, hot-dipped galvanized before stamping.

B. All metal connectors shall be "Gang-Nail" Connectors and shall be marked "Gang-Nail". The connectors shall have a series of nail-like projections which are designed to separate the fibers of the wood into which they are pressed, in accordance with accepted nailing practices.

2.03 FABRICATION

A. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with wood-to-wood bearing in assembled units.

B. Fabricate metal connector plates to size, configuration, thickness and anchorage details required for types of joint designs indicated.

C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.

D. Connect truss members by means of metal connector plates accurately located and securely fastened to wood members by means indicated or approved.

PART 3 - EXECUTION

3.01 HANDLING AND ERECTION

A. Fabricated trusses and subassemblies shall be handled with care so that they are not subject to damage. If the trusses are to be stockpiled or stored prior to erection, they shall be set in the horizontal position, resting upon temporary bearing supports and braced so that they will be subjected to no unusual bending or tipping over.

B. During erection, care shall be exercised to keep transverse bending of the trusses to a minimum. Care must also be taken to install trusses right side up and to have trusses positioned at their respective bearing points as indicated on the truss drawings.

C. The permanent structural cross-bracing, to insure the overall rigidity of the truss system, shall be in accordance with the architectural drawings of the building structure.

D. Proper erection bracing shall be installed to hold the trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads to the trusses.

E. All prefabricated wood trusses are to be installed in accordance with "Bracing Wood Truss Commentary" (BWT-76), or (HFT-80), as published by the Truss Plate Institute.

F. Field erection of the trusses, including items such as proper handling, safety precautions, temporary bracing to prevent toppling or dominoing of the trusses during erection, and any other safeguards or procedures consistent with good workmanship and shall be the sole responsibility of the Contractor.

G. Framing anchors and / or truss hangers shall be provided by the Contractor in accordance with the plans.

H. Temporary construction loads should be spread out over the truss members so as not to cause members stress beyond the limits of unit design.

END OF SECTION 06192

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07135 WATERPROOFING

07150 DAMPPROOFING

07210 BUILDING INSULATION

07240 EXTERIOR INSULATION AND FINISH SYSTEM

07310 ASPHALT SHINGLES

07530 LOOSE-LAID/BALLASTED ELASTOMERIC SHEET ROOFING SYSTEM

07600 FLASHING AND SHEET METAL

07722 ROOF HATCHES

07810 SKYLIGHTS

07900 JOINT SEALERS

SECTION 07135

WATERPROOFING

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment and labor for complete waterproofing systems, including the following:

1. Limited building areas for below-grade walls:

   a. Exterior east wall along Grid "5" from 8" above the exterior masonry weephole line to top of footing at the lower level finish floor portion of the building.

2. Exterior below-grade reinforced concrete holding tank. All surfaces of the tank shall be waterproofed, including top deck, exterior walls to top of footings including the top of the footing surface.

3. Related Work specified elsewhere:

   1. Division 3 - Concrete Work.

   2. Division 4 - Masonry. Installation of termination bars provided under Section 07135 and installed under Division 4 work.

   3. Section 07150 - Dampproofing.

   4. Section 07210 - Building Insulation.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Manufacturer's literature and recommendations for mix proportions and application.

2. Certified test report that grading and analysis meets or exceeds the specified requirements.

3. Graphic details for installation proposed.

1.03 PRODUCT DELIVERY

A. Deliver waterproofing material to job site in manufacturer's original sealed containers with manufacturer's name and brand name legible and intact.

B. Protect the materials of this Section before, during and after installation.

C. In the event of damage, immediately make replacements to the approval of the Engineer, at no additional cost to the Owner.

1.04 WARRANTY

A. Furnish Owner written warranty that areas waterproofed under this Section of the Specifications are, and will remain, watertight under every condition, except major failure or cracking of structural members, for a period of five (5) years from date of Substantial Completion of total Project.

B. Both Contractor and waterproofing applicator are required to countersign warranty.

1.05 QUALITY ASSURANCE

A. Application

1. Waterproofing applicator shall be certified in writing by the manufacturer as his licensed or approved applicator.

B. Pre-waterproofing Conference

1. Prior to installation of waterproofing system, the Contractor shall establish a meeting at project site with Installer, installers of substrate construction, other work adjoining waterproofing system including penetrating work, and representatives of other entities directly concerned with performance of waterproofing system including Owner's representative, insurers, test agencies, governing authorities, product manufacturers, and Engineer. Review requirements, contract documents, submittals, status of coordinating work, availability of materials and installation facilities, proposed installation schedule, requirements for inspections and testing or certifications, weather conditions, governing regulations, insurance requirements, proposed installation procedures, and waterproofing system protection requirements for construction period extending beyond waterproofing installation. Resolve conflicts prior to installation of waterproofing system.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 SYSTEM

A. Acceptable Applicator:

1. System 7 Corporation, 8210 West 125th Street, Savage, Minnesota 55378, 612/890-4584.

2. Approved equal.

B. Acceptable Bentonite Waterproofing System:

1. Where bentonite waterproofing is called for on the Drawings, provide two-part Bentonize spray-applied waterproofing system.

2. Material: Intercontinental Chemical's patented two-part Bentonize system with polymer-enhanced Bentonite (Poly-G) for below-grade structures.

C. Cover Sheet

1. Provide 6 mil polyethylene sheet on vertical wall and horizontal roof decks. Provide 10 mil polyethylene sheet under floor slabs.

D. Protection Course: Rigid extruded insulation boards with the following characteristics as may be manufactured by Dow Chemical Co or equal. Provide board of thickness shown on Drawings.

1. Extruded polystyrene board meeting ASTM C578, Type IV, compressive strength 25 lb/in^2 min (ASTM D1621). Use at building exterior walls, not under building areas.

2. Type 2: Extruded polystyrene board, compressive strength 60 lbs/in^2 (ASTM D1621). Use above deck of below grade backwash tank.

E. Synthetic Sheet Membrane:

1. Provide 60 mil EPDM or approved equal sheet at all transitions, terminations, expansion joints and other areas as shown on the Drawings.

2. Acceptable Manufacturers: Firestone, Good Year, Carlisle.

F. Grade-line aluminum termination bar provided under this Section.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect surfaces to receive the waterproofing prior to onset of work. Applicator and/or representative of the manufacturer shall inspect entire area to be waterproofed. Surface defects and/or improper conditions that would affect installation shall be brought to the attention of the Contractor and Engineer in writing for correction before commencing installation.

3.02 PRE-INSTALLATION MEETING

A. Prior to start of installation of the work of this Section, the Contractor shall arrange a jobsite meeting attended by the Contractor, field supervisor of the applicator firm, and / or representative of the manufacturer, and the Engineer.

B. At the pre-installation meeting, review areas scheduled to receive waterproofing, Division 3, and Division 4 products, and reach agreement on timing and sequences.

3.03 PREPARATION

A. Contractor shall provide a substrate clean and dust-free. All loose aggregate and sharp protrusions shall be removed. Horizontal surfaces and all wall/footing junctions shall be clear of all debris and standing water. Running water shall be diverted away from surfaces to be waterproofed.

B. Protection:

1. Do not proceed with the work of this Section in rainy weather conditions.

2. Do not apply over frost or wet surfaces. Damp surfaces are acceptable if there is no running water present as the source of dampness.

3. Protect installed bentonite from rain and other moisture until backfilled or covered with the next succeeding component. (Follow manufacturer's recommendations.)

3.04 INSTALLATION

A. General: Install in accordance with manufacturer's instructions, recommendations, and specific project application instructions which are applicable to the Work.

B. Below-Grade Wall Surfaces:

1. Adhere EPDM flashing to wall 8" above weephole lines. Step elevations of terminations as required. Attach EPDM and lap over construction as indicated.

2. Spray to thicknesses as shown on Drawings or where not shown, at a minimum thickness of ¼" (1 pound of bentonite per square foot). At all joints and irregularities increase thickness an extra 1/8".

3. Add 1/8" extra material at tie holes, through-wall penetrations, construction joints and surface irregularities.

4. Install 6 mil polyethylene cover sheet over bentonite.

5. Install specified protection course.

6. Install synthetic flashing membrane 24" below grade line terminations, if any.

7. Install 1" bentonite cant at all footing-to-wall joints.

8. Termination Bars to be provided under this Section and installed under Division 4 work.

C. Horizontal Surfaces:

1. Spray to thicknesses as shown on Drawings or where not shown at a minimum thickness of 3/8" (1 pound of bentonite per square foot). At all joints and irregularities increase thickness an extra 1/8".

2. Install a 12"-wide synthetic sheet membrane at all horizontal to vertical transition areas. Form a 2" bentonite cant at transitions.

3. Install 6 mil polyethylene cover sheet.

4. Install specified protection course.

END OF SECTION 07130

SECTION 07150

DAMPPROOFING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this section includes providing all materials, equipment, and labor to dampproof wall areas behind brick masonry wall surfaces starting 8" above weephole lines of brick veneer to top of brick line and foundation walls under building areas. See Sections 07135 for waterproofing materials below the brick elevations.

C. Related Work specified elsewhere:

1. Section 03300 - Cast-in-Place Concrete.

2. Section 07135 - Waterproofing.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Product Data: Submit manufacturer's technical product data, installation instructions, and recommendations for each dampproofing material required. Include data substantiating that materials comply with requirements.

1.03 JOB CONDITIONS

A. Substrate: Proceed with dampproofing work only after substrate construction and penetrating work have been completed.

B. Weather: Proceed with dampproofing work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations.

1.04 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

A. Sonneborn Hydrocide 700 Mastic or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not start Work until surface preparation is completed.

B. Do not apply over frost covered surface.

C. Clean surfaces of all foreign materials.

D. All surfaces to be dampproofed shall be dry, clean, reasonably smooth, free of dust, dirt, voids, cracks or sharp projections.

E. Contractor to lay out lower wall elevations for limits of dampproofing and coordinate with other trades.

3.02 APPLICATION

A. Application during inclement weather not allowed.

B. Apply dampproofing with trowel in continuous, unbroken coating free from surface breaks. Coverage per manufacturer's recommendation.

3.03 CLEAN UP

A. Remove all trash, debris as a result of this work.

B. Clean adjacent surfaces stained by dampproofing smears, drippings.

END OF SECTION 07150

SECTION 07210

BUILDING INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for cavity rigid insulation, building (wall) insulation above and below grade, and miscellaneous insulation including stuffing small openings.

C. Related Work specified elsewhere:

1. Section 07135 - Waterproofing.

2. Section 07240 - Exterior Insulation and Finish System.

3. Section 07530 - Loose Laid / Ballasted Elastomeric Sheet Roofing System.

4. Section 15000: Mechanical System Insulation.

1.02 REFERENCES

A. Industry Standards:

1. TIMA.

2. ASTM C272, Water Absorption.

3. ASTM C518, Thermal Transmission.

4. ASTM D1621, Compressive Properties.

5. ASTM D2126, Thermal and Humid Aging.

6. ASTM E96, Water Vapor Transmission.

7. UL 723, Surface Burning Characteristics.

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Manufacturer's Data, Insulation: For information only, submit two copies of manufacturer's specifications and installation instructions for each type of insulation required. Include data substantiating that the materials comply with specified requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver material to the site in unopened packages, with identification labels intact.

B. Store under water-resistant cover and protect from weather and direct sunlight.

C. Remove damaged materials from site.

1.05 SYSTEM DESCRIPTION

A. Materials of this section shall provide a continuous thermal and vapor barrier at building enclosure elements.

1.06 SCHEDULING

A. Coordinate installation with other trades whose work may be affected or have effect.

1.07 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 RIGID INSULATION

A. Extruded Insulation Board: Meeting ASTM C578, Type IV, compressive strength 25 lb/in² (ASTM D1621).

B. Extruded Insulation Baord: Meeting ASTM C578, Type IV, compressive strength 60 lb/in² (ASTM D16121). Use at foundation walls under building areas.

C. Acceptable Manufacturers: Styrofoam SM as manufactured by Dow Chemical Company or U.C. Industries FoamulaR 250 or Certifoam by Minnesota Diversified acceptable;thickness as indicated.

D. Adhesives: Waterproof adhesive as recommended by insulation manufacturer.

E. Spray foam.

2.02 BATT INSULATION

A. Unfaced Fiberglass batts per ASTM C77684, Type I.

2.03 FIRE SAFING INSULATION

A. United States Gypsum Thermafiber safing insulation of thickness required for applications shown.

PART 3 - EXECUTION

3.01 RIGID INSULATION

A. Examine areas to receive rigid insulation to insure work of preceding trades is completed.

B. Check surfaces to receive rigid insulation to assure they are in uniform plane and free of mortar chips, debris, grease, oil, or other items detrimental to installation. All projections to be removed prior to board installation.

C. Proceed with application of insulation only when conditions are satisfactory.

D. Butt panels tightly together. Compress insulation around reinforcing wire. Protect from damage and replace all damaged areas before covering up. Set with 1½" at 12" o.c. each way dobs of adhesive. Provide snug fit at all joints.

E. Spray foam insulation in all joints larger than 1/16".

3.02 BLANKET INSULATION

A. Install where shown on Drawings.

B. Stuff loose insulation into miscellaneous voids and cavity spaces as indicated or obvious to workman to reduce temperature variations and infiltration.

3.03 CLEANING

A. Remove accumulations of waste materials, rubbish, excess insulation, and containers.

B. Dispose of off site.

END OF SECTION 07210

SECTION 07240

EXTERIOR INSULATION AND FINISH SYSTEM

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes all materials, equipment, and labor for a complete system consisting of insulation, fasteners, adhesive, reinforcing mesh, finish, control joints, and sealants.

C. Furnished and installed in this Section, specified in Section 07900.

1. Sealant product specifications in Section 07900.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Submit one 24" x 24" sample of color panel required. Panel shall show background color, control detail joint and texture. Accepted panel shall serve as standard of quality for entire job.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store materials on site where directed.

1. Store off ground, under cover, protect from weather and construction activities. Store at temperatures of not less than 40°F.

B. Deliver materials to job in manner insuring installation continuity.

C. Store and handle to insure against physical damage.

1.04 JOB CONDITIONS

A. Install in strict accordance with all weather and safety conditions as required by local, state and federal regulatory agencies having jurisdiction.

B. Ambient air temperature shall be 40°F or greater and rising at the time of installation.

C. Protection

1. Protect surrounding areas and surfaces to preclude damage during installation.

1.05 QUALITY ASSURANCE

A. Installer: A firm licensed or otherwise approved by manufacturer of primary materials, including qualified factory training where recommended by manufacturer.

B. Coordination

1. The Work of this Section requires close coordination between related sections.

C. The Manufacturer shall:

1. Have five years' experience with exterior insulation and finish system in this region of the United States and shall have completed projects of same building type, size, and subtrate type as this project.

2. Use insulation board manufacturer approved by the EIFS system manufacturer and meet requirements of this specification and State of Minnesota Building Code.

3. Apply sealant by use of competent contractor experienced in applying high performance industrial and commercial sealants.

D. Design and Detailing per Manufacturer's Recommendations:

1. General:

a. At all locations the insulation board shall be completely encapsulated by the lamina or substrate.

b. All exposed edges, terminations, sealant joints, intersections of dissimilar materials at doors, windows, etc., terminating below grade or at grade shall have the ends of insulation board wrapped with base coat and reinforcing mesh.

c. The use of, and maximum thickness of, insulation board shall be in accordance with the applicable building codes and manufacturer's recommendations.

2. Substrates:

a. Substrate shall be approved by the applicator.

b. The applicator / contractor shall verify that the proposed substrate is acceptable to the applicable regulatory authorities prior to installation of the EIFS system.

c. Substrate system shall be structurally sound.

3. Control Joints:

a. Continuous control joints shall be installed at the following locations:

(1) Where control joints occur in the substrate system.

(2) Where building control joints occur.

b. Approvals, Listings, and Classifications

(1) The EIFS system shall have been approved for use by the State of Minnesota Building Code.

1.06 LIMITED WARRANTY

A. The manufacturer shall provide a five-year limited warranty for labor and materials against loss of bond, peeling, flake, chip, and color fading.

1.07 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 GENERAL

A. The manufacturer, Dryvit System, is acceptable and the following is based on Dryvit. Other accepted manufacturers include Sto Toughwall System, and Thoro Thorowall-H System.

B. All components of the Dryvit System shall be obtained from Dryvit Systems, Inc., or its authorized distributors. No substitutions of, or additions of, other materials shall be permitted without prior written permission from Dryvit Systems, Inc.

2.02 SYSTEM

A. Ultralation system.

2.03 MATERIALS

A. Insulation Board:

1. Extruded polystyrene insulation board approved by Dryvit Systems, Inc., ASTM C578-85, Type IV, styrofoam, amofoam, foamular 250 or 150.

2. Thickness, minimum 2" and thicker where shown, minimum R value of 10.

B. Reinforcing Mesh:

1. Woven glass fiber type.

C. Standard Detail Reinforcing Fabric:

1. Woven glass fiber type.

D. Approved Fasteners for Masonry Substrate:

1. Non-corrosive mechanical fastener with nylon washer.

E. Trim Accessories

1. Control joints, corner beads, corner reinforcement of zinc-coated steel.

2. 26 gauge minimum.

F. Water: Clean, potable, free of foreign matter.

G. Sand: Silica sand, dry, bagged, #40-45 sieve, ASTM C897.

H. Reinforcing Fibers: Chopped fiberglass.

I. Starter: 100% acrylic-based, produced by Dryvit.

J. Finish:

1. Factory-mixed with internal color and texture.

2. Quartputz finish texture.

3. Color selected based on Dryvit color, Mauve #114.

K. Sealant Systems:

1. Sealant for expansion joints shall be as specified in Section 07900, 2.01-A, approved by Dryvit, and shall be included in the work of this section.

2.04 SYSTEM PROPERTIES

A. General Physical and Chemical Tests:

1. Properties shall meet or exceed the following values when tested by the methods listed:

   a. Absorption / Freeze / Thaw: 60 cycles, immersed in water at +68°F (+20°C) for 4 days then cycled from +14°F (-10°C) for 2 hours to +68°F (+20°C) for 2 hours; no visible damage.

   b. Salt Spray Resistance: ASTM B117, 300 hours; no visible damage or discoloration.

   c. Impact Testing: ASTM D2794; greater than 160 inch-pounds.

   d. Compressive Strength: ASTM C109; greater than 6000 psi.

   e. Tensile Strength: ASTM C190; 700 psi.

   f. Tensile Bond Strength: 51.8 psi.

   g. Flexural Strength: ASTM C203; 318 psi.

   h. Fungus Resistance: MIL STD-810B Method 508; no growth.

   i. Abrasion Resistance: ASTM D968, 500 liters; no deleterious effect, negligible weight loss.

   j. Accelerated Weathering: ASTM G23, 2000 hours; no chalking, fading or cracking.

   k. Wind-Driven Rain: FS TT-C-555B; average weight gain less than 28 grams.

   l. Water Vapor Transmission: ASTM E96, permeable to moisture.

   m. Surface Burn Characteristics: ASTM E84. Flame spread less than 25. Smoke developed less than 5.

B. Structural Tests:

1. Impact Resistance: ASTM E695; 233 foot-pounds. L/133 deflection, no cracking.

PART 3 - EXECUTION

3.01 INSPECTION

A. Check that areas to receive insulation and finish system are clean and dry and acceptable for installation.

B. Verify that voids and cracks are filled and that ridges and bulges are removed leaving a smooth surface.

C. Check that penetrations of the system are completed, properly flashed (as applicable).

D. Assure that nailers, grounds, flashings, and expansion joints are installed.

E. Do not commence installation of exterior insulation and finish system until conditions are satisfactory.

3.02 INSTALLATION

A. General

1. Install according to manufacturer's instructions and recommended details.

B. Insulation

1. Fitting: Pre-cut insulation board to fit openings, projections, etc. Stagger vertical joints.

2. Mechanically fasten to the substrate with long dimensions of the board oriented horizontally in a running bond pattern with joints offset with respect to substrate.

3. Insulation board joints shall be staggered and interlocked at corners.

4. If gaps in the insulation board occur, slivers of insulation board shall be cut and shaped to fit the gaps 1/8" and larger and inserted, without using the adhesive mixture.

5. Attach insulation board to the substrate with fasteners to withstand positive and negative wind load pressures as required by the Minnesota State Building Code (1988 UBC). The board shall be fastened snug to the wall. Fasteners shall penetrate the substrate a minimum of 1½".

C. Veneer Base

1. Base Material: Apply mixed base material to the entire surface of the insulation board per manufacturer's instructions.

2. Reinforcing Mesh: Place mesh per manufacturer's instructions. The finished thickness of the reinforced veneer base shall be such that the mesh is fully embedded and surrounded by adhesive. Wrap mesh and veneer base around all edges to back side of insulation where sealant joint or termination of board occurs. Allow the base coating to become dry and hard before proceeding to veneer finish application.

3. Apply trim corners and control joints where indicated.

4. Starter coat to be a smooth, level plane.

5. Provide detail mesh as required at projections.

D. Finish

1. Veneer Finish: Using a clean stainless steel trowel, apply a light coat of the finish material directly to the reinforced base coating. It shall be applied and leveled during the same operation to the minimum attainable thickness consistent with uniform, complete coverage and texture.

E. Field Quality Control

1. Inspections: Conduct regular inspections with the system manufacturer or its authorized representative.

2. Certification: Provide written certification as to the quality of work performed relative to the insulation board, substrate system, details, installation procedures and workmanship.

3. Protect finished work when stopping for the day or when completing an area in order that water will not penetrate behind the panel, nor damage the finished front.

3.03 CLEAN-UP

A. Materials left over, other debris shall be removed from/properly disposed of off the site.

B. Clean adjacent surfaces soiled by operations of this work.

END OF SECTION 07240

SECTION 07310

ASPHALT SHINGLES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this section includes providing all materials, equipment, and labor and includes but is not limited to the following:

1. Self-adhering (ice and water barrier) underlayment.

2. No. 30 underlayment roofing felts.

3. Drip caps, valley flashing, flashing fins.

4. Asphalt shingles, starter course, and ridge shingles.

5. Fasteners and other incidental accessories.

6. Related Work specified elsewhere:

1. Section 07530 - Ballasted Elastomeric Sheeting Roofing.

2. Section 07600 - Flashing and Sheet Metal.

3. Section 07900 - Joint Sealers.

1.02 REFERENCES

A. ASTM D225, Type III, asphalt Class C.

B. ASTM E108, Class C fire resistance.

C. ASTM D3161, Wind resistance.

D. HUD Materials Release 1056b: Ice and Water Shield. ICBO Report No. 3997.

E. ASTM D226, No. 30 felts.

F. ASTM D3018, Type I, asphalt Class A.

G. ASTM D3462, asphalt Class A.

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Manufacturer's literature for materials and recommended installation procedures, UL label information, and ASTM test approvals.

2. Sample of shingles and selected color.

1.04 QUALITY ASSURANCE

A. Underwriters' Laboratories labels.

B. Installer must have minimum of five years' experience in the asphalt shingle roofing business and have experienced workpersons.

1.05 JOB CONDITIONS

A. Do not install underlayment or shingles on wet or dirty surfaces.

1.06 WARRANTY

A. 25-year warranty against manufacturers' defects of shingles.

B. 5-year warranty to repair or replace free of charge to the Owner any defective shingles within the first five years of service.

C. Provide written warranty certificate for above Items A and B.

1.07 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 SHINGLES

A. Manufacturer: Certainteed. Style: Horizon. Color: Harvest Brown.

B. Shingle Characteristics: Organic felt base, one-piece construction, random applied overlays, Class C, UL rating, UL wind resistance label, self-sealing, minimum 250 lbs/sq.

C. Other organic felt base shingles meeting the above requirements for materials, color and texture must be an "approved equal".

2.02 UNDERLAYMENT

A. No. 30 unperforated asphalt saturated felt, ASTM 226.

B. Ice and water shield as manufactured by W.R. Grace or equal.

1. 40 mil membrane of high strength polyurethane coated on one side with thick layer of adhesive-consistency rubberized asphalt. Self-adhering and cold applied.

C. Fasteners

1. Round wire shingle nails, hot dip galvanized steel nails, 11 gauge, with a minimum of 3/8" diameter heads. Nails to be sufficient in length to penetrate 3/4" into roof decking.

D. Plastic Cement

1. Cut back asphaltic type with mineral fiber contents, ASTM D2822.

E. Metal Flashing

1. Strip Flashing and Shingle Tins: 24 gauge galvanized steel, ASTM A361.

F. Metal Drip Edge

1. Prefinished metal 20 gauge steel, with projected leg 3/4" beyond fascia line.

PART 3 - EXECUTION

3.01 GENERAL

A. Inspect substrate. Correct all defects which would adversely affect underlayment and shingle application. Acceptance of substrate as satisfactory is made upon start of work of this Section.

B. Insure that work penetrating roof surface has been completed to the extent that shingles can be applied.

C. Check that flashing has been installed.

3.02 UNDERLAYMENT

A. Ice and Water Shield Equipment:

1. Cover all mansard surfaces of 12/12 slope or less with underlayment.

2. Place 36" wide continuous at all valleys.

3. Place at all ridges, lapping a minimum of 12" each side of ridge.

4. Lap and install per manufacturer's instructions.

5. Replace any damaged underlayment before shingle and / or flashing placement.

B. Felt Underlayment:

1. Place on all surfaces to receive shingles steeper than 13/12 slope.

2. Lap all seams according to shingle manufacturer's recommendations but not less than 2" at horizontal laps and 6" at vertical laps.

3. Fasten securely with staples and temporary battens until shingles are in place.

3.03 SHINGLES

A. Apply shingles per manufacturer's instructions and coordinate with local building codes.

B. All shingle lines to be straight and uniform exposure. Apply starter strip and shingles to overhang eaves by 1½" or ½" beyond metal drip edge.

C. At steep slopes of 60° or greater than 21/12, use 6 fasteners per shingle and immediately upon installation plastic bituminous cement must be used to seal shingles as recommended in manufacturer's literature.

D. Application shall be with galvanized shingle nails with heads 3/8" diameter x 1¼".

E. At valleys, weave shingles over ice and water shield barrier underlayment.

F. Use shingle galvanized metal tabs at sides of vertical or steep adjacent wall surfaces per manufacturer's literature.

G. Use strip metal base flashing at shingle top course abutting vertical surfaces. Coordinate with other applicable trades.

H. Fit shingles around pipe flashing flanges and cement per manufacturer's literature.

I. Apply ridge shingles to all cap and hip ridges with 5" exposure.

3.04 CLEAN AND REPAIR

A. Replace all damaged shingles.

B. Remove excess shingles and debris which are not part of extra stock from site.

END OF SECTION 07310

SECTION 07530

LOOSE LAID/BALLASTED ELASTOMERIC SHEET ROOFING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for a roofing system of Ethylene Propylene Diene Monomer (EPDM) elastic sheet roofing, roof insulation, vapor retarder sheet, ballast, flashing, splicing cement, lap sealant, ballast pavers, protective mat, and all accessories necessary for a complete insulated ballasted elastic sheet roofing system.

C. Related Work specified elsewhere:

1. Section 07210 - Building Insulation.

2. Section 07310 - Asphalt Shingles.

3. Section 07600 - Flashing and Sheet Metal.

1.02 REFERENCES

A. FS H-H-I-1972 Insulation Board.

B. ASTM C136, Sieve Analysis.

C. ASTM D1621, Insulation Board.

D. TIMA.

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Shop Drawings: Submit indicating type of flashings, perimeter and penetration details, roof insulation makeup and layout.

2. Samples: Submit samples of ballast, roof ballast paver, and EPDM, vapor retarder.

3. Manufacturers' Product Information: Including fire and smoke data.

4. Warranty: Submit two copies of warranty for EPDM elastomeric sheet roofing.

1.04 QUALITY ASSURANCE

A. Application

1. Roofing applicator shall be certified in writing by the elastic sheet roofing manufacturer as a licensed or approved applicator.

2. A single installer shall perform the work of this Section as well as Section 07600 and shall have completed projects of similar scope and complexity.

B. Preroof Conference

1. Prior to installation of roofing system, meet at project site with roofer, Owner's representative, subtrades, other work adjoining roof system including penetrating work, rooftop units, and representatives of other entities directly concerned with performance of roofing system including manufacturer, representatives, and Engineer. Where possible, tour representative areas of roofing substrates (decks), and discuss substrate condition. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials and installation facilities, proposed installation schedule, requirements for inspections and testing or certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures. Resolve conflicts and problems before roofing work begins.

C. Quality Control

1. Appoint a representative as "quality controller" with the authority to regulate the quality of execution of the Work.

2. Conduct daily inspections of the Work, and make such tests and measurements as deemed necessary to establish that the Work is in compliance with the Contract Documents, including inspections of system components installed by other trades.

3. Maintain a "quality assurance diary" for each workday indicating weather conditions, temperature, type and quantity of each material applied and all other pertinent information related to the proper installation of the roofing system.

1.05 PRODUCT HANDLING, STORAGE AND DELIVERY

A. Deliver elastic sheet roofing material, insulation and accessories in manufacturer's protective containers, and comply with manufacturer's instructions for storage and handling.

B. Deliver materials requiring fire resistance classification and/or flame spread rating with labels intact.

C. Handle rolled goods to prevent damage.

D. Store all materials on clean raised platforms with weather protective covering.

E. Remove wet materials from site.

F. Protect materials during onsite storage and traffic.

G. Do not store concentrated loads on roof deck.

H. Protect insulation from fire ignition.

1.06 WARRANTY

A. Manufacturer shall provide Owner standard single source written ten (10) year warranty beginning at the date of Substantial Project Completion.

1.07 JOB CONDITIONS

A. Examine substrate and conditions under which elastic sheet roofing work is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Proceed with installation of elastic sheet roofing only after substrate construction has been completed, and after penetrating components have been installed, so that membrane will not be penetrated or damaged by subsequent work.

C. Weather Conditions: Proceed with elastic sheet roofing work only when weather conditions comply with manufacturer's recommendations, and will permit materials to be applied and cured in accordance with those recommendations. Do not exceed temperature limitations recommended by roofing manufacturer.

1.08 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 ROOF INSULATION

A. The following insulation is to be used with the EPDM roof membrane. Type 1 or Type 2 insulation may be used for the base roof insulation.

1. Type 1, phenolic foam core with glass facers laminated to both sides. R20 value approximately 2.4" thick. Flame spread 25 or less, ASTM E84-81A, FS HH-I-1972/GEN, FM approved.

2. Type 2, Extruded Polystyrene, roofing board insulation, Type IV, ASTM C578, Type VI, compressive strength 40 psi/in², 2" thick layers, for total R value of R=20.

3. Type 3, ½" fiberboard insulation.

4. Type 4, tapered insulation, slope ¼"/ft of fiberboard, Perlite, phenolic, or extruded polystyrene insulation.

2.02 LOOSE/LAID BALLASTED ELASTOMERIC SHEET ROOFING SYSTEM

A. The components of the ballasted roofing system shall be roofing products by Firestone, Carlisle, Good Year, or Manville.

1. Membrane shall be (.060" (60 mil)) thick EPDM (Ethylene Propylene Diene Monomer).

2. Membrane sheet size shall be of the largest sheet possible as determined by existing job site conditions.

3. Flashing Membrane shall be .060" thick uncured EPDM.

2.03 MISCELLANEOUS

A. Nailers, Blocking: No. 2 or better, SAS, Douglas Fir-Larch, Hem Fir, or Southern Yellow Pine, preservative treated in accordance with AWPA "LP-2 Pressure Treated with Water-Borne Preservatives."

2.04 BALLAST PAVER

A. Concrete paver manufacturer: Westile. Ballast paver or approved equal, size: 11½" x 16-3/4" x 1½", 1¼" thick, water absorption 5% or less, extruded concrete, raised nonabrasive bottom pads which allow drainage, minimum 5000 psi, maximum weight 12 lbs/sq.ft.

2.05 SLIP SHEET

A. HP protective polyester mat or 45 mil EPDM.

2.06 VAPOR RETARDER

A. Polypropylene / Scrim / Foil, No. 8144, as manufactured by Lamotite or approved equal.

1. Permeance (MVTR) ASTM E96; dry cup; Process A, .02 perms maximum.

2. Aluminum foil: .0003".

3. Scrim: Fiberglass 4 by 4 reinforcement.

4. Adhesive: Flame-resistant.

5. Film: .0015" UT stabilized white polypropylene.

6. Tensile Strength: 40 lbs/in, ASTM D828.

7. Temperature: -40°F to 150°F.

8. Width: 78" or maximum width of sheet possible.

9. Tape: No. 8144 tape of same material as vapor barrier with self-adhesive material.

PART 3 - EXECUTION

3.01 SUBSTRATE PREPARATION

A. Comply with sheet membrane manufacturer's instructions for preparation of substrate to receive elastomeric sheet roofing. Clean substrate of dust, debris and other substances detrimental to elastic sheet roofing work.

B. Verify proper placement of roof drainage systems in relationship to finished roof elevations; this includes:

1. Proper placement of scuppers. Lowest finished roof surface elevation shall be no more than 3/4" from top lip of scuppers.

C. Report unsatisfactory conditions to Contractor and Engineer in writing. Beginning of work: presumed as acceptance of all conditions as satisfactory by roofing sub-contractor.

D. Contractor: Responsible for verification of proper elevations of scuppers. Correct said defects at no additional cost to Owner.

3.02 NAILERS, BLOCKING

A. Batten strips installed at the base of roof projections, penetrations and non-roof edge perimeters shall be per details.

B. Miscellaneous treated wood nailers installed at roof perimeters, at the base of roof projections, and around specified roof penetrations shall be as follows:

1. Total nailer height shall match the total thickness of insulation being used and shall be installed with 1/8" gap between each length and change of directions.

2. Nailer shall be firmly fastened to the deck, wall, or existing structurally sound and secured nailers, so as to resist a force of 200 pounds per lineal foot in any direction (fastened 16" o.c. maximum recommended in most applications).

3. The nailer shall be tapered (if applicable) so that it will always be flush at the point of contact with the membrane in either the vertical or horizontal applications.

3.03 ROOF INSULATION

A. Loosely lay roof insulation with end joints staggered. Stagger joints between layers. Insulation joints shall be a maximum of ¼" or less in width. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered same day with membrane. Install according to manufacturer's recommendations.

3.04 LOOSE/LAID BALLASTED ELASTOMERIC SHEET ROOFING SYSTEM

A. Install elastomeric sheet roofing in accordance with manufacturer's printed instructions consistent with all requirements of the warranty.

B. Loosely lay sheet membrane over roof insulation and allow the membrane to relax 30 minutes minimum before fastening or splicing. Apply adjoining sheets by lapping the edges and splicing. Mechanically fasten the membrane to nailers and around penetrations using recommended roofing nails and termination bars.

C. Complete splice between flashing and sheet roofing before bonding the flashing to vertical surface. Adhesively apply flashing and nail at top of flashing. Flash all penetrations passing through the sheet membrane.

1. Flashing shall be installed per details at roof intersections, around penetrations. Use longest pieces practicable.

D. Ballast:

1. Apply ballast as recommended by membrane manufacturer with not less than 10 pounds per square foot average uniformly over the gross area of the roof. Exercise care not to damage the membrane.

2. Lay ballast pavers over protective mat. All broken or cracked units to be removed and replaced.

3.05 VAPOR RETARDER

A. Clean deck and remove all objects which would puncture or damage vapor retarder sheet.

B. Place vapor retarder loosely over the deck with care not to puncture or tear material.

C. Lap all joints a minimum of 2" and tape all joints and voids with vapor retarder tape.

D. Completed vapor retarder installation shall form a continuous sheet across entire roof except at required openings. At roof openings, cut neatly around opening and lap and tape to construction passing through opening, except at furnace chimneys. At furnace chimneys, hold back vapor retarder 1" from all hot surfaces.

3.06 CLEANING

A. During course of work, inspect surrounding grounds for debris and trash. Remove at the end of each day's work.

B. Upon completion, leave roof areas and surrounding grounds clean of debris and trash.

3.07 INSPECTION

A. Upon completion of the system, an authorized representative of roof membrane manufacturer will make a thorough inspection of the installation to determine that the roof system has been applied according to manufacturer's standards and specifications.

END OF SECTION 07530

SECTION 07600

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Related Work specified elsewhere:

1. Section 07530 - Loose-laid / ballasted elastomeric sheet roofing system.

2. Sheet metal for heating, ventilation systems is in Division 15.

C. Furnished and Installed in This Section, Specified in 07900:

1. Sealant product specifications in Section 07900.

1.02 REFERENCES

A. ASTM A526-80" Specification for Steel Sheet, 2 mc coated (galvanized by the hot-dip process, commercial quality).

B. ASTM B32-83, Specification for Solder Metal.

C. Recommended practices as set forth by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) in the "Sheet Metal Manual" are by reference made a part of this work.

1.03 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Shop Drawings: Submitted showing profiles, joint treatment, fastening methods, gauge and finish of materials.

2. Samples: Submitted to Engineer indicating colors.

1.04 WARRANTY

A. 20-year non-prorated written certificate of warranty covering fade, chalking, and film integrity. Warranty shall include labor and materials through the 20th year.

1.05 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 SHEET METAL MATERIALS, GENERAL

A. Provide all accessories, other items essential to completeness of sheet metal installation, though not specifically indicated, specified. All such items, unless otherwise indicated, specified of same kind of material as item to which applied. Nails, screws, bolts of types best suited for purpose intended, of composition that is compatible with metal to which it will contact.

B. Type, locations of various kinds, gauges, thickness, finish of sheet metal to be used is specified hereinafter, however, where sheet metal is indicated and kind, type of metal is not definitely specified, noted, provide 24 gauge galvanized steel.

C. Zinc-Coated (Galvanized) Steel: ASTM A525, 1.25 oz. per square foot hot-dipped galvanized coating.

D. Prepainted Galvanized Sheet: Colorklad or Pac-Clad acceptable.

1. Provide factory applied protective film. Do not remove until after fabrication.

E. Solder: ASTM B32, 50% tin, 50% lead.

F. Sealant: Use sealants specified in Section 07900.

2.02 FORMED COPINGS

A. 24 gauge prepainted galvanized steel.

B. Formed in 10' sections. Cover top of wall with 10-mil wall flashing, if roofing sheet membrane does not extend over top of wall. Cross joints: made with 3/16" expansion joint, 2"-wide cover plate, sealed with sealant. Secure in place with continuous cleats of same material as coping (color finish exposed); nailed to wood blocking at 6" intervals. Coping corners: mitered seamed, sealed with sealant.

2.03 SOFFITS

A. 24 gauge pre-painted galvanized steel.

B. 16"-wide panel with Flat "S" seams.

C. Trim shapes as indicated.

2.04 **FASCIA**

A. 24 gauge pre-painted galvanized steel.

B. Formed in 10' sections of shapes.

C. Shapes as indicated, seams shall be hemmed and sealed.

2.05 **SEALANT**

A. General Electric silicon, GESIL N, clear sealant or equal.

2.06 **DOWNLEADERS**

A. 24 gauge prepainted galvanized steel.

B. Lap end joints minimum of 1½" in direction of water flow, lock longitudinal joints. Provide elbows at bottom.

C. Downspouts: Held in position with 3"-wide straps of same material as downspout, spaced maximum of 10' o.c., fastened securely to wall.

D. Provide double layer to achieve all exposed surfaces of finished color.

E. Open downleaders 4" deep x 6" wide with returns at open face side.

2.07 **SCUPPERS**

A. 20 gauge prepainted galvanized steel.

B. Joined to metal roof flashings by full soldered or welded seams. Provide 3/4"-high gravel stop across scupper opening. Seal around opening.

PART 3 - EXECUTION

3.01 **WORKMANSHIP**

A. Examine surfaces to be covered by sheet metal. Report any improper defective surfaces to Engineer in writing. Beginning of sheet metal work over surfaces: presumed as acceptance of surfaces as satisfactory by sheet metal sub-contractor.

B. Junctures where sheet metal abuts into adjacent dissimilar materials: executed in manner that will prevent electrolysis between the two materials.

C. Insure that all work is precisely done, true to line, and free from over bending, burning, deforming, stretching, distortion, waves and buckles.

3.02 REPAIR

A. Repair or replace all damaged or defective work.

3.03 CLEANING

A. Clean exposed sheet metal of roofing materials, mortar, hand marks, other foreign materials.

END OF SECTION 07600

SECTION 07722

ROOF HATCHES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work includes all labor, equipment, and material necessary for a complete installation of the indicated roof hatch.

C. Related Work specified elsewhere:

1. Section 07532 - Loose Laid / Ballasted Elastomeric Sheet Roofing System.

2. Section 07600 - Flashing and Sheet Metal.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Submit manufacturer's product literature for information only.

1.03 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 ROOF HATCH

A. Unit: Type L-20 as made by the Bilco Company, New Haven, CT; galvanized steel with red oxide primer in manufacturer's standard gauges, weights; insulated cover, integral curb; factory-assembled, complete with standard hardware. Size: 2'-6" x 6'-6". Units meeting requirements of unit specified by Babcock-Davis, Wasco Products, Bohem Mfg. Co., are acceptable.

PART 3 - EXECUTION

3.01 GENERAL

A. Determine that construction of openings for roof hatches has been completed.

B. Do not proceed with installation until conditions are satisfactory.

C. Fasten securely to blocking and roof deck. Install as per manufacturer's recommendations.

3.02 CLEANING

A. Remove debris from site upon completion.

END OF SECTION 07722

SECTION 07810

SKYLIGHTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this section includes providing all materials, equipment, and labor for a complete installation.

C. Related Work specified elsewhere:

1. Section 07530 - Ballasted Elastomeric Sheeting Roofing.

2. Section 07600 - Flashing and Sheet Metal.

3. Section 07722 - Roof Hatches.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Manufacturer's data indicating unit specifications.

1.03 QUALITY ASSURANCE

A. Meet State of Minnesota Energy Code requirements.

B. Thermal transmittance tests: ANSI / ASTM C236-80 and AAMA 1503.1-80.

1.04 WARRANTY

A. Five-year written warranty from manufacturer.

1.05 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 SKYLIGHT

A. Unit Characteristics

1. Size: Inside curb dimensions 55" x 55".

2. Dome: Acrylic double dome, sealed with gaskets, translucent white exterior, clear interior domes.

3. Finish: Natural mill aluminum finish.

4. Curb: Insulated .030" aluminum inner and outer walls, with PVC thermal barrier. Minimum 1" thick fiber glass insulation. 9" high curb minimum 3" wide integral flashing flange.

5. Condensate gutter.

6. Live Load Capacity: 40 lbs.

A. Manufacturer: Naturalite, Inc., or approved equal.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

A. Coordinate as necessary 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 manufacturer's recommendations, anchoring all items securely into position.

C. Put operating components through at least five complete operating cycles, adjusting as required, and achieving optimum ease of operation.

3.03 CLEANING

A. Clean and remove debris from site upon completion.

END OF SECTION 07810

SECTION 07900

JOINT SEALERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes all material, equipment, and labor necessary for joint sealant work at, but not limited to, concrete and masonry joints, precast ceiling joints, and hollow metal frames.

C. Related Work specified elsewhere:

1. Section 07135 - Bentonite Waterproofing

2. Section 07240 - Exterior insulation and finish system.

3. Section 07600 - Flashing and Sheet Metal.

4. Section 08800 - Glazing.

5. Section 09332 - Tile.

6. Section 09800 - Special Coatings: preparation for painting after sealant application.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Color Samples: Submit actual samples of color range of material for Engineer's selection.

2. Manufacturer's Recommendation: Submit technical data including performance requirements, recommendations and application instructions.

1.03 JOB CONDITIONS

A. Examine the joint surfaces and backing, and their anchorage to the structure, and the conditions under which the joint sealer work is to be performed. Do not proceed with the joint sealer work until unsatisfactory conditions have been corrected.

B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range.

1.04 COMPRESSION SEAL WARRANTY

A. Provide manufacturer's standard materials written two (2) year warranty.

1.05 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 SEALANT, ACCESSORIES

A. Sealant (except at plumbing fixtures): two-part polytremdyne (Tremco "Dymeric") or two-part polysulphide (Pecora GC-5 Synthacalk) or Pecora Dynatroll II two-part gungrade polyurethane. FS TT S 00227E, Type I, Class A or B.

B. Horizontal joint sealant: two-part self-leveling polyurethane, Dynatred Gungrade FS TT-S-227E, Type II, ASTM C920.

C. Primer: when required, as recommended by the Sealant Manufacturer.

D. Caulking Back-up: round bars of Ethafoam, Polycel, compatible with sealant.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant or caulking compound. Etch concrete and masonry joint surfaces as recommended by sealant manfuacturer. Roughen vitreous or glazed joint surfaces as recommended by sealant manufacturer.

B. Prime or seal the joint surfaces wherever shown or recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.02 **INSTALLATION**

A. Set joint filler units at proper depth or position in the joint to coordinate with other work, including the installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between the ends of joint filler units.

B. Install bond breaker tape wherever shown and wherever required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

C. Apply compound with a gun having proper size nozzle or with a knife, as required. Use sufficient pressure to fill all voids and joints solid. Remove excess sealant and leave surfaces smooth, neat and clean, upon completion sealant shall have a smooth, even finish and all joints shall be weathertight. All work shall be in accordance with manufacturer's instructions.

D. Paving sealants shall be applied prior to application of water-repellent coatings.

E. Seal around all openings in exterior wall, all masonry control and expansion joints, and where otherwise shown on Drawings.

F. Seal around plumbing fixtures.

G. Seal all interior precast concrete roof deck joints and wall deck joints prior to application of special coatings.

H. Seal around perimeter of all hollow metal frames in walls.

I. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

J. Recess exposed edges of gaskets and joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from the joint.

3.03 **CURE AND PROTECTION**

A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength,

internal cohesive strength and surface durability. Advise the Contractor of procedures required for the cure and protection of joint sealers during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at the time of the Engineer's acceptance.

END OF SECTION 07900

DIVISION 8 - DOORS AND WINDOWS

08110 STEEL DOORS AND FRAMES

08330 COILING DOORS

08360 SECTIONAL OVERHEAD DOORS

08700 HARDWARE

08800 GLAZING

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for all hollow metal doors, door frames, and frames for an interior lite.

C. Related Work specified elsewhere:

1. Section 04200 - Unit Masonry

2. Section 05500 - Metal Fabrications

3. Section 07900 - Joint Sealers

4. Section 08700 - Hardware (hollow metal doors are scheduled to receive exit devices with no overlapping astragal)

5. Section 08800 - Glazing

1.02 REFERENCES

A. DHI, "Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames, and Builders Hardware."

B. SDI-100, "Standard Steel Doors and Frames".

C. SDI-105, "Recommended Erection Instructions for Steel Frames."

D. UL 10B-1979, "Fire Tests of Door Assemblies."

1.03 QUALITY ASSURANCE

A. Obtain hardware templates from hardware supplier (Section 08700) and obtain necessary hardware for factory application.

B. Certain doors and frames are to bear the Underwriters' Laboratories label of proper classification according to UL 10B-1979, "Fire Tests of Door Assemblies". Label requirements shall take precedence over conflicting details and the Engineer shall be so advised before fabricating work on that item is started.

1.04 DELIVERY STORAGE AND HANDLING

A. Deliver doors and frames in suitable crating or packaging to prevent damage in transit and storage.

B. At job site, store doors under cover in a dry area with doors set upright with ¼" spacers between doors. Keep doors at least 4" above ground. Remove all wet cardboard or similar wrappings immediately.

C. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Engineer; otherwise, remove and replace damaged items as directed.

1.05 JOB CONDITIONS

A. Examine the substrate and conditions under which hollow metal work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers: Trussbilt, Pioneer, Fenestra, Steelcraft, Republic, Amweld, Ceco.

B. Request for approval shall be accompanied by descriptive details or brochures demonstrating compliance with specifications, and sample frame corner.

2.02 MATERIALS

A. Steel: Commercial quality, level, cold rolled steel conforming to ASTM A366, free of scale and surface defects. Commercial quality hot rolled and pickled steel conforming to ASTM A569 may be used at contractor's option for interior frames. Gauges are as follows unless otherwise noted:

1. Interior Frames: 16 gauge.

2. Exterior Frames: 14 gauge.

3. Flush Doors: 16 gauge exterior, 18 gauge interior.

4. Rough Bucks and Stiffeners: 12 gauge.

5. Miscellaneous Trim: 16 gauge.

B. Rust-inhibitive primer: Acceptable for epoxy paint finish. Coordinate with Contractor and Section 09800 - Special Coatings.

2.03 FABRICATION

A. Make hardware mortises and reinforcements according to templates. Provide hinge, lock, door holder and closer hardware reinforcements. Mortise, drill, tap for hardware; fabricate grooves, rabbets as necessary for weather-stripping, soundstripping.

B. Fabricate doors to a maximum tolerance of 1/16" from a straight edge when laid on face of door in any direction, including diagonal.

C. Provide proper Underwriters' Laboratory (U.L.) labels as indicated on the Drawings.

D. Clearances:

1. Edge clearances shall be provided as follows:

a. Between doors and frame, at head and jambs - 1/8"

b. At door sills: where no threshold is used - 3/8" minimum

where threshold is used - ½" maximum between door & threshold

c. Between meeting edges of pairs of doors - 1/8"

2.04 METAL FRAMES

A. Provide metal frames of the types and styles indicated on the Drawings or schedules and complying with SDI 100 for materials and construction requirements.

B. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, as shown on the Drawings.

C. All frames shall have mitered corners, be internally welded and ground smooth and provided with floor anchors.

D. Provide one removable and one fixed stop at perimeter of openings for glazed frames. Removable stop on secure side.

E. Provide closed metal covers over all hardware cutouts to protect against mortar.

F. Provide integral channel frames, subframes and stiffeners to structure where indicated or required for fastening and stiffening frames.

G. In masonry walls, provide three - 16 gauge corrugated, adjustable, slip type standard frame anchors up to 7'-6" height jamb; frames 7'-6" to 8'-0" - four anchors; frames over 8'-0" - one anchor for each 2 feet or fraction thereof in height. In labeled frames, anchors shall be non-removable.

H. Provide steel spreader temporarily attached to feet of both jambs for welded frames.

I. Provide three factory installed silencers on single door frames at strike jamb; four (two at each head) silencers on double door frames.

2.05 FLUSH HOLLOW METAL DOOR

A. Provide metal doors for the types and styles indicated on the drawings or schedules and complying with SDI 100 for materials and construction requirements. Exterior doors shall be fully insulated with foam core.

B. Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than 16 gauge, full width spot welded to both faces. Exterior doors shall have an additional flush closing channel at top edge. Provide openings to bottom closure of exterior door to permit escape of moisture.

C. Edge profiles shall be provided on both vertical edges of doors as follows:

D. Lock edges shall be:

1. Single-acting swing doors - beveled 1/8 " in 2".

2. Double-acting swing doors - rounded.

E. Provide glass light openings as indicated complete with one fixed stop and one removable stop fastened with flat head phillips screws not over 10" o.c.

2.06 HARDWARE LOCATION

A. Locks latches, roller latches and double handle sets	Centerline of lock strike 40-5/16" above floor
B. Cylindrical or Mortise Deadlocks	Centerline of strike 60" above floor

C.	Push Plates	Centerline 45" above floor
D.	Pull Plates	Centerline of grip 42" above floor
E.	Combination Push-Pull	Centerline 42" above floor
F.	Panic Devices	Centerline of strike 40-5/16" above floor
G.	Top Hinge	11-3/4" from rabbet section of head of frame to centerline of hinge
H.	Bottom Hinge	13" from the finished floor to centerline of hinge
I.	Intermediate Hinge	Equally spaced between top and bottom hinge

2.07 SHOP PAINTING

A. Completely clean all frames by degreasing process, followed by one coat rust inhibitive primer equal to withstand a salt spray test (5% solution) of 70 hours. Thoroughly prime all surfaces without runs, smears, or bare spots, and under and inside all removable stops.

B. Completely clean all doors of impurities and pressure sand to a smooth surface and correct all irregularities with metallic putty sanded smooth. Provide one spray coat of primer, baked on. Thoroughly paint unexposed inside surfaces of exterior doors, fire doors, and other doors occurring in excessive moisture area.

C. Provide one gallon minimum of primer for field touch up of splices, connections, welds and abrasions.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Work shall be securely fastened in place, without twists, warps, bulges or other unsatisfactory defacing of workmanship. Set plumb, level square to proper elevation true to line and eye. Set clips and other anchors with piston driven fasteners equal to Ramset or drilled-in anchors as approved. Units and trim shall be fastened together with neat, uniform and tight joints.

B. As masonry is being laid fill jambs solid with mortar and provide accurately cut wood spreaders temporarily at mid-section of frames, install jamb anchors.

C. At steel columns and/or concrete surfaces, install sub-frame or rough bucks as specified. At steel columns use 5/16" diameter self-tapping metal screws and at concrete use expansion bolts of the same diameter. Install frame to sub-frame and/or rough buck with countersunk self-tapping metal screws. Fill screw holes with a suitable metallic filler, sand and prime.

D. Where field installed hardware is required, provide wood or other suitable filler to avoid drilling and tapping into mortar inside frames.

E. For all attachments including removable stops, use flat head self-tapping screws. Drill and tap in the field for surface mounted closers, brackets, rim exit devices, door holders, and other surface hardware. At horizontal exterior surfaces, set screws with neoprene gaskets or set with caulking compound under screw head and wipe clean.

F. All field splices to be welded and filled with body putty and ground smooth, no exposed screw heads will be accepted. Location of splices shall be as determined by Engineer on Shop Drawings.

G. Touch up field splices, connections, welds and abrasions with specified primer after installation.

H. Install fire-rated frames in accordance with NFPA Standard No. 80.

3.02 PROTECTION

A. Protect installed hollow metal work against damage from other construction.

B. Repair or replace all damaged work at no extra cost to Owner.

END OF SECTION 08110

SECTION 08330

COILING DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for fire-rated rolling counter fire door.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of coiling door. Provide operating instructions and maintenance information, and complete information describing fire release system including electrical rough-in instructions.

2. Label Certification: Submit UL certification for fire-rated assembly constructed with materials and methods equivalent to requirements for labeled construction.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Package, handle, deliver and store at the job site in a manner that will avoid damage or deformation.

1.04 QUALITY ASSURANCE:

A. Furnish each overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.

1.05 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Cookson, Atlas, Kinnear, North American, or approved equal.

2.02 INTERIOR SERVICE UNITS

A. Rolling counter fire door equal to Cookson FD10-1 Push-up.

1. Automatic closing, fuseable link activated.

2. Slats: 22 gauge, primed galvanized finish.

3. Rating: UL 1½ hour, "B" label.

4. Manufacturer's standard sill.

PART 3 - EXECUTION

3.01INSPECTION

A. Verify that openings are prepared with headers level, jambs plumb, and openings correctly dimensioned to receive doors.

3.02 INSTALLATION

A. Install per manufacturer's recommendations and NFPA 80 requirements.

B. After installation, adjust for proper operation.

END OF SECTION 08330

SECTION 08360

SECTIONAL OVERHEAD DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for sectional metal overhead doors and related items.

C. Related Work specified elsewhere:

1. Section 05500 - Metal Fabrications

2. Section 08700 - Hardware

3. Section 09800 - Special Coatings

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions. Include manufacturer's operating instructions and maintenance data.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Package, handle, deliver and store at the job site in a manner that will avoid damage or deformation.

1.04 QUALITY ASSURANCE

A. Design doors to withstand 27 psf wind pressure and suction forces, normal to surface of door, with maximum deflection of 1/120 of opening width or height.

B. Provide door installation with maximum air infiltration at head and jambs not exceeding 0.37 cfm per lineal foot at 10 mph wind velocity.

1.05 WARRANTY

A. Provide a five-year written warranty.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Clopay embossed steel insulated door, Model 648 A, or approved equal.

1. 24 gauge steel face, hot-dipped galvanized G60, ASTM 525-81, with raised panel design. Frame: Galvanized 16 gauge.

2. Mill finish aluminum back face sheet.

3. Polystyrene insulation, R value = 6.9, U value = .14, with fire-retardant additive UL R-8194A.

4. Hardware: Hinges hot-dipped galvanized 14 and 18 gauge metal, ball bearing rollers.

5. Standard headroom lift track, 16 gauge vertical and 14 gauge horizontal (reinforced as required for door weight).

6. Torsion spring counterbalance.

7. Locking: Inside spring loaded slide bolt.

8. Wind loading per quality assurance data.

9. Weatherstripping: Bottom weather seal and head and jamb weatherstripping (of neoprene). Jamb and head mounted similar to Sealeze JX90VNY.

B. Operator

1. Troller (draw bar) operator.

2. Motor: Single phase, 115V, ½ HP with capacitor start delayed reverse feature.

3. Door Speed: .8 - 1.0 ft/sec.

4. Safety: Reversing edge.

5. Limit Switch: Adjustable.

6. **Emergency Disconnect:** Allows manual operation in emergency.

7. **Push-Button Control:** Three-button, open-close-stop, stopped or reversed in any position. NEMA, general purpose (indoor use enclosure).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Adjust doors for proper operation after installation and prior to acceptance of building.

END OF SECTION 08360

SECTION 08700

HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Should items of hardware not definitely specified be required for completion of work, furnish such items in type and quality comparable to adjacent hardware.

C. Engineer's approval of schedule will not relieve hardware supplier or responsibility to furnish hardware in all quantities required and in conformance with this Specification.

D. This Section includes the furnishing of all labor for installation, required equipment, and finish hardware material specified herein, listed in the hardware schedule, or required by the Drawings.

E. Where items of hardware not definitely or correctly specified are required for completion of the Work, a statement of such omission, error, or other discrepancy should be directed to the Engineer prior to the date specified for receipt of proposals, for clarification by addendum; or, furnish such items in the type and quality established by this Specification, and appropriate to the service intended.

F. Items of hardware include:

1. Finish Hardware
2. Thresholds and Weatherstrip and Door Frame Drip Cap

G. Related Work Specified Elsewhere:

1. Section 08110: Steel Doors and Frames

2. Section 08360: Sectional Overhead Doors and Operators.

1.02 REFERENCES

A. Builder's Hardware Manufacturer's Association, Inc. (BHMA), 60 E. 42nd St., New York, NY 10017.

Recommended Locations for Builders Hardware

B. American National Standards Institute, Inc. (ANSI), 1430 Broadway, New York,NY 10018.

A115.2 Specifications for Standard Steel Door and Frame Preparations for Bored Cylindrical Locks for 1-3/8" and 1-3/4" Doors.

C. Federal Specifications (FS)

FF-H-106a Hardware, Builders'; Locks and Door Trim-Standard Finishes for Builders Hardware.

D. National Fire Protection Association, Inc. (NFPA), Battery March Park, Qunicy, MA 02269.

E. Underwriter's Laboratories, Inc. (UL), 333 Pfingsten Road, Northbrook, IL 60062

Building Materials Directory

1.03 SUBMITTALS

A. Schedules:

1. Immediately after award of the Hardware Contract, submit five copies of a detailed, vertical type hardware schedule for information.

2. Itemize hardware in the sequence and format established by this Specification.

   a. List and describe each opening separately; include door number, room designations, degree of swing, and hand.

   b. List related details; include dimensions, door and frame material, and other conditions affecting hardware.

   c. List all hardware items; include manufacturer's name, identify product, finish, attachments, and related details where applicable.

3. Keying Requirements: Determine keying requirements, as directed by the Owner, coordinate and match existing keyways as directed, reference to ILCO 101EN, and submit five copies of a detailed keying schedule for approval; resubmit four copies of the corrected schedule when required.

1.04 QUALITY ASSURANCE

A. Manufacturer: Manufacturers and product number listed herein establish a standard of quality. Similar items by other manufacturers may be accepted by prior approval. Except where specified in the Hardware Schedule, furnish products of only one manufacturer for each type of hardware.

B. Supplier: Company specializing in the Builder's Hardware Industry.

1.05 **REGULATORY REQUIREMENTS**

A. Furnish UL listed hardware for all UL-labeled and 20-minute openings in conformance with requirements for the class of opening scheduled.

B. NFPA and UL requirements have precedence over this specification where conflict exists.

1.06 **BASIS FOR COMPENSATION**

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 **GENERAL REQUIREMENTS**

A. Deliver sufficiently in advance of installation. Package separately to prevent mingling of unrelated items. Mark items corresponding to door number, install according to manufacturer's instructions.

B. All locks to have 2-3/4" backset and 4-7/8" x 1¼" (ANSI A115.2) strikes.

C. Furnish wide throw butts to clear trim where necessary and wrought box lock strikes with sufficient lip to protect trim.

2.02 **MANUFACTURERS**

A. This specification is based on products of manufacturers as listed in the table that follows.

B. Acceptable products of other manufacturers are as listed in the table.

C. Product List:

	Specified	Approved
1. Butt Hinges	McKinney	Stanley, Hager
2. Flush Bolts	Ives	
3. Locks	Schlage	Corbin, Russwin, Yale
4. Exit Devices	Von Duprin	no substitution
5. Pulls, Push Plates/Bars	Brookline	Cipco
6. Coordinators	Glynn-Johnson	
7. Closers	LCN	no substitution

8.	Overhead Stops	Glynn-Johnson	Corbin, Russwin
9.	Kickplates	Brookline	Cipco
10.	Stops and Holders	Glynn-Johnson	Ives, Hiawatha
11.	Thresholds	Reese	Pemko, Zero
12.	Weatherstrip	Sealeze Corp.	no substitution
13.	Smoke Seals	Stanley	
14.	Sound Seals, Door Bottoms	Reese	Pemko, Zero

D. The hardware supplier shall furnish a copy of the approved hardware schedule and all pertinent templates or template information to each fabricator of material factory-prepared for the installation of hardware.

E. Marking, Packaging, Delivery and Storage

1. All hardware for each opening shall be packaged separately, marked to show its contents and intended location in the project, and properly packed to protect against damage in transit to the job-site or fabricators of factory installed material.

2. The Contractor shall verify hardware quantities upon delivery and provide storage and protection against loss and damage.

F. Finishes and Base Materials

1. Except where indicated otherwise in the hardware groups, all hardware finishes shall be as specified in the table that follows.

2. Hardware finishes shall be applied over base metals as listed in the table.

3. Finish and Base Metal List:

a.	Butt Hinges	
	(1) exterior	US32D on stainless steel
	(2) interior	US26D on steel
b.	Flush Bolts	US26D on brass or bronze
c.	Locks	US26D on brass or bronze
d.	Exit Devices	US26D on brass or bronze
e.	Pulls, Push Plates/Bars	US32D on stainless steel
f.	Coordinators	USP on steel

g.	Closers	AL on cast iron
h.	Overhead Stops/Holders	US26D on brass or bronze US32D on stainless steel at Chemical Feed Room, Door #03
i.	Kickplates	US32D on stainless steel
j.	Stops, Holders	US26D on brass or bronze
k.	Thresholds	Mill on aluminum
l.	Miscellaneous	US26D on brass or bronze

G. Keying

1. Locks shall be change keyed and master keyed as directed by the Owner and Engineer.

2. Each lock shall have two change keys.

3. Provide six masterkeys.

4. Provide two removable core control keys and three emergency keys.

5. Masterkeys shall be delivered or shipped to the Owner via registered mail.

2.03 MATERIALS

A. Butt Hinges

1. The following table lists butt hinges acceptable for this specification.

	McKinney	Hagar	Stanley
a.	T4B3386	BB1199	FBB199
b.	TB2314	BB1191	FBB191

2. Furnish each door leaf with butt hinges fabricated of contract grade material. Butt hinges shall have flat button tips with non-rising pins for all interior doors and non-removable loose pins for exterior doors. All hinges shall be made to template standards.

3. Furnish hinges for each door leaf in accordance with the following:

a. Two hinges per leaf for doors opening 60" high or less.

b. One additional hinge per leaf for each additional 30" in height, or fraction thereof.

c. Four hinges for Dutch doors 90" high or less.

d. 4½" x 4½" for 1-3/4" thick doors.

B. Flush Bolts and Dustproof Strikes

1. The following table lists flush bolts (a) and dustproof strikes (b) acceptable for this specification:

	Ives
a.	458B
b.	488B x 487B

C. All inactive leaves of pairs shall have two flush bolts 458B-12" unless specified otherwise. The center line of the top bolt shall be not more than 78" up from the finished floor line. The bottom bolt shall be provided with dustproof strike 488B x 487B.

D. Locks

1. Locks shall be of quality and design as listed in the following table:

	Corbin	Russwin	Yale
a.	863-400	400-ASH	CO5400
b.	765L-L9500	5000L-CIT	JN8000L
c.	863-9500	5000-W4-ASH	COR8700

2. Locks shall be of uniform size, regardless of function. Cylinder shall have six pin tumblers. Except where specified otherwise, all locks shall have 2-3/4" backset and ½" minimum throw latchbolt. All deadbolts shall have 1" bolt projection.

3. Lip length of strike plates shall be of proper length for door thickness and jamb condition. All strikes shall be wrought box type.

4. Locks for labeled and "20-minute" doors shall be UL listed.

5. Lock knobs or lever handles on doors to stairs other than exit stairs, loading platforms, stages, boiler rooms, and other hazardous locations shall be knurled.

E. Exit Devices

1. Furnish Von Duprin 88 Series exit devices as specified in the hardware groups.

2. Exit devices shall be UL listed for life safety.

3. Furnish through bolts for all devices specified for mineral core door application.

4. Exit devices for labeled and "20-minute" doors shall be UL listed for life safety and safety to property.

F. Pulls

1. The following table lists pulls acceptable to this specification:

	Brookline	Cipco
a.	807	2612
b.	808	57

G. Push Plates/Bars

1. The following table lists acceptable push plates:

	Brookline	Cipco
a.	69	550 - 8 x 16
b.	54	550 - 4 x 16
c.	220B LBP	2245S
d.	775	292J

2. Push plates shall be .050-16 gauge with four beveled edges.

H. Coordinators

1. All pairs of doors having automatic flush bolts or vertical rod mortise lock fire exit device combinations with astragals shall be furnished with a Glynn-Johnson No. COR-2 coordinator with full remaining width filler bar.

2. Furnish appropriate filler bars for total opening width, closer mounting brackets, carry bars as required and special preparations for top latches.

I. Closers

1. Furnish LCN 4010/4110 Series closers complete with all mounting brackets, drop plates and special shoes as may be required by door and frame conditions.

2. Furnish through bolts for closers specified for mineral core doors.

3. Size of closer shall be as recommended by manufacturer.

4. Install closers on the room side of corridor doors and on the stair side of stairways.

5. Furnish closers for all labeled doors and "20-minute" doors.

J. Overhead Stops

1. Furnish a Glynn-Johnson GJ360 Series overhead stop (GJ560 Series for labeled and "20-minute" doors) for all doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall and for all doors that open against equipment, casework, sidelights or other objects that would make wall bumpers inappropriate.

K. Kickplates

1. Kickplates and armor plates shall be .050 - 16 gauge with three beveled edges, 2" less than the door width on single doors, 1" less than the door width on pairs. Kickplates shall be 10" high.

L. Wall and Floor Stops

1. The following table lists acceptable wall and floor stops.

	Glynn-Johnson	Ives	Hiawatha
a.	WB50	401	1326
b.	FB19X	442	1328

M. Thresholds

1. The following table lists acceptable thresholds.

	Reese	Pemko	Zero
a.	S205	171A	665A
b.	S245 (at Chem Feed Room)		

N. Weatherstrip

1. The following table lists acceptable weatherstripping.

	Sealeze
a.	DS-384 (mill)
b.	DS-484 (dark bronze anodized)
c.	DS-584 (clear anodized)

O. Smoke Seals

1. The following table lists acceptable smoke seals for 20-minute doors.

	Stanley
a.	10-5050

P. Sound Seals

1. The following table lists acceptable sound seals.

	Reese	Pemko	Zero
a.	499	350ASN	770

Q. Door Bottoms

1. The following table lists acceptable door bottoms.

	Reese	Pemko	Zero
a.	430	434A	360

PART 3 - EXECUTION

3.01 APPLICATION

A. Accessories and Attachments

1. Hardware shall include all necessary accessories such as wood or machine screws, bolts, nuts, anchors, toggle bolts, and other fasteners. Each shall be of the proper type, size, material and finish for its intended purpose and according to the materials to which the hardware is to be applied.

2. Installation

1. Install hardware in accordance with manufacturer's printed instructions at mounting heights specified in this section of the specification.

2. Install hardware on UL labeled openings so as to maintain the label.

3. Hardware shall be completely fitted before final coat of paint or other finish is applied and then removed. Mortising and cutting shall be done neatly and evidence of cutting shall be concealed in the finish work. Permanently install hardware after finishing operations are complete. Protect hardware from damage, adjust, and leave in good operating condition.

4. Set threshold in full bed of sealant except at Chem Feed Room where threshold shall be set in bed of mortar.

B. Mounting Heights

1. Mounting heights shall conform to the recommended mounting locations of the National Builders Hardware Association.

3.02 HARDWARE SCHEDULE

GROUP 1 HM X HM, EXT, EXIT DOOR ONLY

Butts	1½ pr FBB179 4½ x 4½ NRP
Lockset	Schlage D250-Orbit (exit lock)
Door Closer	4110 LCN
Weatherstrip	1 set
Sweet	1 set
Threshold	5" aluminum
Rain Drip	Aluminum
Latch Guard	Latch Gard Co., zinc-plated

GROUP 2 HM X HM, EXT

Butts	1½ pr FBB179 4½ x 4½ NRP
Cylinder	1" throw, match ILCO 101EN keyway
Pull	12"
Pushplate	4" x 16"
Door Closer	4110 LCN
Weatherstrip	1 set
Sweep	1 set
Threshold	5" aluminum
Rain Drip	Aluminum
Latch Guard	

GROUP 3 HM X HM, PR DOORS, EXT

All hardware US32D unless noted otherwise.

Butts	3 pr FBB179 4½ x 4½ NRP
Exit Device	Series 99 Von Duprin 9947 NL with pull, US28 9947 EO, exit only, US28
Cylinder	Match ILCO 101EN keyway
Door Closer	LCN closer (SRI finish)
Weatherstrip	2 sets
Sweep	2 sets
Threshold	5" aluminum, Reese S245
Rain Drip	Aluminum

END OF SECTION 08700

SECTION 08800

GLAZING

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for all interior glazing of hollow metal sidelites.

C. Related Work specified elsewhere:

1. Section 08110: Steel Doors and Frames

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Manufacturer's recommended installation instructions to Engineer prior to installation.

1.03 QUALITY ASSURANCE

A. Reference Specification: Glazing Manual by Flat Glass Marketing Association.

B. Materials: Conform in all respects to the "Safety Standard for Engineered Glazing Materials" (16CFR 1201) issued by the Consumer Product Safety Commission and Chapter 54 of the Uniform Building Code.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Package, handle, deliver and store at the job site in a manner that will avoid damage. Scratched glass will be rejected.

1.05 JOB CONDITIONS

A. Examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed. Do not proceed with the glazing until unsatisfactory conditions have been corrected.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 GLASS

GLT 4: ¼" tempered, clear, FS-DDG-451 Grade B, Style 1, Type 1, Quality 93, Class 1, free of tong marks, ANSI Z97.1

2.02 ACCESSORIES

A. Glazing Sealant: One-part polysulphide, similar to Pecora GC-9 Synthacalk, Fed. Spec. TT-S-230C.

B. Setting Blocks: 70-90 Shore "A" durometer, sized to accommodate size of glass used, compatible with glazing sealant.

C. Spacers: Compatible with sealant used.

D. Primer - Sealers, Cleaners: As recommended by glass manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Check that glazing channels are free of burrs, irregularities, and debris.

B. Check that glass is free of edge damage or face imperfections.

C. Do not proceed with installation until conditions are satisfactory.

3.02 PREPARATION

A. Field Measurement:

1. Measure size of frame to receive glass.

2. Compute actual glass size, allowing for edge clearances.

B. Preparation of Surfaces:

1. Remove protective coatings from surfaces to be glazed.

2. Clean glass and glazing surfaces, to remove dust, oil and contaminants. Wipe dry.

3.03 **INSTALLATION**

A. Install glass in accordance with glass manufacturer's recommended instructions.

3.04 **CLEANING**

A. Remove excess glazing compound from installed glass.

B. Remove labels from glass surface as soon as installed.

C. Wash and polish both faces of glass.

D. Remove debris from work site.

3.05 **PROTECTION OF COMPLETED WORK**

A. Attach crossed streamers away from glass face.

B. Do not apply markers to glass surface.

C. Replace damaged glass.

END OF SECTION 08800

DIVISION 9 - FINISHES

09332 TILE

09800 SPECIAL COATINGS

SECTION 09332

TILE

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for tile work.

C. Related Work specified elsewhere:

1. Section 03300 - Concrete Substrate Surface.

2. Section 04200 - Masonry Substrate Surface.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Submit samples for colors in duplicate for each tile.

2. Submit two (2) samples each for each different trim piece required for this project.

3. Submit grout samples indicating color range anticipated, texture.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated by reference.

1. Tile Council of America, Inc., Handbook for Ceramic Tile Installation.

2. ANSI A137.1-88.

3. ANSI A108-85.

B. Site Mock-Up

1. Provide sample mock-up of each type of tile to be used for approval by Owner and Engineer. Sample mock-up shall be aprpoximately 2 to 4 sf in an area of part of the final work.

2. If mock-up is not accepted, correct or completely remove and re-do as approved by the Engineer.

1.04 PRODUCT HANDLING, DELIVERY AND STORAGE

A. Package, handle, deliver and store at the job site in original unbroken containers in a manner that will avoid damage or contamination. All containers shall bear grade seals, manufacturer's name, size, color and quantities.

1.05 JOB CONDITIONS

A. Set and grout tile when ambient temperature is at least 50°F and rising.

1.06 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The following sets the standard of quality for the project:

1. Manufacturer: United States Ceramic Tile Company, or approved equal.

a. Tile for Base: Provide sizes up to 12" x 12" Ultima glazed tile, cushioned edges. Nominal, color selected from any of standard 10 colors. Provide bull nose shapes for typical base, and outside corner trim shapes.

b. Floor Tile: 8" x 8" Ultima glazed tile, cushioned edges, color selected from any standard ten colors.

B. Portland cement: ASTM C 150, type 1.

C. Sand: ASTM C 144.

D. Water: Clean and potable.

E. Cleaners: As manufactured by Hillyard Chemical Company.

F. Grout: Upco Hydroment or approved equal, standard color as selected.

G. Expansion Joints

1. Backup: Ethafoam rod stock

2. Sealant: Tremco Dymeric

PART 3 - EXECUTION

3.01 EXAMINATION OF SURFACES

A. Inspect surfaces to which tile is to be applied and notify the Contractor of any defects.

3.02 SETTING BEDS

A. Provide all labor and materials required for a complete installation of the following Tile Council of America standard setting beds.

B. Interior wall tile: TCA W243 dry-set mortar or latex-cement mortar.

C. Interior floor tile: TCA F113, latex Portland cement mortar.

3.03 INSTALLATION

A. General

1. Installation and workmanship shall be in accordance with ANSI A108.1 and as specified herein. The printed instructions of the tile manufacturer and the manufacturer of proprietary mortars and grouts shall be followed where applicable.

2. Confirm tile pattern and layout with Engineer prior to installation.

3. Before commencing work, establish field pattern and border line locations and center the work symmetrically so that no tile need be cut to less than half size. Joints in wall tile shall be aligned vertically and horizontally; staggered joints will not be accepted. Rub exposed edges smooth.

4. Use skilled workers who are thoroughly trained and experienced and familiar with specified requirements and methods needed for proper performance.

B. Handle, store, mix and apply proprietary setting and grouting materials in compliance with the manufacturer's instructions.

C. Extend tile work into recesses and under equipment and fixtures to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disruption of pattern or joint alignments. All partial tile shall be cut with straight true lines.

D. Comply with manufacturer's instructions for the mixing and installation of proprietary materials.

E. Neutralize and seal substrates in accordance with mortar manufacturer's instructions, where required.

F. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base and trim are the same size. Lay out tile work and center tile fields both directions in each space or on each wall area. Provide uniform joint widths. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.

G. Expansion, Control Joints

1. Expansion joints: Extend completely through tile mortar bed. Preformed back-up material; inserted in expansion, control joints at proper depth to provide correct cavity depth for sealant.

2. Width of expansion, control joints: Same as tile joints.

3. Prior to grouting, keep expansion, control joints open, clean.

4. After tile is grouted, completely dry, remove temporary filler material; brush joints clean, fill expansion, control joints with specified back-up materials, sealant.

5. Provide control joints at building control joint locations.

3.04 CLEANING, PATCHING, PROTECTION

A. After completion, clean all work, point open joints and replace defective work.

B. Protection

1. Floors: Close off work spaces to traffic during installation and at least 48 hours after completion of work.

2. Finished tile floors: Covered with clean building paper before foot traffic is permitted on them. Board walkways shall be placed on floors that are to be continuously used as passageways by workmen. Tiled vertical outside corners (external angles) shall be protected with board corner strips in areas used as passageways by workmen.

END OF SECTION 09332

SECTION 09800

SPECIAL COATINGS

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications

B. The Work required under this Section includes providing all materials, equipment, and labor necessary for surface preparation and coating system application of exposed surfaces in accordance with the schedule included herein.

1. This Work includes the application of special coating systems to all exposed surfaces as scheduled, including surface preparation, priming and topcoats.

2. Special coatings are defined as those types of materials and applications requiring more than normal skills and techniques for mixing, handling, and application.

3. "Exposed Surfaces" is defined to include areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation grilles, etc., are in place in areas scheduled to be coated. However, extend special coatings in these areas as required to maintain the coating system integrity and provide the desired protection.

C. List of items included:

Without restricting the generality of the above, the work to be performed under this section shall include, but not be limited to the following:

1. Special coating system for well discharge pipe, water lines, appurtenant valves, meters, fittings, and treatment and chemical feed equipment.

2. Special coating system for chemical lines.

3. Special coating system for air compressor compressed air lines.

4. Special coating system for factory finished equipment.

5. Special coating system for interior insulated pipe.

6. Special coating system for interior concrete masonry walls, concrete walls, concrete beams, columns and ceiling not in contact with potable water, concrete and concrete block walls, ceiling in chemical feed room.

7. Special coating system for backwash tank interior concrete walls, floor, columns, beams, and ceiling.

8. Special coating system for backwash tank equipment, piping, valves, and appurtenances.

9. Special coating system for interior concrete surfaces of sumps and floor trenches, structures that contain non-potable water wastewater, or sludge.

10. Special coating system for louvers, lintels, doors, structural steel, and fabricated items.

Where items or surfaces are not specifically mentioned, apply special coatings to these the same as adjacent similar materials or areas.

D. Related Sections:

1. Shop priming

   a. Section 05120 - Structural Steel
   b. Section 05500 - Metal Fabrications
   c. Section 05550 - Metal Stairs, Handrails, Railings, Grating, and Floor Plates
   d. Section 08110 - Steel Doors and Frames
   e. Section 08360 - Sectional Overhead Doors and Operators
   f. Section 11224 - Deep Well Vertical Turbine, Pump, and Motor
   g. Section 11500 - Contactor Vessels and Internals
   h. Section 11600 - Package Iron Remove System
   i. Section 11900 - Process Piping

2. Shop coat on process equipment, machinery and electrical equipment. Refer to the sections under which various items of equipment with factory applied shop prime coat are furnished, including but not limited to the following sections. All items of equipment furnished with prime coat finish excluding switchgear shall be coated under this section.

a. Section 11210 - Backflush Booster Pump
b. Section 11211 - Air Compressor System
c. Section 11216 - Submersible Centrifugal Pumps (Backwash Tank)
d. Section 11224 - Deep Well Vertical Turbine Pump and Motor
e. Section 11365 - Fluoridation System
f. Section 11371 - Chlorination System
g. Section 11500 - Contactor Vessels and Internals
h. Section 11600 - Package Iron Removal System

3. Color Coding of mechanical piping, chemical feed tubing, and electrical conduits: Divisions 11, 15, and 16.

a. This Color Coding consists of an adhesive tape system and is in addition to painting of piping and conduits under this section, as specified above.

E. Materials and Equipment not to Receive Special Coating Systems

1. Items of equipment furnished with complete factory finish in conformance with the finish thickness and type of coating specified in this Section or related Sections specified in paragraph 1.01C of this Section of these Specifications, except for items specified to be given a finish coat under this section.

2. Non-ferrous metals, except for items specified and/or indicated to be coated.

3. Surfaces not to receive specialty coatings shall be left completely free of droppings and accidentally applied materials resulting from the work of this section.

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. ASTM D3363-74, "Test Method for Hardness by Pencil Test"

2. ASTM D4060-84, "Test Method for Abrasion Resistance of Organic Coatings by the Taben Abraser"

3. ASTM D4541-85, "Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers"

4. ASTM D117-85, "Method of Salt Spray (Fog) Testing"

5. NSF Standard 61, "Drinking Water System Components - Health Effects"

6. SSPC-SP1, "Solvent Cleaning"

7. SSPC-SP6, "Commercial Blast Cleaning"

8. SSPC-SP7, "Brush-Off Blast Cleaning"

9. SSPC-SP10, "Near-White Blast Cleaning"

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical information including basic materials analysis and installation instructions for each material specified. List each material and cross-reference to the specific coating and finish system and application. Identify by manufacturer's catalog number and general classification.

B. Samples: Prior to beginning work, submit samples for Engineer's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

1. For steel surfaces to be coated on a 12-inch x 12-inch steel plate, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested until required sheen, color, and texture is achieved.

2. On 8-inch square masonry, provide two samples of each type of finish and color; define filler, prime and finish coats.

3. On actual wall surfaces and other interior and exterior building components, duplicate coating finishes of prepared samples. On at least 25 square feet of surface as directed, provide full-coat finish samples until required sheen, color, and texture is obtained; simulate finished lighting conditions for review of in-place work. Samples submitted above shall be used to establish standards of coating application and finish.

1.04 QUALITY ASSURANCE

A. Provide primers, intermediate coats and finish coats produced by a single manufacturer. Use only thinners approved by coating manufacturer and within recommended limits.

B. Review other sections in these Contract Documents in which prime coats are to be provided to ensure compatibility of total coatings

systems for various substrates. Upon request, furnish information on characteristics of specified special coating system, to ensure that compatible prime coats are used. Notify Engineer if any anticipated problems using coating systems which are specified.

C. Where coating materials are in contact with sealants in the finish work, verify that all materials are compatible.

1.05 DELIVERY AND STORAGE

A. Deliver materials in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material
2. Fed. Spec. number if applicable
3. Manufacturer's stock number and date of manufacture
4. Manufacturer's name
5. Contents by volume, for major pigment and vehicle constituents
6. Thinning and mixing instructions
7. Application instructions
8. Color name and number

B. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of special coatings.

C. Store materials not in actual use in tightly covered containers. Maintain containers in storage of coatings in a clean condition, free of foreign materials and residue.

D. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions required to prevent fires.

1.06 JOB CONDITIONS

A. Do not apply coatings when the temperature of surfaces to be coated and the surrounding air temperatures are below 50° F (10°C), unless otherwise permitted by coating manufacturer's printed instructions.

B. Do not apply coatings in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by coating manufacturer's printed instructions.

1. Do not apply coatings unless surface temperature is a minimum of 5° F above dew point.

C. Coating work may be continued during inclement weather only if areas and surfaces to be coated are enclosed and heated within temperature and humidity limits specified by coating manufacturer during application and curing periods.

D. Protect all surfaces not to be coated to absolutely ensure that those surfaces are not stained or otherwise adversely affected by Work under this Section or other Work performed. This specifically includes, but it not limited to, covering concrete floor surfaces to prevent stains and damage from coatings, traffic, or other Work during any of the coating process or other Work related activities.

1.07 COOPERATION WITH OTHER TRADES

A. This Work shall be scheduled and coordinated with that specified in other Sections and shall not proceed until other Work and/or job conditions are as required to achieve satisfactory coating results.

B. Examine the specifications of the various other Sections, become thoroughly familiarized with all their provisions regarding coating.

1.08 MAINTENANCE STOCK

A. Provide maintenance stock of each color of each special coating system specified. Deliver to the Owner at the completion of the entire project. All containers shall be factory labeled indicating name or title of material, manufacturer's stock number and date of manufacture, manufacturer's name, contents by volume, color name and number, and coating number as specified. Maintenance stock shall be new and in full unopened containers.

B. In addition to maintenance stock, provide manufacturer's printed literature indicating description of coating, shipping and storage safety data, surface preparation, and application procedures.

C. Provide maintenance in quantities as noted below. Where specific coats are equal-volume two component (i.e., 1 part "A" to 1 part "B") materials, provide quantity indicated for each part (i.e., 1 gallon part "A", 1 gallon part "B"). Where specific coats are unequal-volume two component (i.e., 2 parts "A" to 1 part "B", etc.) materials, provide appropriate quantity indicated for each part (i.e., 2 gallons part "A", 1 gallon part "B").

1.9 BASIS FOR PAYMENT

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MATERIAL QUALITY

A. Provide the best quality grade of the various types of coatings as regularly manufactured by approved coating materials manufacturers. Do not use materials not displaying the manufacturer's identification as a standard, best-grade product.

B. Provide undercoat recommended by the manufacturer of the finish coats. Use only thinners approved by the coating manufacturer, and use only within recommended limits.

C. Coating shall not be badly settled, caked or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency and shall have excellent application properties.

D. All thinning and tinting materials shall be as recommended by the manufacturer for the particular material thinned or tinted.

2.02 COLORS AND FINISHES

A. Coating colors will be selected from manufacturer's standard.

B. Prior to beginning work, the Contractor shall furnish sample color chips for surfaces to be coated. Match the colors of the chips as specified herein, before proceeding with the work.

C. Proprietary names used to designate colors or materials are not intended to imply that products of the manufacturers are required to the exclusion of equivalent products of other manufacturers, subject to approval by Engineer.

D. It shall be the responsibility of the Contractor to see that all mixed colors match the color selection made by the Engineer prior to application of the coating.

E. Coating shall arrive on the job color-mixed except for tinting of undercoats and possible thinning.

2.03 EQUIVALENT PRODUCTS

A. Products and systems of the following manufacturers are approved as acceptable. Alternate products will require approval by Engineer.

System Schedule	MANUFACTURER		
	Tnemec	Carboline	Glidden
SC-1, SC-2, SC-3, SC-5, SC-6	Series 66	Series 890	Series 5461/5452 Series 5430
SC-4	Series 6 Tneme-Cryl	Series 3300	Series 6900 Low Gloss
SC-7, SC-8	Series 20 Pota-Pox	Series 891	Series 5250/5452
SC-9	Series 46H-413 HI-BUILD Tneme-Tar	Series Carbomastic 18	Series 5270/5271 (Two Coats)
SC-10	Series 70 Endura Shield	Series 134	Series 6200
Block Filler	Series 54-660		

Products supplied shall meet the performance criteria as established for the Tnemec Series special coating within limits as specified for the following ASTM Test Methods: ASTM B117, ASTM D3363, ASTM D4060, and ASTM D4541.

2.04 SYSTEMS SCHEDULE

A. Coatings listed are based on products manufactured by Tnemec Company. Equivalent products may be used as set forth in Paragraphs 2.03 above.

1. Mil thicknesses indicated shall be dry mil thickness.

B. Refer to Article 3.02 for detailed procedures of surface preparation.

1. SC-1: All piping (ductile iron, steel, or copper) containing water.

   a. Surface Preparation: Commercial blast cleaning SSPC-SP6.
   Shop Primer: 66 Hi-Build Epoxoline primer - 4.0 mils

   b. Finish:

   Spot primer after erection:
   66 Hi-Build Epoxoline Primer 4.0 mils

   Second Coat: 66 Hi-Build Epoxoline 4.0 mils

   Third Coat: 66 Hi-Build Epoxoline 4.0 mils

2. SC-2: Chemical lines (PVC carrier conduit)

   a. Surface preparation: Provide sanding to produce matte finish.

   b. Finish:

   First coat: 66 Hi-Build Epoxoline 3.0 mils

   Second coat: 66 Hi-Build Epoxoline 3.0 mils

3. SC-3: Compressed air lines, gas lines (steel).

   a. Surface Preparation: Remove grease, oil, and all foreign matter by solvent cleaning, SSPC-SP1. All interior steel other than pipes shall be followed by commercial blast cleaning SSPC-SP6. Note: Galvanized steel to receive the applicable solvent cleaning preparation only, followed by the 2-coat finish.

   b. Finish:

   First Coat: 66 Hi-Build Epoxoline Primer 3.0 mils

   Second Coat: 66 Hi-Build Epoxoline 4.0 mils

4. SC-4: Factory finished equipment such as electric motors and compressors, shall be coated as follows:

a. Surface Preparation:

1) Surfaces which are sound, fully adhered, not rusty and compatible with the subsequent coatings to be utilized shall be sanded to provide adhesion for the subsequent finish coats. The surface shall be cleaned to remove all dust, dirt, grease, oil and other foreign material or contaminants, SSPC-SP1.

2) All other surfaces shall have the surface preparation required by the applicable SC items.

b. Finish:

First Coat:	66 Epoxoline Primer	3.0 mils
Second Coat:	66 Hi-Build Epoxoline	4.0 mils
Third Coat:	70 Endura Shield (exterior only)	1.5 mils

5. SC-5: Insulated pipe (canvas):

a. Surface Preparation: Remove grease, oil, and all foreign matter.

b. Finish:

First Coat:	6 Tneme - Cryl	3.0 mils
Second Coat:	6 Tneme - Cryl	3.0 mils

6. SC-6: Interior concrete masonry walls, concrete walls, concrete beams, concrete columns and ceilings not in contact with potable water. Concrete and concrete blockwalls and ceiling in chemical feed room.

a. Surface Preparation: Chemical cleaning followed by brush-off blast cleaning, SSPC-SP7.

b. Apply manufacturer's 54-660 block filler to all concrete surfaces prior to application of finish coats.

c. Finish:

First Coat:	66 Hi-Build Epoxoline	6.0 mils
Second Coat:	66 Hi-Build Epoxoline	6.0 mils

7. SC-7: Backwash tank interior, cast-in place concrete walls, floor, columns, beams, and ceiling.

   a. Surface Preparation: Chemical cleaning followed by brush-off blast cleaning.

   b. Finish:

First Coat:	20 Pota-Pox	6.0 mils
Second Coat:	20 Pota-Pox	6.0 mils

8. SC-8: Backwash tank interior equipment, piping, valves, and appurtenances.

   a. Surface Preparation: Commercial blast cleaning SSPC-SP6.

Shop Primer:	20 Pota-Pox primer	4.0 mils

   b. Finish:

Spot primer after erection:	20 Pota-Pox primer	4.0 mils
Second coat:	20 Pota-Pox	4.0 mils
Third coat:	20 Pota-Pox	4.0 mils

9. SC-9: Interior concrete surfaces of sumps and floor trenches that contain non-potable water, wastewater, or sludge.

   a. Surface Preparation: Chemical cleaning followed by brush of blast cleaning, SSPC-SP7.

   b. Finish:

First coat:	46H-413 Hi-Build Tnemec Tar	16.0 mils

10. SC-10: Louvers, lintels, doors; fabricated pipe supports, structural steel (grating support system and stairs), steel surfaces in chemical feed room.

a. Surface Preparation: Solvent cleaning SSPC-SP1 followed by near white blast cleaning, SSPC-10. Notes: (1) Galvanized steel shall receive the applicable solvent cleaning preparation only followed by the 3-coat finish. (2) Aluminum louvers shall receive the applicable solvent cleaning preparation only followed by the 3-coat finish.

Shop Primer:	66 Hi-Build Epoxoline Primer	4.0 mils

b. Finish:

Spot primer after erection:

	66 Hi-Build Epoxoline Primer	4.0 mils
First Coat:	66 Hi-Build Epoxoline	4.0 mils
Second Coat:	66 Hi-Build Epoxoline	4.0 mils
Third Coat:	70 Endura Shield (exterior only)	1.5 mils

2.05 COLOR CODING

A. Furnish appropriate materials as specified in this section in the colors specified in the following schedule for the described system.

B. Colors are based on color selection charts of the three referenced manufacturers.

C. Color Schedule:

Item Description	Coating System	Inemec	Carboline	Glidden
1- Process Piping and Treatment Units	SC-1			
- Influent		BB72 Teardrop	7107	Light Blue
- Effluent		BB72 Teardrop	7107	Light Blue
- Backwash Influent		BB72 Teardrop	7107	Light Blue
- Backwash Effluent		AL42 Honey Locust	0217	Granary
- Carbon Transfer		AB05 Black	C900	Black
- Iron Removal Filter and Appurtenances		BB72 Teardrop	7107	Light Blue
- Contactor Vessels and Appurtenances		BB72 Teardrop	7107	Light Blue
- Well Discharge Head		BB42 Clear Sky	7108	Atomic Blue

Item	Description	Coating System	Inemec	Carboline	Glidden
2	Chemical Feed Lines and Equipment	SC-2			
	- Chlorine (gas and solution)		BU57 Yellow	S625	Safety Yellow
	- Fluoride		BB72 Teardrop w/6-inch CC13 safety red bands at 30-inch intervals	7107 5525	Light Blue Safety Red
3	Compressed Air and Gas Lines	SC-3			
	- Compressed Air Lines		AR12 Foliage	3359	Insulator Green
	- Gas Lines		CC13 Safety Red	5525	Safety Red
4	Factory Finished Equipment	SC-4			
	- Booster Pump		BB72 Teardrop	7107	Light Blue
	- Air Compressor-Receiver Tank and Frame		AR12 Foliage	3359	Insulator Green
	- Well Motor		BB42 Clear Sky	7108	Atomic Blue
5	Insulated Pipe	SC-5	Color to be selected by Owner and Engineer		
6	Interior Concrete Masonry Walls, Concrete Walls, Beams, Columns, and Ceilings	SC-6	Color to be selected by Owner and Engineer		
7	Backwash Tank, Interior Concrete Walls, Columns, Beams, Ceilings, and Floor	SC-7			
	- First Coat		20-1211 Red	0500 Red	Red
	- Second Coat		20-AA83 Tank White	5800 White	White
8	Backwash Tank Interior Equipment, Piping, Valves, and Appurtenances	SC-8			
	- Primer and Second Coat		20-1211 Red	0500 Red	Red
	- Third Coat		20-AA83 Tank White	5800 White	White
9	Interior Concrete Sump	SC-9	Color as supplied by manufacturer		
10	Steel Louvers, Lintels, Doors	SC-10	Color to be selected by Owner and Engineer		
11	Other				
	- Steel Pipes Supports and Metal Framing	SC-10	Color to be selected by Owner and Engineer		

Item Description	Coating System	Inemec	Carboline	Glidden
- Valve Handles for 6-Inch and Larger	SC-1	BB42 Clear Sky	7108	Atomic Blue
- Contactor Vessel Collection Gallery	See Section 11500			
Prime and First Coat		20-1211 Red	0500 Red	Red
Finish Coat		20-AA83 Tank White	5800 White	White
- Iron Filter Internals	See Section 11600			
Prime and First Coat		20-1211 Red	0500 Red	Red
Finish Coat		20-AA83 Tank White	5800 White	White

D. Decal labels shall be placed on pipe together with arrow indicating direction of flow. Labels shall be located not more than 10 feet apart and in general at each valve and piece of equipment. Label shall be worded as shown in quotes on the process Contract Drawings.

Outside Diam. of Pipe or Covering	Size of Letters
1" to 2"	3/4"
2" to 6"	1"
8" to 10"	2"
Over 10"	3"

2.06 APPLICATION EQUIPMENT

A. Application equipment is not required to be new, but shall be adequate for the work and workmanship required herein.

2.07 ACCESSORY MATERIAL

A. This work shall include all required ladders, scaffolding, drop cloths, maskings, scrapers, tools, dusters, respiratory equipment, cleaning solvents and waste, as required to perform the work and achieve the results herein specified.

PART 3: EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions related to the coating work. Before proceeding with the coating work, correct conditions detrimental to its proper and timely completion.

B. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, overspray, or conditions otherwise detrimental to formation of a durable coating film. Remove using appropriate methods and repair or patch undercoats as required before proceeding.

3.02 SURFACE PREPARATION

A. General

1. Perform preparation and cleaning procedures in compliance with the coating manufacturer's instructions for the particular substrate conditions, and as herein specified.

2. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items which are not to be coated, or provide surface applied protection prior to surface preparation and coating operations. Remove, if necessary, for the complete coating of the items and adjacent surfaces. Following coating completion in each space or area, reinstall the removed items, using workmen skilled in the trades involved.

3. Clean surfaces to be coated before applying coatings or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and application so dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

4. Mildew shall be removed and the surface neutralized per the coating manufacturer's recommendations.

5. Efflorescence and stains on any areas shall be corrected before coating.

B. Concrete Masonry Walls

1. Verify that masonry is properly cleaned and pointed as specified in Division 4. Notify Engineer if conditions are incompatible for application of coatings.

2. Remove all sand, dirt, and foreign matter with a "brush-off" blast cleaning process similar to SSPC-SP7.

3. All scratches, cracks, abrasions shall then be cut out and filled with an approved compatible patching material. Patches shall be made flush with adjoining surfaces. Apply Tnemec 54-660 block filler to all surfaces prior to finish coating.

5. Do not apply coatings unless surface moisture content is 12 percent or less. Refer to coating manufacturer's printed recommendations as to acceptable method for determining moisture content. Perform tests in accordance with these recommendations.

C. Steel and Aluminum Louvers, Lintels, Doors

1. Prepare steel in accordance with SSPC-SP10 "Near White".

2. Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1 "Solvent Cleaning".

3. Abrasive shall be free of corrosion-producing contaminants and also free of oil, grease, or other deleterious contaminants.

4. Selection of abrasive size and type shall be based on the type, grade and surface condition of the steel to be cleaned and on the finished surface to be produced for the subsequent coating system.

5. After blast cleaning and prior to application of the coating system:

   a. Remove visible deposits of oil, grease, or other contaminants per SSPC-SP1.

   b. Remove dust and loose residue.

   c. Rectify all surface imperfections which become visible.

D. Concrete Surfaces

1. Chemically clean all surfaces with ProSoCo (Sure Klean) "Heavy Duty Concrete Cleaner", or equal.

2. Thoroughly rinse clean with potable water.

3. After the surface moisture content is below 12 percent (or at a lower level required by the coating manufacturer), prepare all concrete surfaces with a "brush off" blasting procedure similar to SSPC-SP7.

4. All scratches, cracks, abrasions shall then be cut out and filled with Tnemec 54-660 Filler and Surfacer. Patches shall be made flush with adjoining surfaces.

5. Do not apply coatings unless surface moisture content is 12 percent or less. Refer to coating manufacturer's printed recommendations as to acceptable methods for determining moisture content. Perform tests in accordance with these instructions.

6. Acid etch entire surface with phosphoric acid. While still wet, flush with potable water, provide a minimum 36-inch wide band of water rundown. Allow to dry thoroughly. Test for alkalinity. If pH is below 7, repeat washdown with water until pH is 7 or greater.

7. Remove all laitance and other loosely bound material. Patch as specified below.

8. Protect exposed aggregate surface during coating process.

E. Insulated Pipe Covering (Canvas)

1. Remove all dirt, grease, oil, or all extraneous matter.

2. Do not damage covering.

3. Test coverings for moisture. Moisture content shall be 12 percent or less. Refer to coating manufacturer's printed recommendations.

F. Equipment Housings (Steel or Cast Iron), Water Pipes, and Structural Steel

1. Prepare steel in accordance with SSPC-SP6 "Commercial Blast Cleaning".

2. Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1 "Solvent Cleaning".

3. Abrasive shall be free of corrosion-producing contaminants and also free of oil, grease, or other deleterious contaminants.

4. Selection of abrasive size and type shall be based on the type, grade and surface condition of the steel to be cleaned and on the finished surface to be produced for the subsequent coating system.

5. After blast cleaning and prior to application of the coating system:

a. Remove visible deposits of oil, grease, or other contaminants per SSPC-SP1.

b. Remove dust and loose residue.

c. Rectify all surface imperfections which become visible.

3.03 MATERIALS PREPARATION

A. General

1. Carefully mix and prepare materials in compliance with manufacturer's directions.

2. Do not mix coating materials produced by different manufacturers.

3. Store materials in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

4. Stir materials before application to produce a mixture of uniform density, and as required during application. Do not stir film, which may form on surfaces, into material. Remove film and, if necessary, strain material before using.

B. Tinting

1. Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.04 WORKMANSHIP GENERAL

A. Only skilled mechanics shall be employed. Application shall be by spray only, except as otherwise approved by the Engineer.

B. Furnish the Engineer a schedule showing when Contractor expects to have completed the respective coats for the various areas and surfaces. This schedule shall be kept current as the job progresses.

C. Protect the work at all times, and protect all adjacent work and materials by suitable covering or other method during progress of his work. Upon completion of the work, remove all coating spots from floors, glass and other surfaces. Remove from the premises all

rubbish and accumulated materials of whatever nature and leave the work in clean, orderly and acceptable condition.

D. Sealant and caulking shall be taped prior to coating of adjacent surfaces.

E. Remove all overspray from surfaces prior to subsequent coating. Overspray on finish surfaces will not be acceptable.

F. Remove and protect name plates, hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items, or provide ample in-place protection. Upon completion of each space, carefully replace all removed items.

G. Remove electrical panel box covers and doors before painting walls. Coat separately and reinstall after all coating is dry.

H. All materials shall be applied under adequate illumination, evenly applied and flowed-on smoothly to avoid runs, sags, holidays, and air bubbles.

I. Coverage and hide shall be complete. When color, stain, dirt, or undercoats show through final coat, the surface shall be covered by additional coats until the coating film is of uniform finish, color, appearance, and coverage, at no additional cost to the Owner.

J. All coats shall be dry to manufacturer's recommendations before applying succeeding coats.

K. All suction spots or "hot spots" in cement after the application of the first coat shall be touched up before applying the second coat.

3.05 APPLICATION

A. General:

1. Apply special coatings by spray application in accordance with the manufacturer's printed directions.

2. Do not apply succeeding coats until the previous coat has cured as recommended by the coating manufacturer. Sand between coat applications where required to produce an even, smooth surface in accordance with the coating manufacturer's directions.

3. Apply additional coats when undercoats or other conditions show through the final coat until the coating film is of uniform finish, color and appearance.

4. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.

5. Coat the back sides of access panels, removable or hinged covers to match the exposed surfaces.

B. Minimum Coating Thickness: Apply each material at not less than the manufacturer's printed recommended spreading rate. Provide a total dry film thickness of the entire coating system as specified.

C. Prime Coats:

1. Before application of finish coats, apply a prime coat to material which is required to be coated, and which has not been prime coated by others.

2. Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

D. Mechanical Applications:

1. Wherever spray application is used, do not double-back with spray equipment for the purpose of building-up film thickness of two coats in one pass.

E. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish work not in compliance with specified requirements.

3.06 FIELD QUALITY CONTROL

A. The right is reserved by the Owner to invoke the following material testing procedure at any time, and any number of times during the period of coating.

1. The Owner may engage the service of an independent testing laboratory to sample the materials being used. Samples of materials delivered to the project site will be taken, identified and sealed, and certified in the presence of the Contractor.

2. The testing laboratory may perform appropriate tests for any or all of the following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness,

recoating, skinning, color retention, alkali resistance, and quantitative materials analysis.

B. If the test results show that the materials being used do not comply with the specified requirements, the Contractor will be directed to stop the work, and remove noncomplying materials; pay for testing; recoat surfaces painted with the rejected materials; remove rejected materials from previously painted surfaces if, upon recoating with the specified materials, the two coatings are noncompatible.

C. Contractor shall establish and maintain quality control for work under this section to assure compliance with Contract requirements. Maintain records of all certification of surface preparation and mil thickness.

3.07 CLEAN-UP AND PROTECTION

A. Clean-Up:

1. During the progress of the Work, remove from the project all discarded paint materials, rubbish, cans, and rags resulting from the work.

2. Upon completion of Work, clean all spattered surfaces. Remove spattered materials by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3. Upon completion of the Work, clean and remove all dust, abrasive material, or other residuals from surface preparation and coating operations from all surfaces in the facility.

B. Protection:

1. Protect work of other trades, whether to be coated or not, against damage by the work. Correct damage by cleaning, repairing or replacing, and repainting, as directed by the Engineer. Leave all work in undamaged condition.

2. Provide "Wet Paint" signs as required to protect finishes. After coating application, remove temporary protective wrappings provided by others for protection of their work during coating operation.

3. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paint and special coatings.

END OF SECTION 09800

DIVISION 10 - SPECIALTIES

10200 LOUVERS AND VENTS

10520 FIRE PROTECTION SPECIALTIES

SECTION 10200

LOUVERS AND VENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor to furnish and install metal louvers in exterior walls.

C. Related Work specified elsewhere:

1. Section 07900: Sealants

2. Section 09800: Special Coatings

3. Division 15: Mechanical (Interior louvers/diffusers, ductwork to this Section's louvers, final connection to this Section's louvers)

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Product Data: Submit manufacturer's product data for information only.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Package, handle, deliver and store at the job site in a manner which will avoid damage or deformation. Damaged louvers and vents will be rejected.

1.04 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 WALL LOUVERS

A. The specification is based on the products of Ruskin Louvers, or equal, to establish quality.

B. Louvers: Model ELF 128, 6" deep extruded aluminum weather louvers. Blades shall be "K" style, stormproof type blade.

C. Louvers shall be of size as shown on Drawings.

1. Type 0.051-inch thick, 3/4" square mesh galvanized bird screen, 16 gauge.

D. Louvers shall be phosphatized and given prime coat.

E. Minimum 43% free area.

F. Provide aluminum drip cap sill extension.

PART 3 - EXECUTION

3.01 INSPECTION

A. Check openings to assure that dimensions conform to Drawings.

B. Assure that openings are free of irregularities which would interfere with installation.

C. Do not install louvers until defects have been corrected.

D. Separate metal surfaces from dissimilar metals, and from wood and cementitious substrates by a thick coating of fibrated bituminous compound or other separation as recommended by the metal manufacturer, and as required to prevent corrosive action.

E. Anchor louver frame permanently to the substrate, by methods which are adequate for the sizes and location of unit.

3.02 INSTALLATION

A. Install louvers with aluminum clip angles at head jamb and sill, as shown on Drawings.

B. Follow procedures in manufacturer's recommended installation instructions.

3.03 ADJUST AND CLEAN

A. Set adjustable louver blades for uniform alignment in open and closed positions.

B. Adjust louvers so moving parts operate smoothly.

C. Repair damage to louvers to match original, or replace.

END OF SECTION 10200

SECTION 10520

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work under this Section includes providing all materials, equipment, and labor for fire extinguishers, cabinets, and brackets as specified and shown on Drawings.

1.02 SUBMITTALS

A. Submit the following in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Brochure: Submit brochure of materials and installation details to Engineer for information only.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Package, handle, deliver and store at the job site in a manner that will avoid damage. Damaged equipment will be rejected.

1.04 BASIS FOR COMPENSATION

A. All work covered under this section will be included under the lump sum contract price bid.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. All equipment is specified from the line of J.L. Industries; comparable equipment of Elkhard Brass Mfg. Co., General, Noris, Larsen and Badger are acceptable. All fire extinguishers shall bear UL label for type.

2.02 FIRE EXTINGUISHERS, CABINETS, AND BRACKETS

A. FE Type 1: 10# Ambassador Steel, 4A-60BC with No. 3013 F12 Panorama Cabinet, Style F12 (surface mounted).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install level and plumb, true to line.

B. Install where shown on drawings.

C. Check extinguishers for proper charge, operation.

D. Remove and replace damaged defective or under charged units.

END OF SECTION 10520

DIVISION 11 - PROCESS EQUIPMENT

11210	BACKFLUSH BOOSTER PUMP
11211	AIR COMPRESSOR SYSTEM
11216	SUBMERSIBLE CENTRIFUGAL PUMPS (BACKWASH TANK)
11224	DEEP WELL VERTICAL TURBINE PUMP AND MOTOR
11365	FLUORIDATION SYSTEM
11371	CHLORINATION SYSTEM
11500	CONTACTOR VESSELS AND INTERNALS
11501	GRANULAR ACTIVATED CARBON
11600	PACKAGE IRON REMOVAL SYSTEM
11900	PROCESS PIPING

SECTION 11210

BACKFLUSH BOOSTER PUMP

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish and install one (1) in-line end suction centrifugal pump for boosting backflush pressure. The pump shall be complete with coupling and constant speed motor. The pump shall be installed at the location shown on the Contract Drawings. The pump suction source shall be GAC treated water from the effluent distribution pipe and the pump discharge shall be the backflush influent manifold pipe.

B. Products Installed But Not Furnished:

1. Section 11900 - Expansion joints/vibration isolation
2. Section 03600 - Grout for leveling

C. Related Sections

1. Section 03300 - Cast-In-Place Concrete
2. Section 03600 - Grout
3. Section 09800 - Special Coatings
4. Section 11900 - Process Piping
5. Section 16900 - Starters and Motor Control

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. ANSI B16.1-1975. "Cast Iron Pipe Flanges and Flange Fittings, Class 25, 125, 250, and 800"

2. ANSI/ASME B73.2M-1984. "Specification for Vertical In-Line Centrifugal Pumps for Chemical Process"

3. ANSI/ASME B15.1-1984. "Safety Standards for Mechanical Power Transmission Apparatus"

4. ASTM A395-80. "Specification for Ferritic Ductile Iron Pressure - Retaining Castings for Use at Elevated Temperatures"

5. Hydraulic Institute Standards for Centrifugal Rotary and Reciprocating Pumps, 14th Edition, 1982.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements

Operating Condition

Flow (gpm)	1,100
TDH (feet)	45-60 (at required flow at 60 feet TDH and 1,110 gpm))
Min. Hydraulic Efficiency %	75

1.04 SUBMITTALS

A. Operation and Maintenance Instructions

The following documents shall be submitted. See ANSI B73.2M Appendix A for a detailed description of each document. The Contractor shall follow the guidelines established in ANSI B73.2M Appendix A regarding information included and presentation format.

1. Pump and driver outline drawing.
2. Centrifugal pump data sheet.
3. Mechanical seal drawing.
4. Performance curve.
5. Cross-section drawing.
6. Instruction manual.
7. Master document list.
8. Parts list.
9. Motor data.

B. Quality Control Submittals

The Contractor shall submit a certificate documenting the pump and pump items furnished meet the applicable portions of ANSI B73.2M as described in Part 2 of this section.

1.05 DELIVERY AND STORAGE

Contractor shall provide a safe storage area on-site suitable for pump storage prior to installation. Pump shall be stored on a dry elevated foundation and the area shall be protected against freezing and other weather conditions. Pumping unit shall not be wrapped or covered with plastic or other material that would result in condensation or trapped moisture.

1.06 SEQUENCING AND SCHEDULING

The Contractor shall coordinate the pump installation with the work to be performed under the related sections described in this section. Pump installation shall be coordinated with process piping installation to ensure proper pump intake and discharge vertical and horizontal alignment. Pump base shall be supported as shown on the Contract Drawings. Grout leveling for pump support shall be in accordance with Section 03600 of these Specifications.

1.07 MAINTENANCE

A. The following spare parts shall be supplied with the centrifugal pumping unit:

1. Mechanical seal replacement kit
2. Two casing gaskets
3. Two impeller o-rings

B. The spare parts shall be packaged in a manner suitable for long-term storage. Packages shall be clearly marked indicating item(s), size and quantity. Spare parts shall be delivered to the site before Substantial Completion of the project.

1.08 BASIS FOR COMPENSATION

Compensation for all Work performed under this Section of these Specifications shall be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 PUMP GENERAL

A. The centrifugal pumping unit shall be of the in-line suction, center line discharge design with vertical mount motor. The pumping unit shall be dimensionally interchangeable with respect to mounting dimensions, size and location of suction and discharge nozzles, input shafts, base plates, and foundation bolt holes in accordance with ANSI/ASME B73.2M Figures 1 and 2, regardless of pump manufacturer.

B. The centrifugal pumping unit shall meet or exceed all requirements of ANSI/ASME B73.2M. Changes to specific sections or selection of materials described in ANSI/ASME B73.1M are presented below.

DESIGN AND CONSTRUCTION FEATURES

1. Pressure and Temperature Limits

   Pressure Limits - The design pressure of the casing, including stuffing box and gland shall be at least as great as the pressure-temperature rating of ANSI B16.1 Class 125.

2. Flanges - Suction and discharge nozzles shall be flanged and drilled conforming with ANSI B16.1, Class 125.

3. Casing

   Drain Connection Boss - Pump casing shall have boss to provide for drain connection. The drain boss shall be drilled and tapped to accommodate 1/2 inch NPT tap.

   Jackets - Jackets for heating or cooling the casing or stuffing box will not be necessary.

   Gaskets - The casing-to-cover gasket shall be constructed of a non-asbestos material.

   Support - The casing shall be designed to accommodate the auxiliary support shown on the Contract Drawings.

4. Impeller

   Adjustment - Means for external adjustment of the impeller axial clearance shall be provided.

5. Materials of Construction - Pump body and major wetted parts shall be cast ductile iron. The cast ductile iron used shall meet or exceed material specification ASTM A395.

6. Driver and Coupling Method - Pump and motor coupling shall be of the vertical coupled "VC" design.

7. Miscellaneous Design Features

   Safety Guards - A coupling guard in accordance with ANSI/ASME B15.1 shall be furnished for the pumping unit. Guarding of the shaft between the stuffing box and bearing bracket shall be furnished.

   Shaft Seal - Shaft seal shall be mechanical and be replaceable without dismantling the rotating element.

C. Manufacturer's pump curves have been reviewed and the following pump has been determined to be hydraulically acceptable. If the Contractor proposes to provide an alternate pump, Contractor shall submit performance curves prepared by the manufacturer that show that the proposed pump meets these Specifications. An alternate pump is subject to approval by Engineer. The impeller size given below is presented only to indicate hydraulic performance of readily available pump and impeller combinations. The pump manufacturer may customize the impeller in order to meet the hydraulic performance required. It is the Contractor's responsibility to furnish a pump meeting the materials specification established in this section.

1. Ingersoll-Rand Company (New York, New York).

   Pump size and type: 6 x 4 x 10 VOC. 9½-inch impeller.

   Provides 1,100 gpm against a head of 60 feet at a manufacturer's rated efficiency of approximately 75 percent and 25 brake horsepower.

D. External Finish

1. The centrifugal pumping unit and frame shall be prime painted with corrosion resistant epoxy primer. Primer coating shall be compatible with the products specified in Section 09800. Final finishing as specified in Section 09800.

2. All bolts, screws, and other external hardware shall be galvanized for resistance to corrosion.

2.02 MOTOR

A. The pump motor shall be a constant speed, totally enclosed, fan-cooled (TEFC), high efficiency, ball bearing unit of ample power for starting and operating the pump under the full range of the operating curve without overloading.

B. The motor shall be suitable for operation at 460 volts (nominal), 60 Hz, three-phase, and shall have a 1.15 service factor. Nominal motor horsepower rating shall be a nominal 25 (not including the 1.15 service factor). The electrical service has been designed for a nominal 30 hp motor. Should the Contractor supply a larger motor, Contractor shall increase the electrical service at no cost to Owner.

C. Motor shall conform with applicable NEMA, IEEE, and ANSI standards. Motors using non-standard frames or otherwise of special characteristics shall not be used. Motor ratings shall be based on

current NEMA design standards for continuous duty and/or multiple starts per hour. Horsepower, torque, and speed characteristics shall be suitable for the full normal range of operating conditions of the driven equipment without exceeding 95 percent of the nameplate FLI and temperature rise ratings regardless of size. Nameplate FLI shall be based on nameplate HP and shall not include the 15 percent S.F. Wherever horsepower ratings of motors proposed differ from those shown or specified, this fact shall be brought to the attention of the Engineer prior to installation.

D. The motor shall have anti-friction ball bearings, sized for average life of at least 100,000 hours under normal loading conditions (see MG1-14.45). Bearing shall be AFBMA standard sizes. Motors shall be equipped with endshield-mounted ball bearings made to AFBMA standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.

E. Balance and Vibration

1. The vibration in any direction as measured at the bearing housings, with the motor running at normal voltage and frequency, the shaft axis in normal position, and with one-half of a standard key in the keyway shall not be more than 0.0015 inches total amplitude peak to peak.

F. The motor shall have an aluminum or stainless steel nameplate, stamped with the following information:

1. Horsepower (not including 15 percent S.F.)
2. Speed
3. Time Rating
4. Frequency
5. Phases
6. Model Number
7. Rated Voltage
8. Service Factor (1.15 on all motors 1 HP and larger)
9. Full Load Amps (based on nameplate HP, not including 15 percent S.F.)
10. Insulation Class
11. NEMA Design
12. NEMA Code Letter

13. Maximum Ambient Temperature
14. Bearing Identification

G. NEMA locked-rotor characteristics shall not exceed Code G.

H. External Finish

1. The motor shall be prime painted with corrosion resisting epoxy primer. Primer coating shall be compatible with the products specified in Section 09800. Final finishing shall be as specified in Section 09800.

2. All bolts, screws, and other external hardware shall be treated by zinc with irridite or zinc chromate for resistance to corrosion.

I. The motor shall have a minimum NEMA efficiency of 92.4 percent.

2.03 SOURCE QUALITY CONTROL

A. Centrifugal pumping unit components shall be supplied by the same equipment supplier and shall be totally compatible with all the components of the centrifugal pumping unit. Items required for installation of the centrifugal pumping unit and appurtenances shall be by the same manufacturer and type as those specified elsewhere in these Specifications.

PART 3: EXECUTION

3.01 PUMP AND MOTOR INSTALLATION

A. Install pump and motor according to manufacturer's specifications supplemented by the installation guidelines presented in the "Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps" under the Instructions for Installation, Operation and Maintenance section. The pump and motor shafts shall be aligned according to the manufacturer's specifications and procedure. The Contractor shall install expansion joints at both the intake and discharge nozzles as shown on the Contract Drawings.

Installation of the pumping system shall be conducted under the supervision of a qualified representative of the equipment supplier.

3.02 MOTOR START UP

A. Check to ensure proper lubrication, drive alignment and condition, proper rotation, and any or all other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation shall be indicated by a conspicuous and legible tag.

B. As part of the operational test the Contractor shall arrange for checking and recording of load current and verification of rating of overload heatings. No unattended operation of the equipment shall be permitted until completion of this procedure.

3.03 OPERATOR TRAINING

A. Provide a minimum of one hour of operator training at Owner's convenience after system is operational.

3.04 FIELD QUALITY CONTROL

The Contractor shall establish and maintain quality control for Work under this section to assure compliance with contract requirements and maintain records of quality control for all construction operations including, but not limited to, the following:

1. Pump and motor leveling and location
2. Motor shaft and pump shaft alignment and coupling procedures
3. Performance testing and motor start-up data.

A copy of the records of inspection and tests, as well as the records of corrective actions taken shall be furnished to the Owner and Engineer.

END OF SECTION 11210

SECTION 11211

AIR COMPRESSOR SYSTEM

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish and install one (1) base mounted compressor assembly, which includes two (2) compressor pumps, two (2) motors, dual controls, vertical air receiver tank, refrigerant air dryer, filters, regulators, air relief valves, lubricator, miscellaneous valves, fittings, and appurtenances. Compressor pumps, motors, control panel, and receiver tank shall be mounted on a steel frame. The compressor unit shall be installed in the location shown on the Contract Drawings. The Contractor shall plumb the compressed air delivery line from the supply tank to the compressed air manifold pipe as shown on the Contract Drawings.

B. Products Installed But Not Furnished:

1. Process piping and fittings for connection of air supply line to compressed air manifold pipe: Section 11900.

C. Related Sections

1. Section 05500 Metal Fabrications
2. Section 09800 Special Coatings
3. Section 11900 Process Piping
4. Section 16900 Starters and Motor Control
5. Section 11600 Package Iron Removal System

1.02 SYSTEM DESCRIPTION

A. Compressed air will be used to pressurize carbon transfer tank trucks or the contactor vessels during carbon transfer operations. The compressed air will be the driving force for moving a carbon/water slurry through the carbon transfer piping and tanks. Compressed air will also be used for pneumatic valve actuators and pressure aeration of the influent to the iron removal system. During carbon transfer operations, the pneumatic valve actuators and iron removal system pressure aerator will not require compressed air. Pneumatic valve actuator and iron removal pressure aerator operations will occur simultaneously. Contractor shall be solely responsible for coordination of the a carbon transfer, pressure aerator, and pneumatic valve actuator air requirements to ensure that the supplied

air compressor system meets the multiple air requirements as established in this Section of these Specifications.

B. Performance Requirements

1. Air Requirements

Carbon Transfer Operations

35 cubic feet per minute after compression to be delivered at 20 psig to the contactor vessels. Contractor shall note that the air requirements are presented as air delivery after compression to a minimum of 20 psig, not as free air prior to compression.

Pressure Aeration System

The iron removal pressure aeration system air shall be supplied by the air compressor system specified in this Section. Back pressure at the point of application of the compressed air will be a maximum of 100 psig. Air compressor system shall be capable of providing compressed air at a pressure exceeding 100 psig and at the rate determined by the iron removal system supplier.

Pneumatic Valve Operations

Pneumatic cylinder valve actuator operation air shall be supplied by the air compressor system specified in this section. Pneumatic valve actuator air supply shall be 80 psig minimum. Air requirements shall be determined by valve supplier and iron removal system supplier.

2. Duty Cycle

Air compressor system shall be designed for 100 percent duty cycle during carbon transfer operations. Duty cycle for other operations shall be less than 40 percent.

3. Starts Per Hour

Air compressor system shall be designed for less than 12 starts per hour for operations other than carbon transfer.

1.03 SUBMITTALS

A. Manufacturer's Literature/Data

The Contractor shall submit to design specifications of the compressor system. Design specifications are to include rated compressed air delivery rate and pressure, motor horsepower, supply tank capacity and pressure rating, and compressor pump construction details and type, control system schematic and component information, refrigerant air drying system specifications, air regulator, air relief, and lubricator specifications.

B. Operation and Maintenance Instructions

The Contractor shall submit compressor system operation and maintenance manuals and master parts list.

1.04 DELIVERY AND STORAGE

Contractor shall provide for a safe storage area on-site suitable for compressor system storage prior to installation. Compressor unit shall be stored on a dry elevated foundation and the area shall be protected against freezing and other weather conditions. Compressor unit shall not be wrapped or covered with plastic so as to trap moisture or cause condensation.

1.05 SEQUENCING AND SCHEDULING

The Contractor shall coordinate the compressor system installation with the work performed under the related sections. Steel framing and grating installation shall be coordinated with compressor system support frame installation. Contractor shall be responsible for coordination of steel frame and grating compatibility with compressor system support frames.

1.06 MAINTENANCE

A. The following spare parts shall be supplied with the air compressor unit:

1. Twelve compressor intake air filters
2. Eight belts for drive systems.

B. The spare parts shall be packaged in a manner suitable for long-term storage. Packages shall be clearly marked indicating item(s), size and quantity. Spare parts shall be delivered to the site and stored

in the location directed by Owner before Substantial Completion of the project.

1.07 BASIS FOR PAYMENT

Payment for all work covered under this section of these Specifications shall be included in the lump sum price bid.

PART 2: PRODUCTS

2.01 COMPRESSOR UNIT GENERAL

A. The compressor pumps shall be of the twin cylinder (two stage), reciprocating single acting, piston-type. Compressor pumps shall be no-load starting. Pistons and cylinders shall be constructed of precision ground cast aluminum or cast iron. Connecting rods shall be constructed of steel or aluminum alloy and provide for high strength and long life. Compressor pump valves shall be high efficiency wafer type with removable seats and designed for long service life. Compressor pumps shall be as manufactured by Quincy, Champion, Comp Air Kellogg, or approved equal.

B. The air receiver tank shall meet or exceed all ASME codes for compressed air pressure vessels and shall be designed for a minimum working pressure of 175 psi. The tank shall be 200 gallons minimum. Contractor shall be responsible for supplying a larger receiver tank if the duty cycle and starts per hour requirements are not achieved with a 200-gallon air receiver tank. The air receiver tank shall stand vertical. The remote air receiver thank shall be mounted on the same frame as the compressor pump and controls. The air receiver tank shall include a safety valve, service valve, automatic and manual drain valves, and pressure gauge. All pipe and fittings required for connection shall be the size and type specified in Section 11900 and as shown on the Contract Drawings.

C. Contractor shall be responsible for setting the controls and sizing the air receiver tank to accommodate the performance requirements as specified in this section. Regulators shall provide for air delivery control from the air receiver tank to the various compressed air manifold pipes to within an accuracy of ± 1/2 psi. All compressor unit appurtenances shall be totally compatible with other components of the compressor unit and related processes and provide for operation of the compressor unit for its intended purpose.

D. Compressor unit and frame shall be supplied with vibration isolation.

E. External Finish

1. The compressor pumps and motors shall be prime painted with corrosion resistant metal primer and finish painted with a durable machinery enamel. Air receiver tank and support frame shall be shop primed with an epoxy primer compatible with the coatings specified in Section 09800. Final finishing of the frame and receiver tank shall be as specified in Section 09800.

2. All bolts, screws and other external hardware shall be galvanized for resistance to corrosion.

2.02 MOTOR

A. The compressor system motors shall be constant speed, totally enclosed, fan cooled (TEFC), high efficiency, ball bearing unit of ample power for starting and operating the compressors under the operating conditions specified, without overloading.

B. The motor shall be suitable for operation at 460 volts (nominal), 60 Hz, three-phase, and shall have a 1.15 service factor. Motor horsepower rating shall be nominal 10 (not including the 1.15 service factor). The electrical service has been designed for two (2) nominal 10 hp motors. Should the Contractor supply larger motors, both motors shall be the same horsepower and Contractor shall increase the electrical service at no cost to Owner.

C. Motors shall conform with applicable NEMA, IEEE, and ANSI standards. Motors using non-standard frames or otherwise of special characteristics shall not be used. Motor ratings shall be based on current NEMA design standards for continuous duty and/or multiple starts per hour. Horsepower, torque, and speed characteristics shall be suitable for the full normal range of operating conditions of the driven equipment without exceeding 95 percent of the nameplate FLI and temperature rise ratings regardless of size. Nameplate FLI shall be based on nameplate HP and shall not include the 15 percent service factor. Wherever horsepower ratings of motors proposed differ from those shown or specified, this fact shall be prominently noted on the shop drawings submitted, or otherwise brought to the attention of the Engineer.

D. Motors shall have anti-friction ball bearings, sized for average life of at least 100,000 hours under normal loading conditions (see MG1-14.45). Bearings shall be AFBMA standard sizes. Motors shall be equipped with endshield-mounted ball bearings made to AFBMA standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to

minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. Sealed bearings shall be allowed provided the service life of the bearings is equivalent to 100,000 hours. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.

E. Balance and Vibration

1. The vibration in any direction as measured at the bearing housings, with the motors running at normal voltage and frequency, the shaft axis in normal position and with one-half of a standard key in the keyway shall not be more than 0.0015 inch as total amplitude peak to peak.

F. The motors shall have an aluminum or stainless steel nameplate, stamped with the following information:

1. Horsepower (not including 15 percent S.F.)
2. Speed
3. Time Rating
4. Frequency
5. Phases
6. Model Number
7. Rated Voltage
8. Service Factor (1.15 on all motors 1 HP and larger)
9. Full Load Amps (based on nameplate HP, not including 15 percent S.F.)
10. Insulation Class
11. NEMA Design
12. NEMA Code Letter
13. Maximum Ambient Temperature
14. Bearing Identification

G. NEMA locked-rotor characteristics shall not exceed Code H.

H. External Finish

1. The motors shall be prime painted with corrosion resisting metal primer, and finish painted with a durable machinery enamel.

2. All bolts, screws, and other external hardware shall be treated by zinc with irridite or zinc chromate for resistance to corrosion.

I. The motors shall have a nominal NEMA efficiency of 89.5 percent.

2.03 CONTROLS

A. The air compressor system shall have an integral control system to operate the compressors and maintain desired pressure in the receiver tank. The controls shall be mounted in a NEMA 12 enclosure that is mounted to the assembly as shown on the Contract Drawings. The unit shall be completely factory wired, requiring only a field power connection.

B. The control panel shall receive a 40 amp, 480 volt, three-phase service, and shall contain a control power transformer with fused and grounded secondary. The panel shall contain an adjustable differential pressure switch for each compressor motor on-off control, "off-automatic" selector switches, running time meters, and fused combination starters with manual reset bimetallic thermal overloads. The starters shall be NEMA rated with an external disconnect handle to allow turning off each unit individually without opening the enclosure. Control panel shall include an automatic alternator that allows for alternating the compressor pumps and motors for each start at low air load requirements. The automatic alternator shall also allow for operation of both compressors and motors during high air load requirements during carbon transfer operations. Both compressor motors shall run when the system pressure falls below a specified level.

2.04 REFRIGERANT AIR DRYER

A. Air for pneumatic valve actuator operation shall be refrigerant dried. Refrigerated air drying system shall have a minimum capacity of 5 SCFM at 100 psig, 100°F inlet and ambient temperature, and dew point of 35°F. The air drying system shall include an automatic drain system and require minimum operator attention. Refrigerant air dryer shall be equivalent to Norgren Model D11-005-1D00.

B. The air dryer shall be suitable for operation from a 20 amp, 115 volt, 60 Hz, single phase electric power supply.

2.05 AIR LINE FILTERS

A. Air line filter for carbon transfer air line shall be 1-inch NPTF ported basic 1-inch body. Filter shall be rated for a minimum 150 psig. Body shall be constructed of aluminum. Filter element shall be 40 micron constructed of plastic. Bowl shall be 32 ounce constructed of aluminum. Manual drain control shall be included. Seals shall be Buna N. Carbon transfer air line filter shall be equivalent to Parker Model 08F-5-3-A.

B. Refrigerant air dryer inlet air line filter shall be 1/2-inch NPTF ported basic 1/2-inch body. Filter shall be rated for a minimum 150 psig. Body shall be constructed of aluminum. Filter element shall be 40 micron constructed of plastic. Bowl shall be constructed of transparent polycarbonate and 8 ounce capacity. Filter shall include a manual drain. Seals shall be Buna N. Pneumatic cylinder air line filter shall be equivalent to Parker Model 07F-3-1-A.

C. Carbon transfer air line oil removal filter shall be 1-inch NPTF ported. Oil removal filter shall be rated for a minimum 150 psig and remove 99.9 percent minimum of liquid aerosols. Body shall be constructed of aluminum. Filter element shall be constructed of borosilicate and felt glass fibers. Bowl capacity shall be 32 ounces and constructed of aluminum. Filter shall include manual drain. Seals shall be Buna N. Carbon transfer air line oil removal filter shall be equivalent to Parker Model 13F-5-5-J.

D. Refrigerant air dry inlet air line oil removal filter shall be 1/2-inch NPTF ported. Oil removal filter shall be rated for a minimum 150 psig and 99.9 percent removal of liquid aerosols. Body shall be constructed of aluminum. Bowl shall be 8 ounce capacity and constructed of polycarbonate. Filter element shall be constructed of borosilicate and felt glass fibers. Filter shall include manual drain. Seals shall be Buna N. Pneumatic cylinder air line oil removal filter shall be equivalent to Parker Model 12F-3-1-F.

2.06 AIR LINE REGULATORS

A. Carbon transfer air line regulator shall be of the standard relieving type and capable of reducing pressure from the receiver tank air pressure of to 10 psig at a minimum pressure drop across the regulator. Regulator shall be 1-inch NPTF ported. Secondary pressure ranges shall be 1-60 psig $\pm$ 1 psig. Regulators shall include 60 psi 2-inch diameter gauge mounted on the downstream end. Regulators shall be equivalent to Parker Model 08R-5-11-A.

B. Pneumatic cylinder air line and pressure air line regulators shall be of the standard relieving type and capable of reducing air pressure from the receiving tank to 50 psig at a minimum pressure drop across the regulator. Regulator shall be 1/2-inch NPTF ported. Secondary pressure ranges shall be 2-125 psig $\pm$ 1 psi. Regulators shall include a 125 psi 2-inch diameter gauge mounted on the downstream end. Regulators shall be equivalent to Parker Model 07R-3-13-A.

2.07 PNEUMATIC VALVE AIR LINE LUBRICATOR

Pneumatic valve air line lubricator shall be of the micro-mist design and lubricate compressed air at a rate as determined by the iron removal system valve system. Pressure rating shall be 150 psig, minimum. Body shall be constructed of polycarbonate. Lubricator shall be equivalent to Parker Micro-Mist Air Line Lubricator.

2.08 SOURCE QUALITY CONTROL

Compressor system components shall be supplied by the same equipment supplier and shall be totally compatible with all components of the compressor unit. Items required for installation of the compressor unit and appurtenances shall be of the same manufacture and type as those specified elsewhere in these Specifications.

PART 3: EXECUTION

3.01 COMPRESSOR UNIT AND MOTOR INSTALLATION

A. The compressor system, air receiver tank, motor, frame, and controls shall be installed according to manufacturer's specifications and under the supervision of a qualified representative of the equipment supplier.

B. Install pipe and fittings necessary for air supply line connection to the compressed air manifold pipe in accordance with Section 11900.

3.02 MOTOR START UP

A. Check to ensure proper lubrication, drive alignment and condition, proper rotation, and all other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation shall be indicated by a conspicuous and legible tag.

B. As part of the operational test the Contractor shall arrange for checking and recording of load current and verification of rating of overload heaters. No unattended operation of the equipment shall be permitted until completion of this procedure.

3.03 COMPRESSOR SYSTEM FINAL ADJUSTMENT AND TESTING

A. After the compressor system has been placed in operation, the equipment supplier's representative shall make all final adjustments for the proper operation of the equipment.

B. The Contractor shall perform a leak test on the entire system to ensure leak-free operation. The system, including compressed air line to air receiver, air receiver, and air supply line to compressed air manifold pipe, shall be pressurized to a minimum of 120 psi and maintain system pressure ± 2 psi for a minimum of two hours. Repair all leaks, replace all defective pipe and fittings, and retest for leaks.

3.04 OPERATOR TRAINING

Provide a minimum of four (4) hours of operator training at Owner's convenience after system is operational. Training to be provided by qualified representative of equipment supplier.

3.05 FIELD QUALITY CONTROL

The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements and maintain records of his quality control for all construction operations including, but not limited to, the following:

1. Motor shaft and pump shaft alignment and coupling procedures
2. Frame unit leveling
3. Leak testing
4. Start-up records

A copy of the records of inspection and tests, as well as the records of corrective actions taken shall be furnished to the Owner and Engineer.

END OF SECTION 11211

SECTION 11216

SUBMERSIBLE CENTRIFUGAL PUMPS (BACKWASH TANK)

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to furnish and install one backwash sludge pump, backwash supernatant pump, discharge piping, valves and appurtenances, guide rail systems, electrical power supply, and other miscellaneous items required for complete installation.

C. Related Sections.

1. Section 03300 - Cast-In-Place Concrete
2. Section 03600 - Grout
3. Section 05500 - Metal Fabrications
4. Section 09800 - Special Coatings
5. Section 11900 - Process Piping
6. Section 16900 - Starters and Motor Control
7. Section 16950 - Instrumentation and Control

D. Products installed but not furnished under this Section:

1. Section 03300 - Expansion Anchor Bolts
2. Section 11900 - Expansion Joints/Vibration Isolation
3. Section 11900 - Discharge Piping

1.02 SYSTEM DESCRIPTION

A. Performance requirements:

1. Backwash Sludge Pump

Operating Conditions

Flow (gpm)	120
TDH (ft)	16 (at 120 gpm and min. eff.)

Minimum Hydraulic Efficiency (%)	48 (at flow and head requirements established above)

2. Backwash Supernatant Recycle Pump

Operating Conditions

Flow (gpm)	120
TDH (ft)	235 (at 120 gpm)
Minimum Hydraulic Efficiency (%)	40 (at flow and head requirements established above)

1.03 SUBMITTALS

A. Manufacturers Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Sludge discharge and supernatant recycle pump performance curves.
2. Sludge discharge and supernatant recycle pump materials of construction.
3. Sludge discharge and supernatant recycle pump motor.

B. Shop Drawings - Submit shop drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Sludge discharge pump installation, guide rail system installation, and manhole connection details.

2. Supernatant recycle pump installation, guide rail system installation, and manhole connection details.

C. Operation and Maintenance Instructions - Submit operations and maintenance instructions for the following materials and equipment in accordance with the general procedures set forth in Division 1.

1. Sludge discharge pump and controls
2. Supernatant recycle pump controls.

1.04 DELIVERY AND STORAGE

Contractor shall provide a safe storage area on-site suitable for pump storage prior to installation. Pumps shall be stored on a dry

elevated foundation and the area shall be protected against freezing and other weather conditions. Pumping unit shall not be wrapped or covered with plastic or other material that would result in condensation or trapped moisture.

1.05 SEQUENCING AND SCHEDULING

The Contractor shall coordinate the pump installation with the work to be performed under the related sections described in this Section and the work described elsewhere in these Specifications. Pump installation shall be coordinated with process piping installation to ensure proper pump intake and discharge vertical and horizontal alignment. Pump base shall be supported as shown on the Contract Drawings. Grout leveling for pump support shall be in accordance with Section 03600 of these Specifications.

1.06 WARRANTY

A. Contractor shall furnish the Owner a written warranty to cover the pumps and motors against defects in workmanship and material for a period of five (5) years or 10,000 hours of operation under normal use and service, whichever comes first. The Contractor shall pay for 100 percent of the cost for all replacement parts and repair labor for a minimum of 2 years or 4,000 hours. Contractor shall pay 100 percent of the replacement parts cost for the remaining 6,000 hours of operation or three (3) years.

1.07 BASIS FOR COMPENSATION

Compensation for all Work performed under this Section of these Specifications shall be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 SLUDGE DISCHARGE PUMP

A. General

1. Sludge discharge pump shall be a submersible centrifugal non-clog wastewater pump suitable for pumping iron sludge. The pump shall be supplied with a mating cast iron 4-inch diameter flanged discharge connection. Pump shall be automatically and firmly connected to the discharge connection and guided by no less than two guide bars extending from the top of the backwash tank manhole to the discharge connection. Sealing of the pumping unit to the discharge connection shall be watertight and

require no entry into the backwash tank for connection or disconnection.

B. Pump Construction

1. Major pump components shall be of grey cast iron conforming to ASTM A30 specifications with smooth surfaces devoid of blow holes or other irregularities. All exposed fasteners shall be AISI Type 304 stainless steel. All metal surfaces coming in contact with the pumpage other than stainless steel or brass, shall be protected with an epoxy-based primer and finish coating system as specified in Section 09800 (SC-8) of these Specifications. O-rings for watertight sealing shall be nitrile rubber. No secondary sealing compounds such as grease will be allowed.

2. Pump shall be furnished with a tandem mechanical shaft seal system consisting of two totally dependent seal assemblies. If seals operate in an oil reservoir to lubricate the lapped seal faces, this oil reservoir shall be gasketed and sealed to provide for no leakage of oil into the pumped liquid.

3. Pump shaft shall be constructed of AISI Type 420 stainless steel. Pump shaft shall be an extension of the motor shaft. No couplings will be allowed.

4. Impeller shall be grey cast iron conforming to ASTM A30, Class 30 specifications. Impeller shall be dynamically balanced and be capable of handling solids. A full vaned impeller shall be used to maximize efficiency.

C. Cooling System

1. Pump motor shall be sufficiently cooled by the pumped fluid.

D. Cable Entry Seal

1. The cable entry seal shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry seal shall provide ease of changing the cable when necessary using the same entry seal.

E. External Finish

1. Pump external surfaces shall be coated as specified in Section 09800 (Schedule SC-8) of these Specifications.

G. Motor

1. The pump motor shall be a squirrel-cage, induction, shell type design, housed in an air filled, watertight chamber. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The motor shall be designed for continuous duty, capable of sustaining a minimum of ten (10) starts per hour. The rotor bars and short circuit rings shall be of aluminum.

2. Each unit shall be provided with an adequately designed cooling system consisting of a water jacket which encircles the stator housing. The water jacket shall be provided with a separate circulation of the pumped liquid. Cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provisions for a separate, clear external motor cooling as well as lower seal flushing shall also be provided.

3. The junction chamber, containing the terminal board, shall be sealed from the motor by elastomer compression seal (O-ring). Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board which shall be leakproof.

4. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with an supplemental to external motor overload protection and wired to the motor control center specified in Section 16900.

5. Each motor shall have an electrode mounted in the seal chamber, which shall detect a seal failure by the presence of water. The seal failure electrode shall be connected to the remote alarm equipment through the control cable specified for the motor thermal switch. The supplier shall note that seal failure condition will initiate an alarm but not shut down the motor. If the pump's supplier warranty requires that the seal failure electrode must cause motor shutdown, then the pump supplier shall coordinate and pay for this change at no cost to the Owner.

6. Pump shall be capable of running dry while out of the pumped liquid for extended periods without damage.

7. Operating voltage - 460 VAC, 3-phase, 60 hertz.

8. Provide cable suitable for submerged duty in length adequate for installation indicated on the Drawings.

H. Manufacturer's pump curves have been reviewed and the following pump has been determined to be hydraulically acceptable. If the Contractor proposes to provide an alternate pump, Contractor shall submit performance curves prepared by the manufacturer that clearly show that the proposed pump meets these Specifications. An alternate pump is subject to the approval of the Engineer. Allowable pump manufacturers are Flygt, Gormann-Kupp, ABS, and Hydro-Matic. It is the Contractor's responsibility to furnish a pump meeting the materials specifications established in this Section.

1. Flygt (Norwalk, Connecticut)

   Model 3085/82 CP

   438 1 Vane Impeller

   3 Phase 2 HP Motor

   Pump provides 120 gpm at 17 feet

   TDH and an efficiency 48 percent

   Pump maximum efficiency (48 percent) at 150 gpm and 16 feet of head

I. Pump Guide Rail System and Cable Rack

1. Contractor shall furnish and install submersible pump guide rail system totally compatible with the supplied pump. Guide rail system shall allow for complete pump removal or replacement without personnel entering the backwash tank.

2. Guide rails shall be galvanized Schedule 40 steel pipe and be firmly attached to the manhole riser and backwash tank floor. All guide rail system fasteners shall be galvanized steel.

3. Contractor shall provide manhole cable rack and float switch attachment bracket as shown on the Contract Drawings.

4. Contractor shall be responsible for coordinating manhole frame and cover compatibility with guide rail system and pump supplied.

2.02 SUPERNATANT RECYCLE PUMP

A. General

1. Supernatant recycle pump shall be a slim portable submersible drainage pump. The pump shall be supplied with a 3-inch diameter NPT discharge head. Pump shall be firmly connected and guided by no less than two guide rail bars as shown on the Contract Drawings.

B. Pump Construction

1. Pump shall be constructed of mainly aluminum for ease of handling. Aluminum casting shall be smooth and devoid of blow holes or other irregularities. All exposed fasteners shall be aluminum. Non-aluminum parts or materials in contact with the fluid shall be coated as specified in Section 09800 (SC-8) of these Specifications. O-rings for sealing shall be nitrile rubber. No secondary sealing compounds such as grease will be allowed.

2. Pump shall be furnished with a tandem mechanical shaft seal system. The seals shall work independently and seal off the motor from the pump section.

3. The junction chamber shall be completely sealed off from the surrounding liquid and from the motor unit.

4. Strainer holes shall be 1/4-inch x 2 each in size. Strainer shall provide for adequate open space to prohibit turbulence near the pump intake.

5. Impeller shall be an open radial high head type.

6. Pump wear parts shall be coated with nitrile rubber and easily replaced when necessary. Impeller wear plate shall be adjustable to re-establish performance criteria.

C. Cooling System

The pumped liquid shall provide all the necessary cooling. Pump shall be able to operate when the surface of the liquid being pumped is above or below the pump motor.

D. Cable Entry Seal

1. The cable entry seal shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry seal shall provide for ease of changing the cable when necessary using the same entry seal.

E. External Finish

1. Pump external surfaces shall be coated as specified in Section 09800 (Schedule SC-8) of these Specifications.

F. Motor

1. The pump motor shall be a squirrel-cage, induction, shell type design, housed in an air filled, watertight chamber. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The motor shall be designed for continuous duty, capable of sustaining a minimum of ten (10) starts per hour. The rotor bars and short circuit rings shall be of aluminum.

2. Each unit shall be provided with an adequately designed cooling system consisting of a water jacket which encircles the stator housing. The water jacket shall be provided with a separate circulation of the pumped liquid. Cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provisions for a separate, clear external motor cooling as well as lower seal flushing shall also be provided.

3. The junction chamber, containing the terminal board, shall be sealed from the motor by elastomer compression seal (O-ring). Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board which shall be leakproof.

4. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with an supplemental to external motor overload protection and wired to the motor control center specified in Section 16900.

5. Each motor shall have an electrode mounted in the seal chamber, which shall detect a seal failure by the presence of water. The seal failure electrode shall be connected to the remote alarm equipment through the control cable specified for the motor thermal switch. The supplier shall note that seal failure condition will initiate an alarm but not shut down the motor. If the pump's supplier warranty requires that the seal failure electrode must cause motor shutdown, then the pump supplier shall coordinate and pay for this change at no cost to the Owner.

6. Pump shall be capable of running dry while out of the pumped liquid for extended periods without damage.

7. Operating voltage - 460 VAC, 3-phase, 60 hertz.

8. Provide cable suitable for submerged duty in length adequate for installation indicated on the Drawings.

G. Manufacturer's pump curves have been reviewed and the following pump has been determined to be hydraulically acceptable. The following pump has also been determined to meet the application and installation requirements. If the Contractor proposes to provide an alternate pump, Contractor shall submit performance curves and installation drawings that clearly indicate that the proposed pump meets these Specifications and can be installed essentially as shown on the Contract Drawings. An alternate pump is subject to approval by the Engineer. It is the Contractor's responsibility to furnish a pump meeting the material specifications established in this Section and the installation requirements shown on the Contract Drawings.

1. Flygt (Norwalk, Connecticut)

   Model BS 2084 Version HH

   Radial Type Impeller

   3 Phase 22 Hp Motor

   Pump provides 130 gpm at 250 feet

   TDH and at a brake horsepower of 24. Pump shutoff head is 425 feet.

H. Pump Guide Rail System and Cable Rack

1. Contractor shall furnish and install guide rail system as shown on the Contract Drawings. Guide rails shall be AISI Type 304 stainless steel Schedule 40 pipe. Guide rail brackets, stiffener plates, and base plate shall be AISI Type 304 stainless steel. Guide rail collar stops shall be AISI Type 304 stainless steel. Other items shown on the Contract Drawings shall be as specified in Sections 11900 and 05500. All welds between stainless steel materials shall be stainless steel. Guide rail system shall be firmly attached to the manhole riser and backwash tank floor.

2. Contractor shall be responsible for coordinating manhole frame and cover compatibility with fabricated guide rail system and pump supplied.

3. Contractor shall provide manhole cable rack as shown on the Contract Drawings.

2.03 SOURCE QUALITY CONTROL

A. Submersible centrifugal pumping units for each pump shall be supplied by the same equipment supplier and shall be totally compatible with all the components of the individual pumping systems. Sludge discharge pump and supernatant recycle pump may be of different manufacture. Products and materials required for installation of the pumping units and appurtenance shall be of the same manufacturer and type as those specified elsewhere in these Specifications.

PART 3. EXECUTION

3.01 PUMP AND MOTOR INSTALLATION

A. Install pumps and motors according to manufacturer's recommendations. The pump and motor shafts shall be aligned according to the manufacturer's specifications and procedure. The Contractor shall install expansion joints as shown on the Contract Drawings.

Installation of the pumping system shall be conducted under the supervision of a qualified representative of the equipment supplier.

B. Contractor shall coordinate the required work to complete pump installations including, but not limited to, controls, power supply, and process piping.

C. Contractor shall demonstrate that the pumps are easily removable from the backwash tanks.

3.02 MOTOR START-UP

A. Check to ensure proper lubrication, drive alignment and condition, proper rotation, and any or all other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation shall be indicated by a conspicuous and legible tag.

B. As part of the operational test the Contractor shall arrange for checking and recording of load current and verification of rating of overload heatings. No unattended operation of the equipment shall be permitted until completion of this procedure.

3.03 OPERATOR TRAINING

A. Provide a minimum of eight hours of operator training at Owner's convenience after system is operational.

3.04 FIELD QUALITY CONTROL

The Contractor shall establish and maintain quality control for Work under this Section to assure compliance with contract requirements and maintain records of quality control for all construction operations including, but not limited to, the following:

1. Pump and motor leveling and location
2. Motor shaft and pump shaft alignment and coupling procedures
3. Performance testing and motor start-up data.

A copy of the records of inspection and tests, as well as the records of corrective actions taken shall be furnished to the Owner and Engineer.

END OF SECTION 11216

SECTION 11224

DEEP WELL VERTICAL TURBINE PUMP AND MOTOR

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. This section of the Specifications covers all labor, equipment, and materials necessary to furnish and install a deep well vertical turbine pump, discharge head, and motor for existing Well 4. The Work includes, but is not limited to, shortening or extending the existing well casings, sealing the inner and outer casings, furnishing and installing casing vent, and furnishing and installing a pump, discharge head, motor, and appurtenances.

B. The following products shall be furnished as specified in this Section:

1. Vertical turbine pump including casing vent, water level gauge, suction pipe, pump bowl assembly, discharge column, lineshaft, pump base grout plate, discharge head, headshaft and motor, and all other materials and equipment required for complete installation.

C.. Related Sections

1. Section 03600 - Grout (leveling grout plate)
2. Section 03300 - Cast-in-Place Concrete (pump base)
3. Section 11900 - Equipment Piping and Appurtenances
4. Section 05500 - Steel and Iron Fabrications (anchor bolts and hardware)
5. Section 09800 - Special Coatings (Finish Paint)

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. ANSI/AWWA C654-87, "Standard for Disinfection of Wells"

2. ASTM A36, "Specification for Structural Steel"

3. ASTM A48, "Specification for Gray Iron Castings"

4. ASTM A53, "Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless"

5. ASTM A108, "Specification for Steel Bars, Carbon, Cold Finished, Standard Quality"

6. ASTM A276, "Specification for Stainless and Heat-Resisting Steel Bars and Shapes"

7. ASTM B584, "Specification for Copper Alloy Sand Castings for General Applications"

8. ASTM B505, "Specification for Copper-Base Alloy Continuous Castings"

9. ASTM A105, "Specification for Forgings, Carbon Steel, for Piping Components"

10. ASTM B62, "Specification for Composition Bronze or Ounce Metal Castings"

1.03 PROJECT/SITE CONDITIONS

A. Refer to Section 01010 for a detailed description of information available regarding Well 4.

B. Well Data Summary:

1.	Inside Diameter of Well Casing	12 inches
2.	Depth of Casing	415 feet
3.	Total Depth of Well	503 feet
4.	Static Water Level	130 feet
5.	Measured Drawdown at 1,200 gpm	50 feet
6.	Estimated Pumping Water Level at 1,200 gpm	190 feet
7.	Pump Set Level (top of pump)	250 feet

1.04 SUBMITTALS

A. Submit complete Shop Drawings showing all details of materials to be furnished and installation, including shaft diameters, dimensions, elevations, anchoring details, casing vent and cap, etc.

B. Submit Operation and Maintenance Manual for the pump and motor including product literature, manuals, repair and maintenance procedures, parts lists, and suppliers' phone numbers and addresses.

1.05 SEQUENCING AND SCHEDULING

A. Contractor is solely responsible for coordinating the Work of this Section with that of other sections to obtain a complete installation as shown in the Drawings and described herein. This specifically includes, but is not limited to coordinating cut-off or extending of the existing Well 4 casing, construction of the cast-in-place concrete pump base, installation and anchoring of the grout plate, and verification of all elevations and dimensions.

1.06 BASIS FOR COMPENSATION

A. Compensation for all work covered under this Section of these Specifications will be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 MOTOR

A. The motor shall be a high efficiency vertical hollow shaft (VHS) motor with a 200 horsepower (HP) nameplate rating for use with 460 Volt, 3 phase, 60 cycle power supply. The motor shall be designed to operate at between 1,750 and 1,800 RPM and shall be capable of continuous operation of the pump specified herein.

B. The motor thrust bearings shall have adequate capacity to carry the weight of all the rotating parts plus the hydraulic thrust of the pump impellers and have an ample safety factor. This safety factor shall be based on an average life expectancy of 5 years operation at 24 hours per day. The motor shall be provided with a ball type non-reversing ratchet which shall absolutely prevent the motor from being reversed by the back flow of water through the pump.

C. The furnished motor shall have a totally enclosed, fan cooled (TEFC) enclosure and shall be of the across the line, squirrel cage induction type and shall conform to current NEMA requirements, Code F or better for motor starting requirements. The mounting and shaft diameter shall be compatible with the furnished discharge head.

D. In addition, the motor furnished shall meet the following requirements:

1. The motor shall conform with all applicable NEMA, IEEE, and ANSI standards. Motors using non-standard frames will not be permitted.

2. The motor rating shall be based on NEMA MG1-20.43 number of starts. Horsepower, torque, and speed characteristics shall be suitable for the full range of operating conditions of the driven equipment without exceeding 95 percent of the nameplate FLI and temperature rise rating regardless of size. Nameplate FLI shall be based on nameplate horsepower and shall not include the 1.15 service factor. The motor shall have a 1.15 service factor. Horsepower rating shall not vary from that specified.

3. The supplier furnishing the motor shall be responsible for delivery, handling, and setting regardless of the local agreements as to actual work jurisdiction. This responsibility shall include checking lubrication, drive alignment and condition, indication of proper rotation, and any or all other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation shall be indicated by a conspicuous and legible tag installed by the responsible individual.

4. The motor bearings shall be AFBMA standard sizes. The motor shall be equipped with endshield mounted ball bearings made to AFBMA standards and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease without major motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.

5. The vibration in any direction, measured at the bearing housings, with the motor running at normal voltage and frequency, the shaft axis in normal position, and with one-half of a standard key in the keyway, shall not be more than 0.0015 inches total amplitude peak to peak.

   If balancing weights are added to the rotor, they shall be permanently secured by welding, peening, or other method approved by the Engineer.

6. The stator frame and endshield shall be of rigid cast iron construction. Extruded aluminum frames shall not be used. Fan covers and conduit boxes may be cast iron, aluminum or steel, depending on the manufacturer's standard.

7. Conduit box openings shall be arranged so that conduit can be brought in from top, bottom or either side. Conduit hole size

shall conform to NEC Standards depending on motor rating. Conduit and box shall be located as shown on the Contract Drawings.

8. The motor shall be drilled and tapped for and furnished with a lifting eyebolt.

9. Motor leads into the conduit box shall have the same insulation class as the winding and may be equipped with a numbered brass or copper terminal staked or otherwise mechanically fastened to the lead sufficient to resist 15 pounds pull. Leads shall be marked throughout the entire length to provide identification after terminals are taped and clipped.

10. The fan forcing ventilating air through or over the motor may be steel, aluminum or molded plastic, whichever is the manufacturer's standard.

11. An aluminum or stainless steel nameplate shall be included. The nameplate shall be stamped to include the following information:

    a. horsepower (not including service factor)
    b. speed
    c. time rating
    d. frequency
    e. phases
    f. model number
    g. rated voltage
    h. service factor (1.15)
    i. full load amps (based on nameplate HP, not including service factor)
    j. insulation class
    k. NEMA design
    l. NEMA code letter
    m. maximum ambient temperature
    n. bearing identification

12. The motor connection diagram shall be permanently attached to the motor, either inside the conduit box or on the motor frame in a location readable from the conduit box side.

13. The motor shall be prime painted with a corrosion resisting metal primer. Finish paint shall be as specified in Section 09800 of these Specifications. Prime paint may be shop applied, but shall be completely compatible with the specified finish paint.

All bolts, screws, and other external hardware shall be treated by zinc with irridite or zinc chromate for corrosion resistance.

14. The motor testing procedure shall be in accordance with the American Standard Test Code for polyphase induction motors and generators, IEEE 112A. All motors shall be given a routine test to determine that they are free from electrical or mechanical defects. The routine test shall, as a minimum, conform to MG1-12.51.

15. Before shipment, the shaft extension and any other bare exposed metal parts of the motor shall be coated with an easily removable rust preventative.

    The motor shall be securely fastened to a hardwood skid or pallet for fork truck handling and be covered for protection against dirt and moisture during transit and for short time outdoor storage.

16. The motor shall meet or exceed the starting locked rotor and maximum breakdown torques specified by NEMA for the NEMA design. The locked rotor starting currents shall not exceed NEMA maximum values for the specified NEMA design and rating.

    The current density and heating characteristics shall be such that the motor will not suffer damage if subjected to a maximum of ten (10) seconds stall at six times the full load current. Except as noted, the service factor of the motor shall be in accordance with NEMA Standards. The insulation system of the motor shall be designed for 40,000 hours operation under usual service conditions as described under NEMA 1-14.02. The motor manufacturer shall use IEEE standards to establish the suitability of the insulation system to meet these requirements.

17. The nominal NEMA efficiency shall be 95 percent. Efficiency shall be defined in the latest edition of the IEEE Standard 112 and NEMA MG1-12.53a,b.

2.02 PUMP DISCHARGE HEAD

A. The pump discharge head shall be of high grade cast iron (ASTM A48, Class 30) and shall be structurally capable of supporting the motor, pump column, bowls and suction pipe. The discharge outlet shall have a nominal 10-inch diameter ANSI Class 125 flange connection. The discharge head shall be compatible with the motor mounting requirements and shall be machined to mate securely with the motor face. The bottom of the discharge head shall be machined flat for

gasketed and bolted attachment to a separate grout plate. The discharge head shall provide for a prelubrication arrangement and water level indicator air line attachment as shown on the Contract Drawings.

The discharge head shall be furnished with a water lubricated stuffing box type seal for the headshaft. The stuffing box shall be furnished with provision for discharge bleedoff. The stuffing box shall be furnished with at least six rings of graphite impregnated packing, seal cage, and a bronze split ring type gland.

2.03 GROUT PLATE

A. Furnish machined to the dimensions shown in the Drawings and in accordance with the requirements of Section 05500 of these Specifications. Blanchard grind top side for mating with discharge head. Material shall be ASTM A36 steel plate.

2.04 HEADSHAFT

A. The headshaft through the stuffing box shall be AISI 416 SS and shall be sized and keyed to be compatible with the lineshaft and the motor. An adjusting method shall be provided on the top of the headshaft to allow impeller adjustment. The adjustment method shall provide a positive locking device.

2.05 WELL CASING VENT

A. Casing vent shall be constructed of Schedule 40 steel pipe with welded connections and fittings. Provide smooth interior without protrusions or weld slag. Hot dip galvanize prior to field installation. Repair field welds with cold galvanize. Furnish removable vent cap complete with corrosion resistant 20 mesh screen. Furnish separate downhole access as shown on the Contract Drawings.

2.06 PUMP DISCHARGE COLUMN

A. The pump discharge column shall be interchangeable sections of 8 (eight) inch diameter, 10-foot long, ASTM A53 Type S (seamless), Grade A, Schedule 40 steel pipe. Contractor shall determine if heavier weight pipe is required based on consistency with lineshaft design specified below and shutoff head of furnished pump. The top and bottom sections of column shall be 5 feet in length. The total length of discharge column shall be 250 feet. The column sections shall be connected with threaded, sleeve type couplings. The discharge column couplings shall be of ASTM A108 Grade 1020 steel. The outside diameter of the couplings shall not exceed 10 inches.

2.07 PUMP LINESHAFT AND COUPLINGS

A. The lineshaft shall be furnished in interchangeable 10-foot sections comprised entirely of ASTM A276 Type 416 stainless steel, turned and polished, with threaded sleeve type couplings. The lineshaft shall have a surface finish not to exceed RMS 40 (ANSI B46.1). The lineshaft couplings shall be of the same material as the lineshaft. The lineshaft couplings shall be threaded to tighten during pump operation. To assure accurate alignment the lineshaft must be straight within 0.005 inch measured at the midpoint of a 10-foot section and the butting faces shall be machined square to the axis of the shaft, with the maximum permissible axial misalignment of the thread axis with the shaft axis of 0.002 inches in 6 inches.

The lineshaft shall have a minimum diameter of 1 11/16 inches. The size of the shaft shall be no less than that determined by ASA Specification B58, Section 4.3 per Table 5.6, AISI C-1045 Lineshaft Selection. The Contractor shall be responsible for determining the size of the lineshaft to 1) satisfactorily support the loads and torques which will be imposed, and to 2) restrict elongation due to hydraulic thrust within the axial clearance of the impellers in the pump bowls. The lineshafts shall be furnished with without sleeves at bearing wear surfaces.

2.08 LINESHAFT BEARINGS AND RETAINERS

A. Lineshaft bearings shall be synthetic rubber mounted at the midpoint of each lineshaft section. Bearings shall be retained in bronze slip type conforming to ASTM B145. Retainers shall be furnished with a flat surface on each side to provide seating surface for ends of discharge column setting.

2.09 PUMP BOWL ASSEMBLY

A. The pump bowl assembly shall be a multiple stage, vertical turbine, designed to mount to threaded discharge column and 8-inch diameter threaded suction pipe, and compatible with lineshaft. The pump bowl assembly shall be of the open line shaft configuration and designed to operate between 1,750 and 1,800 revolutions per minute (RPM).

The pump bowls shall be constructed of ASTM A48, Schedule 30 close grained cast iron; free from blow holes, sand holes, and all other defects; and accurately machined and fitted to close tolerances. The bowls shall be capable of withstanding a hydrostatic pressure equal to the greater of twice the pressure at rated capacity or 1 1/2 times shutoff head. The inside of the bowls shall be porcelain enamel-

lined and shall have a nominal outside diameter not to exceed 10 inches.

The impeller shaft shall be of ASTM A276 Type 410 or Type 416 stainless steel, turned and ground. The impeller shaft shall be supported by water lubricated bronze and synthetic rubber bearings located on both sides of each impeller. The length of the bearings shall be a minimum of three times the shaft diameter.

The impellers shall be polished ASTM B584 alloy 836 bronze, accurately machined and finished for close running clearances, and dynamically balanced for optimum performance and minimum vibration. The impellers shall be securely fastened to the impeller shaft with keys, taper bushings or lock nuts. Each bowl shall have a replaceable wear ring to prevent leakage of water between bowl and impeller. The impellers shall be adjustable vertically by means of a top shaft nut at the top of the motor.

The furnished pump shall deliver a minimum of 1,150 gallons per minute (gpm) and a maximum of 1,250 gpm at a total dynamic head (TDH) of 395 feet. The combined pump bowl efficiency when pumping against 395 feet TDH shall be a minimum of 78 percent. The furnished pump shall also be capable of delivering a minimum of 1,080 gpm at a TDH of 420 feet. The furnished pump shall also be capable of delivering a maximum of 1,350 gpm at a TDH of 340 feet. The specified TDH values are calculated from the pump discharge head outlet and do not include hydraulic friction losses in the suction pipe, pump, discharge column or discharge head. Contractor shall be responsible for adding the appropriate head losses for the discharge column and head furnished in order to meet the flow requirements.

Manufacturer's pump characteristic curves have been reviewed for the following pumps and they have been determined to be hydraulically acceptable. Alternate pumps are subject to approval by the Engineer. The bowl and impeller numbers given below are presented only to indicate the desired hydraulic performance. It is the Contractor's responsibility to furnish a pump meeting the materials specifications established herein and to confirm that the furnished pump meets the specified performance requirements.

1. Byron Jackson Pump, Division of Borg Warner Corporation (Los Angeles, California)

   13 Stage, Bowl Assembly 10-inch HQ-"H", Impeller No. 169686-LY, 6 7/16-inch diameter, 1770 RPM.

2. Peabody Flowing

11 Stage, Bowl Assembly 10-inch 10BKH, Impeller A, 1760 RPM.

3. Jacuzzi

13 Stage, Bowl Assembly 10-inch 10YC, Impeller A (No. 3540), 8 1/4-inch diameter, 1760 RPM.

2.10 SUCTION PIPE

A. The suction pipe shall be 10 feet in length, 8-inch diameter, threaded, seamless ASTM A53 Grade A, Schedule 40 steel pipe. No strainer shall be furnished on the suction pipe.

2.11 WATER LEVEL INDICATOR

A. Furnish a depth to water gauge (commonly called altitude gauge), tubing and all necessary fittings for a complete system to allow measurement of depth to water in Well 4. The gauge should read the depth from the base of pump discharge head to water directly in units of feet. The gauge face should have a range of 0 to 300 feet with an accuracy of 1/2 percent over the full range. The gauge shall be connected to an airline which shall be secured to the discharge column using electrical ties at intervals not to exceed 10 feet. The air line shall be of 3/8-inch outside diameter and 1/4-inch inside diameter polyethylene tubing. The tubing shall be a single piece without splices. The Contractor shall record the exact length of tubing installed and the depth of the end of the tubing below the base of the pump discharge head. The air line and depth to water gauge shall be fitted with a valve stem type fitting to allow water level readings with an air compressor or standard hand pump.

2.12 SOURCE QUALITY CONTROL

A. In order to assure uniform quality and full compatibility, all pump components (bowl assembly, column, lineshaft, couplings, bearings, bearing retainers, discharge column, and discharge head) shall be supplied by the same manufacturer.

PART 3: EXECUTION

3.01 CONTRACTOR'S QUALIFICATIONS

A. All pump installation and well disinfection work described in this section of the Specifications shall be performed by professionals qualified and licensed for pump installation and maintenance in accordance with Laws and Regulations, in particular the requirements of the Minnesota Department of Health. All electrical work related to pump motor and controls wiring shall be performed by persons meeting the requirements set forth in Division 16 of these Specifications.

3.02 PUMP BASE AND CASING VENT

A. Well 4 construction originally consisted of a 24-inch diameter outer casing with an 18-inch diameter inner casing. A 12-inch inner liner was added at a later date.

B. The concrete pump base shall be constructed of reinforced cast-in-place concrete as shown on the Contract Drawings and in accordance with Section 03300 of these Specifications. The 24-inch outer casing and the 18-inch inner casing shall be cut-off or extended to the elevations shown in the Contract Drawings. Cut casings square using saw or torch. Grind edges smooth for subsequent welding operations. Take all measures necessary to prevent debris, tools, and equipment from entering well by using safety cords, packers, covers, etc. There shall be no protrusions of pipes, weld slag, or similar materials into the inside of the inner casing. Seal annulus between inner liner and outer casing with weld plate as shown in Contract Drawings. Use continuous weld full perimeter of both pipes to prevent entrance of water. Hold anchor bolts in place with template during placement of concrete. Protect threads on anchor bolts during subsequent construction. Place grout plate with machined surface up and protect machined surface during construction. Level plate precisely using nuts on underside of plate. Place grout to the dimensions shown in Contract Drawings and in accordance with the requirements of Section 03600 of these Specifications. Allow a minimum of 14 days before pump placement.

3.03 PUMP INSTALLATION

A. Pump installation shall be performed only under the supervision of a representative authorized and approved by the pump manufacturer. Immediately prior to placement, all parts below the discharge head shall be disinfected in accordance with Section 4 of AWWA C654-87. All line shafts shall be checked for straightness in the field

immediately prior to installation and shall be straightened to the tolerance specified in Part 2 of this Section. The Contractor shall furnish the Engineer with documentation showing the shaft straightness measurements.

The pump discharge column shall be assembled to provide tight, leak free joints with the joints butted to insure proper alignment after assembly. Line shaft couplings shall be securely tightened and all bearings and shaft sleeves shall be placed in accordance with the manufacturer's recommendations.

3.04 MOTOR STARTUP

A. Check to ensure proper lubrication, drive alignment and condition; indication of proper rotation; and any or all other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation shall be indicated by a conspicuous and legible tag.

B. As part of the operational test, the Contractor shall arrange for checking and recording of load current and verification of rating of overload heaters. No unattended operation of the equipment shall be permitted until completion of this procedure.

3.05 DISINFECTION AND STARTUP

A. Following motor installation, the Contractor shall make all necessary pre-startup checks and adjustments for the pump and motor. The well shall be disinfected and pumped to waste in accordance with the requirements of the Minnesota Department of Health (MDH) Water Well Construction Code and AWWA C654-87, whichever is more stringent.

3.06 WELL IDENTIFICATION

A. Furnish and install a corrosion resistant (bronze, brass, or stainless steel) identification plate. The plate shall at a minimum contain the Minnesota Geological Survey Unique Number and identify the well as St. Louis Park Municipal Well 4. The plate shall be cast or stamped and shall be permanently affixed to the pump base in a conspicuous location. The plate shall be a minimum of 3 inches by 5 inches, with clearly legible lettering. The plate shall contain other information as may be required by Laws and Regulations.

3.07 OPERATOR TRAINING

A. Provide a minimum of two hours of operator training at the Owner's convenience after equipment is operational.

3.08 FIELD QUALITY CONTROL

A. Contractor shall establish and maintain procedures to assure quality control and compliance with the requirements of this Section. Contractor shall record and furnish to Owner the following information:

1. manufacturer, model number, serial number, and options identification for all materials supplied;

2. length of discharge column actually placed;

3. static water level at time of placement; and

4. precise position of end of water level indicator tube with respect to discharge column.

END OF SECTION 11224

SECTION 11365

FLUORIDATION SYSTEM

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, labor, and equipment necessary to install a complete fluoridation system. Fluoridation system consists of chemical feed pumps, storage tanks, siphon break tank, valves, tubing, and ejector/diffuser assembly.

C. Related Sections

1. Section 11371 - Chlorination System
2. Section 11900 - Process Piping
3. Section 16950 - Instrumentation and Control

1.02 ABBREVIATIONS

HDPE - high density polyethylene
PP - polypropylene
PVC - polyvinylchloride
PVFD - polyvinylidene fluoride
TFE - tetrafluoroethylene

1.03 SUBMITTALS

A. Contractor shall submit copies of fluoridation system Operation and Maintenance Manuals in according with the procedures in Division 1, General Requirements. The manuals shall include for all fluoridation equipment installed product literature and manuals, repair and maintenance procedures, parts lists and suppliers' phone numbers and addresses.

1.03 BASIS FOR COMPENSATION

A. Compensation for all Work included in this section is included in the lump sum bid price.

PART 2: PRODUCTS

2.01 CHEMICAL FEED PUMP

A. The electronic positive displacement feed pumps shall be suitable for pumping hydrofluosilicic acid with an adjustable output from 0.012 gph to 1.2 gph. Adjustment shall be by means of readily accessible dial knobs, one for changing stroke length and the other for stroke frequency. The fluoride feed pump shall be capable of injecting against pressures up to 50 psi. Fluoride injection pumps shall be capable of injecting against pressures up to 100 psi. Internal pressure relief shall be incorporated in the pump drive to stop all pumping action at 120 psi. Metering pumps shall include internal injection anti-siphon and back pressure values. The pumps shall be equal to Precision 10000P-11000P Series, Pulsatron Series E Plus, LMI Series A, and Wallace and Terrnann Series 45.

B. Provide a wall supported shelf sufficient to support each pump.

C. The chemical metering pump shall operate from a 120 VAC, 60 Hz, source. The source will be switched to control pump operation.

2.02 FLUORIDE STORAGE TANKS

A. Shall be constructed of polyethylene with a minimum wall thickness of 1/4-inch and shall be of leakproof, one-piece construction without seams, joints or welds.

B. Shall have a minimum capacity of 140 gallons and shall be calibrated at a minimum to the nearest 10 gallons with indelible markings on the outside of the tank. The liquid level shall be visible from the outside of the tank.

C. Shall be furnished with a well-fitting reinforced cover and shall seal tightly to prevent contamination of the fluoride solution.

D. Shall be furnished with fittings for the outlet, vent and fill connections as shown in the Contract Drawings.

2.03 FLUORIDE SIPHON BREAK TANK

A. Shall be constructed of polyethylene and shall be of leakproof, one-piece construction without seams, joints or welds with a well fitting cover to prevent contamination of the fluoride solution.

B. Shall be supplied with fittings for inlet, outlet and overflow connections as shown in the Contract Drawings.

2.04 HDPE TUBING

A. Tubing used in the fluoridation system shall conform to the specification in Section 11371 of these Specifications except as specified in this section.

B. HDPE tubing used in the fluoridation system shall be marked with blue tape at 2-foot intervals.

2.05 PLUG VALVES

A. As specified in Section 11371.

2.06 POLYPROPYLENE (PP) TUBE FITTINGS

A. Shall be constructed of white polypropylene with compression type fittings with inserts for use with 1/2-inch outer diameter HDPE tubing as supplied by Cole-Parmer or functionally equivalent.

2.07 FLUORIDE DIFFUSER ASSEMBLY

A. Fluoride diffuser assembly shall be 1/2 inch constructed of high impact PVC plastic. Diffuser assembly shall include a ball valve as shown on the Contract Drawings.

2.08 CHECKED INLET ASSEMBLY

A. Checked inlet assembly shall be 1/2 inch and constructed of PVC. The ball foot valve shall be designed to maintain the prime on the suction side of the chemical metering pump. Valve shall include a PVC debris screen. Checked inlet assembly shall be as manufactured by Chemtrol, GF, or Hayward.

2.09 SOURCE QUALITY CONTROL

A. The Contractor shall be responsible for maintaining and verifying source quality control for all materials related to installation of the fluoridation and shall verify quantities when ordering. All materials of a specified type shall be from the same manufacturer including, but not limited to, tubing, valves and fittings.

PART 3: EXECUTION

3.01 INSTALLATION

A. Fluoride Storage Tanks

1. Install fluoride storage tanks as shown in the Contract Drawings. Tanks shall be installed so that the covers can be opened without obstruction. Install plug valves to isolate fluoride feed intakes.

2. Install tubing and screened foot check valve assembly inside each fluoride storage tank as shown in the Contract Drawings.

B. Fiberglass Shelves

1. Install fiberglass shelves, pumps and controllers, and the fluoride siphon break tank as shown in the Contract Drawings. Shelves shall be mounted using anchors that will support the weight of the shelf plus the equipment supported by the shelf. Washers shall be used on all screws used for mounting.

2. Fiberglass shelves supporting the pumps shall be mounted so that the controls can be adjusted without the use of a stool or ladder.

3. The shelf supporting the fluoride siphon break tank shall not be mounted directly above any of the pumps, and shall be mounted at a minimum 1 foot above the fluoride feed pump and shall not obstruct opening the covers on the fluoride storage tanks.

C. Fluoride Feed Pump

1. Install fluoride feed pump as shown in the Contract Drawings. Firmly bolt to fiberglass shelving to prevent movement.

D. Fluoride Injection Pumps

1. Install fluoride injection pumps, tubing, and valves as shown in the Contract Drawings. Firmly bolt to fiberglass shelving to prevent movement.

E. Siphon Break Tank

1. Connect tubing and include an extra bulkhead nut to secure siphon break tank to fiberglass shelving.

F. Fluoride Diffuser Assembly

1. Install at location shown in the Contract Drawings. Tapping saddle (as specified in Section 11900) shall be used for taps larger than 3/4-inch diameter. Check and repair all leaks. Install a check valve to prevent back flow from the point of injection and a ball valve so that the tubing can be disconnected.

G. HPDE Tubing

1. Tubing shall be securely mounted to the wall. Wall mounts shall be placed such that the maximum tubing deflection between mounting points is less than 1/4 inch. Wall mounts shall be placed on each side of all bends and corners such that tubing does not kink. All tubing runs shall be neatly installed and shall be parallel to the floor and walls. Corners shall be made by bending the tubing except where kinking would result. Tubing outside the chemical feed room shall be routed continuously inside the carrier conduit as shown on the Contract Drawings. No joints, fittings, or splices will be allowed between the chemical feed room and the injection point.

H. Polypropylene Tube Fittings

1. Shall be installed as needed. The Contractor shall be responsible for determining locations requiring installation of fittings. The number of fittings installed shall be minimized to reduce potential fluid leakage. Fittings shall be installed at all locations where bends or corners in the tubing cannot be made without crimping.

I. Exterior Fluoride Vent

1. Assemble exterior fluoride vent as shown in the Contract Drawings. All tubing and pipe connection shall be air tight.

2. Teflon tape wrap shall be used on all pipe threads.

3. Completely fill annular space in between the CPVC pipe and the concrete wall with non-shrink grout. Apply fire-resistant sealant around the pipe on the exterior to provide a weatherproof seal. Apply fire-resistant sealant around the PVC pipe on the interior of the chemical feed room to provide an airtight seal. See Division 15 for pipe penetration sealing requirements.

3.02 FIELD QUALITY CONTROL

A. After the fluoridation system is installed the Contractor shall visually check all connections for leaks and repair any found.

B. The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements and maintain records of his quality control for all operations including, but not limited to, the following:

1. Verification of equipment sizing and dimensions.

2. Installation of tubing, fittings and valves.

3. Installation of shelving at proper height.

3.03 ADJUSTMENT

A. A qualified representative of the equipment supplier shall supervise installation and start-up of the system and shall provide a minimum of two hours of training of Owner's personnel on how to properly operate and adjust the system. The equipment supplier's representative shall make all final adjustments for proper operation of the equipment. A qualified representative of the equipment supplier shall be available for a minimum of four additional hours to assist Owner's personnel at the facility during shake-down period.

END OF SECTION 11365

SECTION 11371

CHLORINATION SYSTEM

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. Al Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes all labor, equipment and materials necessary to install two vacuum operated chlorination systems, one each for pre-iron removal chlorination and one for post-treatment chlorination. Each chlorination system consists of a dual 150-lb chlorine cylinder scale, two vacuum regulators, one automatic switch over module, one manual chlorine flow controller, one chlorine flow meter, one vacuum operated solenoid valve, and one chlorine ejector-diffuser assembly. Chlorination system shall also includes two chlorine booster pumps, a dual point chlorine leak detection system, and safety equipment.

C. Related Sections

1. Section 11365 - Fluoridation System
2. Section 11900 - Process Piping
3. Section 16950 - Instrumentation and Control
4. Section 16900 - Starters and Motor Control

1.02 ABBREVIATIONS

HDPE - high density polyethylene
PP - polypropylene
PVC - polyvinylchloride
PVFD - polyvinylidene fluoride
TFE - tetrafluoroethylene

1.03 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature for the following materials and equipment in accordance with the procedures set forth in Division 1 of these Specifications:

1. vacuum regulators
2. switch-over modules

3. gas flow meters
4. cylinder scales
5. multi-point electronic chlorine sensor unit
6. chlorine injector assembly
7. chlorine booster pumps
8. respiratory protection equipment.

B. Operations and Maintenance Instructions - Submit copies of chlorination system operation and maintenance construction manuals in accordance with the procedures described in Division 1, General Requirements. The manuals shall include for all chlorination equipment installed: product literature and manuals, repair and maintenance procedures, parts lists, suppliers' phone numbers and addresses, and calibration curves.

1.04 QUALITY ASSURANCE

A. It is the intent of the Contract Documents that the chemical feed system, which includes equipment called for under this Section, Section 11365 (Fluoridation System), shall be furnished and installed by a single source supplier. The single source supplier shall be responsible for determining the compatibility of furnished materials for the intended purpose. The single source supplies shall be Feed-Rite Controls, Inc. for Capital Controls equipment, Vessco, Inc. for Wallace and Tiernan equipment or approved equal.

B. The major components of the chlorination system are based upon the use of Advance Series 200 gas chlorination equipment as manufactured by Capital Controls Company, Inc. (Colmar, Pennsylvania) and distributed by Feed-Rite Controls, Inc. Wallace and Tiernan (Belleville, New Jersey) chlorination components based upon the Series 100 gas chlorination equipment line distributed by Vessco, Inc. will also be acceptable.

1.05 BASIS FOR COMPENSATION

A. Compensation for all Work included under this section is included in the lump sum price bid.

PART 2: PRODUCTS

2.01 VACUUM REGULATORS

A. The vacuum regulators shall be direct cylinder mounted by means of a positive yoke-type gasket connection. Each regulator shall be equipped with a gravity actuated loss of chlorine indicator, and

integrally mounted chlorine gas flow meter. The chlorine flow meters shall show which chlorine source is in use and shall indicate the amount of gas being fed at an accuracy of ± 4 percent of the flow meter capacity. The vacuum shall be controlled by a spring opposed regulator which shall close tight on loss of vacuum. Pressure shall be prevented from building up in the system by means of a spring-loaded, diaphragm-actuated emergency relief valve located in each cylinder-mounted vacuum regulator.

B. The vacuum regulators shall be furnished with compression type fittings for 1/2-inch outer diameter HDPE tubing.

2.02 SWITCHOVER MODULE

A. The automatic switchover module shall be vacuum operated, switching from an empty cylinder to a full cylinder. There shall be no manual reset required when switchover has been made and empty cylinder replaced with a full cylinder. The module shall be wall mounted and operated with a spring loaded toggle. The switchover shall be factory set and shall not require field adjustment.

2.03 GAS FLOW METERS AND SHUTOFF VALVES

A. The two remote gas flow meters shall be wall mounted as shown o the drawings. Each meter shall have individually adjustable solid silver rate valves with solid silver seats and equipped for wall mounting in water plant. Each panel shall contain a 100 ppd meter.

2.04 SCALES

A. The scales shall be a steel base direct dial indicating two cylinder scale with tare adjustment and safety chains. Scales shall have an accuracy of 1 percent of full scale and a readability to 1/2 pound. Scales shall include adjustable tare weight controls and the indicator dial shall read net pounds remaining. Scales shall be Wallace and Tiernan Series 50345 or approved equal.

2.05 MULTI-POINT ELECTRONIC CHLORINE SENSOR, INDICATOR/RECEIVER AND ALARM INDICATOR

A. The electronic chlorine sensor shall include two sensing modules, one indicator/receiver unit, remote indicator and power back-up, and be Series 1620B as manufactured by Capital Controls Company, Inc. (Colmar, Pennsylvania), or approved equal meeting these specifications and functionally and dimensionally compatible with chlorination equipment supplied.

B. The chlorine sensor modules shall be separate from the indicator/receiver unit and shall be housed in a high-impact, corrosion resistant NEMA 4X enclosure. The chlorine sensor module shall have a minimum detectable concentration of 0.5 part per million chlorine.

C. The indicator/receiver shall have LED indicators showing power, ready, malfunction, alarm, and a bar graph displaying chlorine gas concentration from 0 to 10 parts per million and shall flash the pre-set alarm level. The receiver shall have an adjustable timer to warm and stabilize the sensor upon start-up. The indicator/receiver shall have a corrosion resistant NEMA 4X enclosure. The unit shall have a set of SPDT 10 amp contacts that change state upon alarm. These contacts shall be connected to the plant instrumentation system (Section 16950) for remote alarm.

D. The remote alarm indicator shall be Number 1620 as manufactured by Capital Controls Company, Inc. (Colmar, Pennsylvania) and shall have LED indicators for power, malfunction, alarm and a bar graph displaying chlorine gas concentration from 0 to 10 parts per million. The remote indicator shall receive a 120 VAC, 60 Hz power source. Remote alarm indicator shall be housed in NEMA 4 enclosure. The enclosure shall be 12"x12"x6" deep (nominal) with a padlock hasp and 6"x6" vandal-proof plexiglass window in the front door. Locate the monitoring panel within the enclosure so that it is visible through the window.

E. The power back-up shall be Number 1640 as manufactured by Capital Controls Company, Inc. (Colmar, Pennsylvania), 18-volt DC rechargeable battery and shall respond automatically upon power failure. The power back-up shall have LED indicators showing battery low, ready, low (charge rate), high (charge rate), power, and annunciator.

F. The indicator/receiver shall receive 120 VAC, 60 Hz, single phase power. The output signal to the remote alarm shall be 4-20 mAdc.

2.06 HDPE TUBING

A. HDPE tubing shall be 1/2-inch outer diameter, 3/8-inch inner diameter and equivalent in all respects to Nalgene 480 HDPE tubing as manufactured by Nalge Company (Rochester, New York), and distributed by Plastics Engineered Products, Inc. (Branchburg, New Jersey). At a minimum, the HDPE tubing shall have the same kink resistance when bent as the Nalgene 480 tubing. HDPE tubing shall conform to NSF Standard 14 for use with potable water supplies.

B. HDPE tubing used in the chlorination system shall be marked with yellow tape at 2-foot intervals.

C. The HDPE tubing shall not collapse under the vacuum of the chlorination system.

2.07 PLUG VALVES

A. Plug valves used in the chlorination system shall be equivalent in all respects to No. TZ-6394-41 in the Cole-Parmer 1987-88 Plasticware Catalog as distributed by Cole-Parmer Instrument Company (Chicago, Illinois). The plug valves shall be constructed of TFE. Nylon, PVC or PP will not be acceptable. The plug valves shall have compression fittings for 1/2-inch outer diameter HDPE tubing.

2.08 CHLORINATION SYSTEM TUBE FITTINGS

A. Chlorination system tube fitting shall be compression fittings and shall be constructed of TFE or PVFD. Nylon, PVC or PP will not be acceptable.

2.09 CHLORINE EJECTOR ASSEMBLY

A. The chlorine ejectors shall be furnished with Nozzle 12H and be of the anti-siphon type as manufactured by Capital Controls Company, Inc. (Colmar, Pennsylvania), or approved equal meeting these Specifications and functionally compatible with chlorination equipment supplied. The chlorine ejectors shall have a capacity of 100 pounds per day against a back pressure of 100 psi and shall have internal check valves. The ejector shall be furnished with 1 1/4-inch NPT inlet and outlet fittings. The chlorine ejector assembly shall be furnished with compression type fittings for 1/2-inch outer diameter HDPE tubing.

B. The assembly shall be furnished with a PVC ball valve and a diffuser.

2.10 CHLORINE BOOSTER PUMPS

A. Chlorine booster pups shall be of centrifugal type. Only one pump will operate at any given time. Booster pump controls are as specified in Section 16950 of these Specifications. Booster pump shall be capable of boosting pressure 60 psi for chlorine ejector-diffuser operation. Booster pump pressure and flow capacity shall be fully compatible with chlorine ejection diffuses supplied. Pumps shall have totally enclosed, fan cooled (TEFC) motors suitable for 460 VAC, 3 phase operation.

B. Chlorine booster pumps shall be 2 hp minimum. Each booster pump shall be able to provide the required flow and pressure to operate both chlorine ejectors. Duplicity of booster pumps is only to provide backup should one booster pump fail to operate. Booster pumps shall be totally compatible with the chlorine ejector/diffusor assemblies supplied. Booster pumps shall be Sta-Rite Series J, Aurora Series G, or approved equal.

2.11 EXTERIOR CHLORINE VENT

A. The exterior chlorine vent shall be assembled as shown in the Contract Drawings.

B. The 1/2-inch diameter x 1-inch diameter NPT male connector shall be dimensionally equivalent to Swagelok SS-810-1-16KT and shall be constructed of CPVC and furnished with a knurled nut and TFE ferrule for use on polyethylene tubing.

C. The chemical feed vent screen shall be 20 mesh Saran screen.

2.12 Vacuum Solenoid Valves

A. Vacuum solenoid valves shall be fitted with 1/2-inch tube connectors and be constructed of material compatible with chlorine gas. Vacuum solenoid valves shall receive 120 VAC power for activation. Valves shall be normally closed unless power is applied. Vacuum solenoid valves shall be Capital Controls Series BM or equal.

2.13 CHLORINE CYLINDER SECURING CHAINS AND MOUNTS

A. Chlorine cylinder securing chains and mounts shall be furnished and installed as shown on the Contract Drawings. Structural tubing shall be mounted to the wall and all surfaces coated as specified in Section 09800 (SC-1). Each securing chain and mounts shall support the weight of two full chlorine cylinders.

2.14 RESPIRATORY PROTECTION EQUIPMENT

A. Shall be Model 501 Ultra-Lite No. 1 on demand type as manufactured by Scott MSA meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH) for use where chlorine gas is handled. All facepiece and hose connections shall be interchangeable with existing respirator equipment used by the Owner. The unit shall use compressed air and have a minimum capacity of at least 30 minutes. The unit shall be furnished with all necessary equipment for use including, but not limited to, air cylinder and valve

assembly, facepiece, regulator, harness frame assembly and pressure reducer.

B. A storage cabinet as manufactured by Encon Safety Products (Houston, Texas) for use with Scott MSA or functionally equivalent shall be furnished.

2.15 PROTECTIVE EQUIPMENT

A. Two sets of the following shall be furnished:

1. Rubber gloves.
2. Dust respirator of a type certified by NIOSH for toxic dusts.
3. Protective apron.
4. Safety goggles.

2.16 IDENTIFYING DEVICES

A. Contractor shall furnish and install an adhesive placard on the chemical feed for chlorine. The placard shall meet the requirements as established in the 1990 Uniform Fire Code.

B. Contractor shall furnish and install a "NO SMOKING" sign inside the chemical feed room. Sign shall be engraved plastic type. Letters shall be 2 inches high, white in color on a black background.

2.17 SOURCE QUALITY CONTROL

A. The Contractor shall be responsible for maintaining and verifying source quality control for all materials related to installation of the chlorination system and shall verify quantities when ordering. All materials of a specified type shall be from the same manufacturer including, but not limited to, tubing, valves and fittings.

B. Tubing used in the chlorination system shall be from the same color lot.

PART 3: EXECUTION

3.03 INSTALLATION

A. Chlorine Vacuum Regulators

1. Vacuum regulators shall be mounted on the chlorine cylinders according to manufacturer's recommendations and all tubing and electrical connections made.

Chlorine Flow Meters

1. Shall be installed in parallel and shall be wall mounted. The minimum distance above the floor shall be 3 feet and the maximum distance above the floor 5 feet.

B. Chlorine Feed Vacuum Solenoids

1. Feed vacuum solenoids shall be wall mounted in chemical feed room immediately after automatic flow proportioning chlorine feed control valves. Modify tubing connections as needed for 1/2-inch outer diameter HDPE tubing using compression type fittings.

C. Electronic Chlorine Sensor

1. One electronic chlorine sensing module shall be wall mounted 2 inches above the concrete floor in the chemical feed room as shown in the Contract Drawings. The other sensing module shall be mounted 2 inches above the floor on the east wall of the Mechanical Bay.

2. The indicator/receiver shall be wall mounted in the main building next to the observation window 5 feet above the concrete floor.

3. The remote indicator shall be mounted on the outside of the chemical feed room entrance 5 feet above ground level.

4. Confirm all wiring requirements with the equipment supplier.

D. HDPE Tubing

1. Tubing shall be securely mounted to the wall. Wall mounts shall be placed such that the maximum tubing deflection is less than 1/4 inch. Wall mounts shall be placed on each side of all bends and corners such that the tubing does not kink. All tubing runs shall be neatly installed and shall be horizontal and vertical to the floor. Corners shall be made by bending the tubing except where kinking would result. Tubing outside the chemical feed room shall be run inside the carrier conduit and shall be continuous. No joints, fittings or splices shall be allowed outside the chemical feed room.

E. Plug Valves

1. Plug valves shall be mounted to the wall by installing wall mounts on the inlet and outlet tubing within 1/2-inch of the compression fittings. The plug valves shall be mounted with the valve stem perpendicular to the wall pointing outward.

F. Chlorination System Tube Fittings

1. The Contractor shall be responsible for determining locations requiring installation of fittings. The number of fittings installed shall be minimized to reduce potential vacuum losses. Fittings shall be installed only when bending the tubing would otherwise result in kinking or when joining tubing together.

G. Chlorine Ejector Assemblies

1. Shall be installed according to manufacturer's recommendations and shall be installed perpendicular to the concrete floor.

2. The diffuser shall be located as shown in the Contract Drawings. A tapping saddle (specified in Section 11900) shall be used for taps larger than 3/4-inch diameter. The diffuser shall extend to the centerline of the pipe.

I. Exterior Chlorine Vent

1. The compression fitting on the 1/2-inch diameter x 1-inch diameter male connector shall be installed to provide an airtight seal.

2. All fitting joints shall be airtight.

3. Teflon tape wrap shall be used on all pipe threads.

4. Holes through the chemical feed wall shall be bored, not chiseled, and shall not be more than 1 inch in diameter greater than the CPVC pipe.

5. Fire-resistant sealant as specified in Division 15 shall be applied to fill the space between the 1-inch diameter CPVC coupling and the interior wall of the chemical feed room to form an airtight seal. Fire-resistant sealant shall be applied around the 1-inch diameter CPVC pipe on the outside wall for weatherproofing.

6. The annular space between the CPVC pipe and the concrete wall shall be completely filled with non-shrink grout.

I. Chlorine Cylinder Securing Chains and Mounts

1. The open eye bolts with toggle nuts shall be securely installed on the horizontal restraining bar as shown in the Contract Drawings.

2. The maximum slack in the securing chains shall be 1 inch when connected to the open eye bolts with cylinders in place.

J. Automatic Chlorine Switchover Module

1. Securely mount to the wall in the chemical feed room as shown in the Contract Drawings.

K. Chlorine Booster Pump

1. Securely mount chlorine booster pump to the concrete floor and install piping (Section 11900 and Division 15) as shown in the Contract Drawings.

2. Each pump shall be installed with a check valve, to prevent back flow. Piping to completely isolate each pump for removal.

Each pump shall also include a ball valve and union on both the discharge and suction.

L. Respiratory Protection Equipment

1. Install storage cabinet at a location to be confirmed by Owner. Securely mount to the wall by drilling and using anchors which will support the weight of the cabinet and respiratory equipment.

3.02 FIELD QUALITY CONTROL

A. After the chlorination system is installed, the Contractor shall check for vacuum losses and calibrate flow meters and feed control valves. Calibration curves shall be prepared of valve setting and flow meter reading for each 10 percent increment on the valve setting for each valve. The calibration curves shall be submitted as part of the Operating Manual.

B. The Contractor shall visually check for leaks in the booster pump piping and shall repair all leaks.

C. The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements and maintain records of his quality control for all operations, including, but not limited to, the following:

1. Installation of tubing, fittings and valves.

2. Calibration and fine tuning of flow meters and control valves.

3. Airtight seals on all opening for tubing and pipe.

3.03 ADJUSTMENT

A. A qualified representative of the equipment supplier shall supervise installation and start-up of the system and shall instruct plant personnel how to properly operate and adjust the system. The equipment supplier's representative shall make all final adjustments for proper equipment operation.

3.04 TRAINING

A. The equipment supplier shall provide a minimum of 4 hours operator training at Owner's convenience after system is operational.

END OF SECTION 11371

SECTION 11500

CONTACTOR VESSELS AND INTERNALS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Contractor shall design, furnish and install contactor vessels as shown on the Contract Drawings. Dimensions of the contactor vessels shall be as shown on the Contract Drawings. Contactor vessels shall be delivered to the site complete as specified in this Section. Contractor shall be responsible for installing and levelling of vessels.

The intended use of the contactor vessels are as fixed bed granular activated carbon adsorbers. The granular activated carbon will be slurried into the vessel during initial carbon charge. The carbon will remain stationary in the vessel during operation as a fixed bed. Once the carbon has reached its adsorptive capacity (estimated at 9 to 15 months), the spent carbon will be slurried out of the vessel and virgin carbon will be slurried back into the vessel. The carbon will be slurried out of the vessel at a rate of 5 to 15 pounds per minute at a slurry density of between 1 and 4 pounds of carbon per gallon of water. The size of the granular activated carbon particles will generally be between U.S. standard sieve sizes of 8 and 40. The abrasion number as measured by the Ro-Tap method is approximately 70-85.

B. Related Sections.

1. Section 03200 - Concrete Reinforcement
2. Section 03300 - Cast-in-Place Concrete
3. Section 03600 - Grout
4. Section 05500 - Metal Fabrications
5. Section 09800 - Special Coatings
6. Section 11900 - Process Piping

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. ANSI B16.5 - 1981. "Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys"

2. ANSI B16.11 - 1980. "Forged Steel Fittings, Socket Welding and Threaded"

3. ANSI B18.2.1 - 1981. "Square and Hex Bolts and Screws"

4. ANSI B18.2.2 - 1973 (R 1983). "Square and Hex Nuts"

5. ANSI B18.22.1 - 1965 (R 1981). "Plain Washers"

6. ANSI/ASME B1.20.1 - 1983. "Pipe Threads, General Purpose"

7. ANSI/ASME B36.10M - 1985. "Welded and Seamless Wrought Steel Pipe"

8. ANSI/ASME B36.19M - 1985. "Stainless Steel Pipe"

9. ASME 1987. "ASME Boiler and Pressure Vessel Code, Section VIII Pressure Vessels"

10. AWWA C653-87. "Disinfection of Water Treatment Plants"

11. ASTM A53-86. "Specifications for Pipe, Steel, Hot Dipped, Zinc Coated Welded and Seamless"

12. ASTM D4366-84. "Method for Hardness of Organic Coatings by Pendulum Damping Tests"

13. ASTM A516-80. "Specifications for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service"

14. NACE - TM-01-70 No. 1 "Visual Standard for Surfaces of New Steel Air Blast Cleaned with Sand Abrasive"

15. SSPC - SP5.1982. "White Metal Blast Cleaning"

16. SSPC - SP10.1982. "Near White Metal Blast Cleaning"

1.03 SYSTEM DESCRIPTION

A. Contactor Vessel Design Requirements:

1.	Maximum Normal Working Pressure	90 psi
2.	Maximum Allowable Working Pressure	150 psi
3.	Maximum Operating Temperature	150°F
4.	Internal Pressure Only	

5. Internal "False Bottom" Underdrain Cone — 20 psi pressure differential in either direction

6. ASME Certified

B. Underdrain/Collection Cone Design Requirements

1. Internal cone shall be designed for a differential pressure of 30 psi in either direction (uplift during backflush or downflow).

2. Cone steel thickness shall be 1/2-inch minimum.

1.04 SUBMITTALS

A. Contactor Vessels (prior to delivery to site).

1. Design calculations, drawings, and specifications including but not limited to:

   a. Sidewall thickness
   b. Head thickness
   c. Cone thickness
   d. Internal and external weld details.

   Note that these are not shop drawings and no approval of design is required nor will it be provided. Submittal is for information purposes only.

2. ASME Certification for each contactor vessel.

B. Contactor Vessel Surface Preparation and Coating Schedule

1. The Contractor shall submit to Engineer at least one month prior to first scheduled event a tentative schedule for each vessel regarding the fabrication completion, surface preparation, external coating, and interior lining. The schedule will be used by the Engineer to schedule the inspections and tests that may be performed by Owner or Engineer. The types of tests and inspections that may be conducted are described in Paragraph 2.02 of this Section. The Contractor shall notify the Engineer of any deviations from the schedule at least seven (7) calendar days prior to beginning any scheduled activity.

C. Warranty

1. Contractor shall submit a warranty certificate for the contactor vessels as specified in Part 1.09 of this section. Wording of warranty certificate shall be subject to approval by Owner.

1.05 QUALITY ASSURANCE

A. The materials used for this Work shall be new and conform to the Specifications in Part 2 of this Section.

B. Contractor shall be responsible for alignment and orientation of all products and equipment installed under this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for the safe handling and shipment of the vessels to the site. Any damages occurring as a result of handling or delivery shall be corrected by the Contractor to the satisfaction of the Engineer and Owner. Repair of structural damage to contactor vessel shall require recertification by ASME.

B. Contractor shall coordinate delivery and installation scheduling of vessels with construction operations in order to facilitate safe storage and installation and on-site coating in accordance with requirements described elsewhere in this Section.

C. Vessels shall be stored on site in an upright position to protect the finish and in an area protected from adverse weather conditions and other construction activities.

D. Surface finish shall be protected during all phases of shipment and installation. Cables, chains, or other restraining devices used to secure vessel shall be completely padded to prevent damage.

1.07 SEQUENCING AND SCHEDULING

A. Contractor shall be responsible for coordination of Work performed under this section with work performed under all other sections.

B. Contractor shall be responsible for scheduling the installation of the vessels in order to meet the requirements of project completion as set forth in Division 1 of these Specifications.

C. Contractor shall schedule and perform all sandblasting and grinding for interior and exterior surface preparation off-site. Contractor shall, at a minimum, apply the prime coat of the exterior surface and

the initial coats of the vessel interior lining system and collection gallery interior lining system off-site. Major sandblasting of contactor vessels will not be allowed on-site. Sandblasting on-site may be permitted for minor repairs and touch-up prior to final coating, subject to approval of Engineer and Owner.

1.09 WARRANTY

A. Contractor shall provide a special warranty for the contactor vessels and internals. The warranty period shall be five years from the date of substantial completion. Vessels, linings, and surface coatings shall be warranted to be free from any defects in fabrication, application, or installation for this period. It shall be the Contractors responsibility to correct any defects encountered during the warranty period, including but not limited to peeling, blistering or other failure of the exterior paint and interior vessel lining; corrosion of the vessel resulting from failure of the coatings or incomplete coverages or other damage resulting from Contractor's failure to fully comply with these Specifications.

Contractor shall be responsible for the labor and materials involved with complete carbon change-out and carbon charge should a contactor vessel failure result in a loss of carbon or require carbon removal and replacement to complete the necessary repair. Any internal repair shall require complete removal of carbon prior to repair; and replacement with virgin carbon after repair. All costs incurred as a result of contactor vessel repair and carbon replacement costs shall be covered by the Contractor.

1.10 MAINTENANCE

A. Contractor shall supply Owner with the following spare products. Spare products shall be identical and totally compatible with like products specified in Part 2 of this section.

1. Underdrain Nozzles. Ten nozzles.
2. Rinse Heads. One unit complete plus twelve nozzles.

B. Spare products and parts shall be packaged in a manner suitable for long-term storage at the facility. Packages shall be clearly marked indicating the item, part, size, and quantity. All spare parts and products shall be delivered to the site and stored prior to Substantial Completion.

1.11 BASIS FOR COMPENSATION

A. Payment for all work covered by this section of these Specifications shall be included in the lump sum price bid.

PART 2: PRODUCTS

2.01 MATERIALS

A. Carbon steel plate for contactor vessel pressurized components shall conform with ASTM-A516 Grade 70 specifications.

B. Carbon steel plate for structural use shall conform with ASTM-A36 specifications. Structural shape dimensions shall conform with AISI standards.

C. Stainless steel plate shall conform with ASTM A240, Type 316L specifications.

D. Stainless steel pipe shall conform with ASTM A312, Grade TP316L and ANSI/ASME B36.19M specifications. Pipe threading shall conform with ANSI/ASME B1.20.1 specifications.

E. Pipe fittings shall be AISI Type 316L. Fittings shall dimensionally conform with ANSI/ASME B16.3 specifications. Fitting threads shall conform with ANSI/ASME B1.20.1 specifications.

F. Stainless steel hardware shall be AISI Type 316. Bolt and nut threads shall conform with ANSI B1.1.

G. Stainless steel nozzles shall conform to ASTM A312, Grade TP316L and ANSI/ASME B36.10M specifications. Schedule 80 pipe shall be used unless otherwise specified or if ASME design requires thicker. Stainless steel nozzle flanges shall conform to ASTM A182, Grade F316L and drilled in conformance with ANSI B16.5, Class 150. Nozzle flanges shall be flat faced.

H. Carbon steel nozzles (or manways) shall conform to ASTM A53, Grade B and ANSI/ASME B36.10M specifications. Schedule 80 pipe shall be used unless otherwise specified or if ASME design requires thicker. Carbon steel nozzle flanges shall conform with ASTM A105 and drilled in conformance with ANSI B16.1, Class 150. Nozzle flanges shall be flat faced.

I. Underdrain Nozzles

1. Couplings fabricated into the contactor vessel underdrain cone shall be forged stainless steel conforming to ASTM A182, Grade F316L and dimensionally conforming to ANSI B16.11 specifications. Couplings shall be 3,000 psi rated and threaded in conformance with ANSI/ASME B1.20.1 specifications.

2. Underdrain nozzles shall be constructed of AISI Type 316L stainless steel. Nozzle screen length and diameter shall be 1 1/2 inches and 2 inches minimum, respectively. Screen slot opening shall be 0.007-inch. Nozzles shall be 1-inch male NPT thread. Nozzles shall be Type 100N, as manufactured by Johnson Screens, St. Paul, Minnesota, or approved equal.

J. Rinse heads shall be 3-inch NPT female threaded and be constructed of AISI Type 316 Stainless Steel. Rinse head shall be of the non-rotating type and provide for full rinsing of the contactor vessel interior. Rinse head shall be complete with full cone spray nozzles constructed of AISI Type 316 stainless steel. Rinse head shall be supplied with 3/4-inch NPT female threaded outlet connections for spray nozzle mounting. Spray nozzles shall be 3/4-inch NPT male threaded. Rinse heads shall be Model No. 12900-1-3/4 as manufactured by Spraying Systems Co. of Wheaton, Illinois, or approved equal. Full cone spray nozzles shall be Model No. 3/4 HH-7 as manufactured by Spraying Systems Co. of Wheaton, Illinois, or approved equal.

K. Interior vessel lining system shall be a heavy duty, thick film, vinyl ester coating and shall be Plasite 4110 as manufactured by Wisconsin Protective Coating Corporation (Green Bay, Wisconsin) or approved equal. At a minimum the vessel lining shall meet the requirements of the U.S. Federal Register, Food and Drug Regulations, Title 21, Paragraph 175.300, and shall be corrosion and abrasion resistant in a moving wet granular activated carbon environment. The vessel lining shall be chemically resistant to chemical compounds present in the water matrix and shall not leach any chemicals in excess of the Minnesota Department of Health recommended allowable limits for drinking water contaminants as defined in Release No. 2, November, 1988. Equivalent products must have demonstrated successful performance in at least five GAC pressure vessel treatment of potable water applications for at least five years.

The vessel lining shall have a minimum dry film density of 79.1 lbs/ft^3 or 0.26384 lbs/ft^2 at 40 mils. The average abrasive loss per 1000 cycles of a 1000 gram weight Taber CS-17 wheel shall not be greater than 11 milligrams. The Konig Pendulum surface hardness

shall be at a minimum 134 seconds using a glass standard equal to 250 seconds as measured by ASTM D4366-84.

L. Collection gallery coating system shall be a high-build epoxy coating suitable for immersion service. Coating system shall conform to NSF Standard No. 61 for potable water contact. Coating system loss shall be no more than 120 mg after 1,000 cycles per ASTM Test Method D-4060 with CS-17 wheel and 1,000 gram load and dry film thickness of 4 to 5 mils. Adhesion requirements shall be minimum 950 psi pull under ASTM Test Method D-4541 and 8 to 10 mil dry film thickness. No blistering, rusting, cracking or delamination and no more than 1/16-inch rust creepage at scribe shall occur after 1,000 hours of exposure under ASTM Test Method B-117 and 8 to 10 mil dry film thickness. Collection gallery coating system shall be Tnemec Series 20 Pota-Pox, Carboline Series 891, Glidden Series 5250/5452, or approved equal. Contractor shall coordinate coating system used to ensure that coating is of the same manufacture as the material supplied under Section 09800 of these Specifications.

M. Exterior coating system shall be a high-build epoxy coating suitable for coating of steel tanks. Coating loss shall be no more than 130 mg after 1,000 cycles per ASTM Test Method D-4060 with CS-17 wheel, 1,000 gram load at a dry film thickness of 8 to 12 mils. Coating adhesion requirements shall be a minimum 1,000 psi pull per ASTM Test Method D-4541 at a dry film thickness of 8 to 12 mils. Coating must pass 3H (gouge) requirement as per ASTM Test Method D-3363 at a dry film thickness of 8 to 12 mils. No blistering, cracking, rusting, or delamination of film and no more than 1/32-inch rust creepage at scribe shall occur after 1,500 hours of exposure per ASTM Test Method B-117 at a dry film thickness of 8 to 12 mils. Vessel exterior coating system shall be Tnemec Series 66, Carboline Series 890, Glidden Series 5461/5452 primer and Series 5430 finish, or approved equal. Contractor shall coordinate coating system used to ensure that coating is of the same manufacture as the material supplied under Section 09800 of these Specifications.

N. Effluent septa screen shall be constructed of AISI Type 316L stainless steel. Screen length and diameter shall be 9½ inches and 28 inches minimum, respectively. Screen slot opening shall be 0.007-inch. Screen shall have an end cap at one end and a flange welded to the other end. Flange shall be for a nominal 10-inch diameter pipe (flange OD 16 inches) constructed of ASTM A182, Grade F316L stainless steel and drilled in conformance with ANSI B16.5, Class 150. Flange shall be flat faced. Nozzle collapse pressure shall be 60 psi minimum, internal support bars may be used to increase strength. Effluent septa screen shall be Model No. CR800 as manufactured by Johnson Screens, St. Paul, Minnesota or approved equal.

2.02 FABRICATION

A. Design

1. Contactor vessels shall be designed by a duly Registered Professional Engineer. Vessels shall be designed for a maximum normal working pressure of 90 psi, maximum allowable working pressure of 150 psi, and a maximum working temperature of 150°F. Vessel design shall conform with Section VIII of the ASME code for pressure vessels. Each vessel shall be certified and stamped as specified in Section VIII of the ASME code. Vessels shall have flanged and dished heads. Vessel design shall include, at a minimum, spot radiography of welds. Fabricator shall perform the degree of radiography specified per Section VIII of the ASME Code.

2. Contactor vessel internal cone shall be designed for a 30 psi pressure differential in either direction (uplift during backflush and downflow). Cone shall be 1/2-inch thick minimum. Cone shall be conical and without knuckle at edge of cone.

3. Designer shall include lift hooks suitable for contactor vessel handling during fabrication and installation at the site. Lift hooks shall be designed for the entire vessel weight, internals, and stresses that will be encountered during shipping and handling. Lift hooks shall be permanent fixtures of the vessel shell and be designed to prevent damage to the interior lining system from stresses induced from lifting. Lift hooks shall not interfere with any of the process piping or internals associated with the contactor vessels.

4. Contractor shall be responsible for detailed design of the contactor vessel support legs. The design shall be in conformance with the dimensional requirements and concept designs shown on the Contract Drawings. Vessel legs shall be designed for the weight of the vessel plus a dead load of 100,000 pounds (approximate weight of GAC and water during operation). Design may include gusset plates between the legs and vessel side shell provided that they do not change the vessel leg and support pad center line locations and orientation. Vessel legs shall be below the grating as shown on the Contract Drawings.

5. The Contractor shall be responsible for assuring that the completed contactor vessels will function for their intended use and shall warrant the completed vessels as described in Paragraph 1.09 of Section 11500 of these Specifications. The

shall be responsible for the design of those details which are necessary for the Contractor to warrant the integrity of the interior lining. For this reason, minor deviations from the designs prepared by Engineer will be allowed, subject to review by Engineer and approval by Owner prior to fabrication. Minor design deviations which may be considered include:

a. Minor design deviations with regard to connection of the underdrain nozzles to the underdrain cone to the extent that nozzles remain easily replaceable and structurally stable.

b. Influent baffle plate assembly.

c. Carbon slurry inlet and outlet connections.

d. Nozzle layout.

e. Weld, chamfer and other finish details of vessel interior surfaces and internals.

The following items are not acceptable design deviations:

a. Changes in false bottom cone and collection gallery.

b. Interior cone angle.

c. External vessel dimensions.

d. Number of underdrain nozzles.

B. Fabrication

1. Contactor Vessels

a. All joints shall be full penetration butt-welded. Skip welds will not be allowed.

b. All internal welds shall be ground smooth to a minimum 1/4-inch radius or as specified on the Contract Drawings. All seams shall be welded on both the interior and exterior of the vessel and on both sides of the internal cone. No sharp edges shall be allowed.

c. All external welds shall be ground smooth and no sharp edges shall be allowed.

d. All internal sharp edges shall be ground smooth to a minimum 1/4-inch radius or as specified on the Contract Drawings.

e. Tolerances

1. Nozzles

i.	Deviation of flange facing from location as specified on Contract Drawings.	± 1/4 inch
ii.	Deviation of flange facing from horizontal, vertical or intended position.	± $1/2^0$
iii.	Deviation of bolt holes in any direction.	± 1/16 inch

2. Shell

i.	Deviation from verticality.	± 1/2 inch
ii.	Difference between maximum and minimum inside diameter.	1% of nominal diameter

f. Elliptical manways shall be of the full gasketed type with one or two bolt fastening for quick opening. Manways shall be designed in accordance with ASME Code Section VIII for pressure vessels.

g. Rod and filler materials for welding Type 316L stainless steel to Type 316L stainless steel and welding Type 316L stainless steel to carbon steel shall be Type 316L or 317L stainless steel.

h. Contractor shall be responsible for field verification of all vessel support pad locations and elevations and other site conditions so that the vessels may be installed as shown on the Contract Drawings.

2. Contactor Vessel Internal Cone and Underdrain Nozzle Assembly

a. Internal cone plate shall be butt welded to interior of the vessel at the perimeter of the cone and vessel side shell.

b. Internal cone to vessel side shell weld shall be as shown on the Contract Drawings.

c. Internal cone and nozzle joint shall be welded and ground smooth as shown on the Contract Drawings.

d. Couplings shall be welded to the internal cone as shown on the Contract Drawings. Welds and sharp edges shall be ground smooth to a minimum 1/4-inch radius.

3. Drilling of exterior structural shapes for pipe supports which are welded to the vessel side shell or leg shall be as shown on the Contract Drawings.

C. Vessel Interior Lining

1. The Contractor shall notify the Owner and Engineer at least 7 calendar days prior to vessel lining. The Engineer reserves the right to be present and observe the lining process for each vessel.

2. Surface Preparation

a. All sharp edges shall be ground smooth to produce a minimum 1/4-inch radius and all imperfections, such as, delaminations, scabs, slivers, and slag shall be corrected prior to abrasive blastings.

b. The steel substrate shall be prepared according to lining material manufacturer's recommendations including abrasive blasting in conformance with a SSPC-SP5 (white metal) blast specifications and abrasive use, degree of profile, blasting nozzle and pressure, surface cleaning and temperature. Surface preparation shall conform with NACE Standard RP-01078. Surface preparation shall also conform with Wisconsin Protective Coating Corporation "Specifications and Application of Plasite 4000 Series for Immersion Service", Bulletin PA4000 and Bulletin PA3 "Lining of Vessels for Immersion Service". If conflicts between these specifications exist, the most stringent requirements shall apply. An iron-free silica sand abrasive material shall be used for abrasive blasting.

c. Contractor shall notify Engineer seven (7) calendar days prior to vessel lining and shall provide access to vessels for observation by Engineer or Owner to ensure that all requirements of these Specifications or the lining material

manufacturer's specifications, whichever are most stringent, are achieved prior to vessel interior or exterior coating applications. Contractor shall not proceed with the coating of a vessel without written acknowledgement from the Engineer that surface preparation has been observed. Should a vessel fail any inspection or test performed by the Owner or Engineer, the Contractor shall be responsible for costs associated with subsequent inspections.

3. Application

a. The initial coat of lining material shall be shop applied in accordance with manufacturer's recommendations and as shown on the Contract Drawings. Subsequent coats may be shop or field applied.

Carbon transfer nozzle, circular manway interior surfaces, and up to and including exterior flange faces shall be coated. All interior carbon steel surfaces shall be coated. The upper (GAC) side of the underdrain cone shall be coated. Influent rinse line, nozzle coating shall be terminated a minimum of 2 inches onto the nozzle outside diameter surface. Head to nozzle welds shall be coated. Vent line nozzle to vessel head weld shall be coated and coating shall be terminated a minimum of 2 inches onto the nozzle inside diameter surface. Elliptical manway nozzle and inside cover surface shall be coated.

b. Application shall begin within 8 hours following surface blasting or before formation of rust bloom. The coating material shall be applied in two or three multi-pass spray coats to a nominal film thickness of 40 mils. Finished dry film thickness shall be 40 mils $\pm$ 4 mils. Overcoating will not be allowed.

c. Atomizing air spray equipment recommend by the manufacturer preferably with new hoses, shall be used to apply horizontal and vertical passes with 50% overlap resulting in a maximum dry film thickness of 18 to 22 mils per coat.

d. Subsequent coats shall not be applied until previous coats have "set" according to manufacturer's recommendations. Thinning of coating material shall be in accordance with manufacturers recommendations. Overcoating shall be performed as soon as possible but in all cases within the time recommended by the manufacturer. Subsequent coats

shall be applied within the maximum time established by the manufacturer to assure bonding between coats. Surfaces shall be cleaned between coats to remove dust, overspray, oxidation, and other contaminants that might affect bonding of coats. Cleaning shall be in accordance with manufacturer's recommendations

e. The coating shall be protected from moisture by condensation or any source before coating reaches "non-tacky" stage. Coating shall not be exposed to direct or indirect sunlight for more than 24 hours.

f. Small to moderate runs and sags shall be brushed out. Heavy runs and sags shall be solvent washed to bare metal and recoated in the proper manner.

g. Contractor shall notify Engineer seven (7) calendar days prior to vessel lining and shall provide access to vessels for observation by Engineer or Owner to ensure that all requirements of these Specifications or the lining material manufacturer's standards, whichever are most stringent, are achieved for vessel interior or exterior coating applications. Should a vessel fail any inspection or test performed by the Owner, Engineer or subconsultant, the Contractor shall be responsible for all costs associated with subsequent inspections or tests. Contractors shall make available to Owner, Engineer, or subconsultant scaffolds, lifts, and other apparatus to use for testing procedures. Contractor shall provide access to all portions of surfaces for testing to be performed by the Owner, Engineer, or subconsultant.

4. Curing

a. Surface temperature, air temperature and humidity, ventilation, and cure time shall be in accordance with manufacturer's recommendations.

b. If forced curing is used, all applicable state, local and national safety codes covering, but not limited to working conditions, scaffolding, clothing, fire and explosion hazards, safety equipment, solvent, lighting, ventilation and electrical grounding of vessels shall be maintained.

c. Contractor shall consult lining manufacturer for recommended final cure testing procedure. At a minimum, either a solvent test or Konig Pendulum Hardness Test shall

be performed. If a solvent test is used, the final cure will be reached if no sign of dissolving is evident for an exposure period of 10 minutes. If the Konig Pendulum Hardness Test is used, a minimum hardness of 134 ± 3 seconds using a glass standard of 250 ± 3 seconds shall be acceptable. Estimate of coverage shall be made with a wet film gauge immediately after making a spray pass with gun.

5. Repairs

   a. Damaged areas shall be cleaned by removing all contaminants and loose coating followed by abrasive blasting to SPCC-SP5 specifications. Repair coating may be brush or spray applied but areas larger than one square foot shall not be brush applied. Repair holidays by sanding surface and brush applying coating to specified thickness.

6. Apply top coating after all repairs to base coat have been made according to manufacture's recommendations.

7. Inspection and Testing Performed by Owner or Engineer

   a. Inspections and tests may be performed by Owner or Engineer during various stages of vessel fabrication, coating, and installation. Contractor shall provide access for the Owner or Engineer and shall notify Engineer at least seven (7) days prior to vessel surface preparation for interior and exterior coating and final inspection of interior lining and exterior coating.

   b. Tests that may be performed by the Owner or Engineer include but are not limited to:

      i. Preliminary inspection of equipment and supplies to verify that type, capacity and operating conditions in accordance with these Specifications include but are not limited to: a clean, dry properly trapped and filtered air supply of sufficient volume and pressure; clean spray equipment; and abrasive is the proper size and is non-contaminating. The surface may be inspected to determine if pre-baking or pre-cleaning before blasting is required.

      ii. Intermediate inspection to verify that the surface meets the blasting and profile specifications using a surface profile measuring device or standard comparator panels.

iii. Final inspection may include the following:

1. General Appearance. Film shall be free of runs of sags, orange peel, pinholing, fisheyes, overspray, trash in the film, and voids.

2. Film thickness shall be determined by a non-destructive dry film thickness gauge for the use on protective coatings with an accuracy of ±5 percent and which has been properly calibrated.

3. Discontinuity (holiday) testing shall be performed using a high voltage detector.

D. Collection Gallery Coating System

1. Collection gallery surfaces shall be shop prepared to an SSPC-10 (near white metal) blast finish using an iron free silica abrasive blasting material. Collection gallery shall be shop primed to a minimum of 4 mil dry film thickness.

2. Contractor may shop apply final coats and touch up in the field or apply final coats in the field. Coating shall be as specified in Paragraph 2.01L of this Section. Collection gallery coating dry film thickness shall be 10 to 12 mil.

3. Carbon effluent nozzle interior surface shall be coated up to and including exterior flange facing.

4. Collection gallery coating system shall terminate on the underside of the underdrain as shown on the Contract Drawings. Cone to side shell weld shall be coated.

E. Exterior Finish

1. Contactor vessel exterior surfaces shall be shop prepared to a SSPC-10 (near white metal) blast finish and be shop primed. A minimum of 4 mil dry film thickness of primer shall be applied prior to vessel transport.

2. Contractor shall apply final finishing and touch up in the field after installation or apply final finishing in the field after installation. Coating shall be as specified in Paragraph 2.01M, Section 11500 of these Specifications and be of the same manufacture and lot number as the paint supplied for items of the same color which will be field painted. Touch-up work in the field shall match the applied finish exactly and color

variation or finish difference will not be acceptable. Total exterior coating shall be 10 to 12 mil dry film thickness.

2.03 SOURCE QUALITY CONTROL

Products and materials specified under the specific paragraphs of this section shall be of the same manufacture and be identical and interchangeable with products of the same specifications and size. Contractor shall be responsible for implementing quality assurance and quality control for all aspects of vessel fabrication and coating. Owner or Engineer's testing shall not be considered as a substitute for Contractor's independent quality control and testing program.

PART 3: EXECUTION

3.01 Installation

A. Removable vessel internals including underdrain nozzles, inlet baffle plate assembly, interior rinse system, and effluent septa screen shall be installed as shown on the Contract Drawings in the shop or on-site. If the Contractor selects to install these items at the point of fabrication, Contractor shall implement shipping and handling precautions to provide for safe and damage free delivery of the vessels to the site. Contractor shall be responsible for correcting any damage to the vessels as a result of shipping or handling. If structural damage to the vessel occurs, vessel shall be ASME recertified.

B. Contractor shall install contactor vessels as shown on the Contract Drawings. Contractor shall be responsible for all leveling and alignment of the contactor vessels. Steel shims of equal size to the bearing surface to the vessel pier plate may be used for vessel leveling. Top of pier plate and bottom of contactor leg base plate shall be coated with a bituminous sealer and allowed to dry prior to installation.

C. Contractor shall be responsible for connection of the contactor vessel nozzles to the process piping as shown on the Contract Drawings. Any deviation in the process piping or vessel installation shall be corrected by the Contractor at no cost to the Owner. This specifically includes any adjustments in process piping required as a result of fabrication misalignment within the tolerances specified in this section.

3.02 TESTING

A. Testing of lining material integrity as specified in Part 2 of this section may be repeated at the site by Owner or Engineer to ensure that the vessel lining material was not damaged during shipment or handling. Contractor shall be responsible for all repair and re-testing of vessel at no cost to Owner should initial test fail. Contractor shall provide scaffolding and other equipment required for access by Owner or Engineer's field testing procedures.

B. After installation of the contactor vessels and connection to the process piping, all vessels shall be pressure tested to 100 psi and held at the test pressure for a minimum of 2 hours. Pressure deviations greater than 2 psi maximum during the test period that cannot be attributed to temperature changes will not be acceptable. Contractor shall use water as the testing fluid. Pressure test shall include all process piping connections to the vessel and the rupture disks. Test is not intended for vessel shell or weld testing. Contractor shall take the necessary corrective actions to repair or replace defective parts and installation deficiencies and re-test the vessel. Contractor shall be responsible for disposing of all water used for pressure testing. Contractor shall obtain the necessary permits for discharge of the water.

3.03 DISINFECTION

A. After vessel pressure testing and no more than four (4) calendar days prior to carbon charging, each vessel shall be disinfected in accordance with AWWA C-653. Contactor vessel shall be dosed with chlorine reagent yielding a minimum 25 mg/L free chlorine residual. The vessel shall remain in contact with the chlorine solution for a minimum 24 hours. At the conclusion of the 24 hour disinfection period, the water shall be tested for free chlorine. If the free chlorine residual is less than 15 mg/L, the disinfection process shall be repeated until a residual of 15 mg/L is maintained in the vessel for a period of 24 hours. Contractor shall be responsible for coordinating the vessel disinfection with the disinfection of the process piping to ensure that cross-contamination between the two systems does not occur. Appropriate isolation or protective techniques shall be implemented to prevent cross-contamination. Contractor shall be responsible for obtaining the required permits and disposal of water used for disinfection.

B. After the disinfection procedure has been completed, contactor vessel shall be filled with a minimum 5 mg/L chlorine solution. Free chlorine residual shall be tested daily by the Contractor and if the free residual is below 2 mg/L, chlorine shall be added so that a 5

mg/L solution minimum is attained. This procedure shall continue until the vessel is scheduled for carbon charging.

C. Prior to carbon charging, the contactor vessel shall be thoroughly drained and flushed. Flushing of vessel shall be sufficient when the free chlorine residual of the rinse water is not more than 1 mg/L greater than the rinse supply water. Contractor shall be responsible for obtaining the necessary permits for disposal of water used to flush the system.

D. After disinfection and flushing and immediately before carbon charging, the water will be sampled and tested for quality, including bacteriological, by the Owner. Contractor shall contact Owner 24 hours in advance when individual vessels or vessels groups are ready for testing. If the water does not meet the bacteriologic quality standard of the Minnesota Department of Health, the Contractor shall perform all operations necessary to disinfect the vessel system or system. All costs associated with the resampling and analysis resulting from failed bacteriologic tests shall be covered by the Contractor. The laboratory used for any analyses of the redisinfected samples shall be of the Owner's choosing.

3.04 FIELD QUALITY CONTROL

A. Contractor shall establish and maintain quality control for Work performed under this Section to assure compliance with contract requirements and maintain records of his quality control for all construction operations including but not limited to the following:

1. Materials and products used,
2. Fabrication specifications and fabrication operations,
3. Tolerances,
4. Test procedures and results,
5. Vessel surface preparation and coating application procedures and test results,
6. Installation and alignment procedures.
7. Vessel lining coating repair or replacement

A copy of the records of inspection, tasks performed, and test results, as well as the records of corrective action taken, shall be furnished to the Owner and Engineer.

B. Contractor shall be responsible for maintaining quality control and quality of workmanship for the installation and connection of the contactor vessels to the process piping as specified in these specifications and as shown on the Contract Drawings.

C. The Contract Drawings indicate certain required pipe sizes and the general arrangement for the contactor vessels, associated piping, and equipment. Valves, fittings and other appurtenances furnished shall be of such dimensions to allow for the installation of the vessels and piping substantially as shown on the Contract Drawings. Locations of all process piping, piers, and accessories shall be verified in the field by the Contractor. In the event it should become necessary to change the location of any of the work due to interference with other work, the Contractor shall consult with the Owner and Engineer before making any changes and all such changes shall be made without added cost to the Owner. Under no circumstances shall the vessel or pipe sizes indicated on the Contract Drawings be changed without written approval of the Owner and Engineer.

END OF SECTION 11500

SECTION 11501

GRANULAR ACTIVATED CARBON

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work covered under this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes furnishing all labor, equipment, and materials necessary to:

1. Prepare, submit, and demonstrate conformance to a Carbon Transfer Plan that details procedures that will be used to transfer granular activated carbon (GAC) into the facility and ready carbon for potable use.

2. Furnish and install 20,000 pounds (dry weight) of bituminous coal based GAC into each of four (4) existing downflow contactor vessels as shown on the Drawings and described in Section 11500 of these Specifications. Total GAC to be furnished for this Project is 80,000 pounds (dry) minimum.

3. Perform all services necessary to prepare installed GAC for potable water delivery.

4. Contractor shall coordinate the activities of GAC Manufacturer and GAC Service Subcontractor to fulfill all requirements of this Section.

C. Contractor shall be solely responsible for operation and maintenance of all Project equipment and facilities required to complete the Work described in this Section. This specifically includes, but is not limited to, valves, pumps, compressors, filters, controls, and other components of the Project.

D. Related Sections:

1. Section 11210 - Backflush Booster Pump
2. Section 11211 - Air Compressor System
3. Section 11216 - Submersible Centrifugal Pumps (Backwash Tank)
4. Section 11224 - Deep Well Vertical Turbine Pump and Motor
5. Section 11365 - Fluoridation System

6. Section 11371 - Chlorination System
7. Section 11500 - Contactor Vessels and Internals
8. Section 11600 - Package Iron Removal System
9. Section 11900 - Process Piping
10. Section 15400 - Plumbing
11. Section 16900 - Starters and Motor Control
12. Section 16950 - Instrumentation and Control

1.02 SUBMITTALS

A. Carbon Transfer Plan

Submit a Carbon Transfer Plan meeting the requirements of paragraph 3.01 of this Section. Submit in accordance with the requirements for an administrative submittal set forth in Division 1 of these Specifications.

B. Quality Control

Submit the certifications and test results called for in paragraph 2.01 of his Section. Submit in accordance with the requirements set forth in Division 1 of these Specifications.

1.03 DEFINITIONS

A. GAC Manufacturer

The person, partnership, corporation, or other legally recognized business entity that converts raw material into the GAC product specified for use in this Section. The GAC Manufacturer shall have controlling interest (at least 51 percent ownership) in the physical facilities used to produce the GAC, and shall actively control operations and quality assurance/quality control aspects of those facilities.

B. GAC Service Subcontractor

Subcontractor responsible for transporting GAC to the Site and for fulfilling responsibilities set forth in this Section regarding transfer of GAC into contactor vessels and readying GAC for potable use. GAC Service Subcontractor may be Contractor, GAC Manufacturer, or other Subcontractor, but in any case must meet the requirements set forth in paragraph 1.05 below.

1.04 APPROVED GAC MANUFACTURERS

A. The following GAC Manufacturers are approved for GAC products specified in this Section.

1. Atochem North America, Inc.

Corporate:

Atochem North America, Inc.
Three Parkway
Seventh Floor
Philadelphia, PA 19102
Attn: Mr. Bill Rigney
(215) 587-7899

Local Representative:

Atochem North America, Inc.
701 Highbury Lane
Geneva, IL 60134
Attn: Mr. Bill Glaysher
(708) 513-1700

2. Calgon Carbon Corporation

Corporate:

Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA 15230
Attn: Mr. Roger Zanitsch

Local Representative:

Calgon Carbon Corporation
4343 Commerce Court, Suite 400
Lisle, IL 60532
Attn: Mr. Henry Kaufman
(708) 505-1919

B. Alternate GAC Manufacturers must be approved by Engineer and Owner. Alternate GAC Manufacturers must submit supporting data and information demonstrating compliance with the following requirements:

1. Meets the definition of a GAC Manufacturer set forth in paragraph 1.03 of this Section.

2. Engaged in the production of GAC product(s) meeting the requirements of paragraph 2.01 of this Section for at least five (5) years.

3. Maintains a routine quality assurance/quality control program to assure quality and consistency of the specified GAC product that is at least as stringent as that of the approved GAC Manufacturers set forth in this Section.

C. Approval of GAC Manufacturer, either by name in this Section or by alternate submittal review process, does not in any way constitute a waiver of the other requirements of these Specifications. It shall remain the Contractor's responsibility to furnish GAC that fully meets all requirements of these Specifications.

D. Named approved GAC Manufacturers have recommended the approved GAC products described in paragraph 2.01 of this Section for potable water treatment in a pressurized contactor vessel system. Approved GAC Manufacturers have also recommended the named products as effective for removal of polynuclear aromatic hydrocarbon (PAH) compounds to the low part per trillion concentration range. Contractor and GAC Manufacturer shall be responsible for review these Specifications and for confirming those recommendations, and shall notify the Engineer if any inconsistencies or incompatibilities are discovered.

1.05 GAC SERVICE SUBCONTRACTOR QUALIFICATIONS

A. GAC Service Subcontractor shall meet the following minimum qualifications:

1. Shall be routinely engaged, as a major component of its business activity, in the manufacture or furnishing and installation of GAC or GAC water treatment systems.

2. Shall have technicians trained and proficient in the hydraulic transport of GAC in slurry form from bulk transport vehicles to pressure contactors using air as the motive force.

3. Technicians shall have slurried at least 200,000 pounds of GAC to/from pressure contactor vessels and bulk transport vehicles.

4. Technicians shall be trained and proficient in the preparation of GAC for potable water treatment (backflushing, downflow washing, etc.).

5. Engaged in activities as described above for a period of not less than five (5) years.

1.06 TRANSPORT, DELIVERY AND STORAGE

A. Transport may be by bulk transport vehicle or packages. However transported, GAC shall be transferred into contactor vessels from bulk transport vehicles as a carbon water slurry using air as the motive force.

B. If transported by package (bag or box), packages shall be transferred into bulk transport vehicles off-site. Transfer of packaged carbon to bulk transport vehicle will not be permitted on public right-of-way or within the construction limits shown on the Drawings.

C. The bulk transport vehicle shall be capable of delivering a full contactor charge (20,000 pounds, dry weight) in a single load. Delivery of GAC shall be in a vehicle approved by the U.S. Food and Drug Administration for food grade use that has been used only for transport of virgin grade carbon. If requested by Engineer or Owner, Contractor shall furnish a signed affidavit stating that transport vehicle meets these requirements.

D. Packages used for GAC transport shall be sanitary containers approved for shipment of food grade GAC.

E. Packages and transport vehicles shall not be stored on-site. Bulk transport vehicle may be on-site only during transfer operations.

1.07 SEQUENCING AND SCHEDULING

A. GAC delivery shall not proceed until contactor vessels have been disinfected and testing by Owner completed as set forth in Section 11500 of these Specifications.

B. GAC delivery shall not proceed until all equipment required for GAC transfer and preparation is installed, tested, and ready for use.

C. GAC delivery shall be scheduled immediately prior to start-up of the complete Project to avoid prolonged periods of static water in the GAC once installed. If the GAC is to be in stagnant water for more than five (5) calendar days, Contractor shall propose a method for disinfecting GAC without use of chlorine or other compounds that would adversely affect GAC adsorption capacity.

1.08 BASIS FOR COMPENSATION

Compensation for all Work covered under this Section of these Specifications will be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 GRANULAR ACTIVATED CARBON

A. Material Requirements

1. Granular activated carbon (GAC) shall be GAC 830 as manufactured by Atochem North America, Inc., Filtrasorb 300 as manufactured by Calgon Carbon Corporation, or an approved equivalent product produced by an approved GAC Manufacturer as described in paragraph 1.04 of this Section.

   Listing approved products by name does not in any way constitute a waiver of the other requirements of these Specifications. It shall remain the responsibility of the Contractor to furnish a product that fully meets all of the requirements of these Specifications.

2. Approved equivalent products shall meet all the requirements of this Section. In addition, GAC Manufacturer's seeking approval for equivalent products shall submit the following information regarding the proposed product:

   a. Names, addresses, and telephone numbers of at least five (5) owners of potable water treatment facilities using the proposed product in a pressure contactor vessel containing at least 10,000 pounds of GAC.

   b. Results of pilot scale testing or full scale system monitoring that demonstrates the proposed product performs at least as well as the approved products in the removal of the PAH compounds that are present in the water from St. Louis Park Well 4.

   c. Alternate products shall have been submitted to the National Sanitation Foundation as of the date of issuance of these Specifications for certification by NSF under NSF Standard 61, "Drinking Water System Components - Health Effects".

   d. Alternate products shall not have received a failed status based upon review under NSF Standard 61.

3. GAC shall be "virgin" grade and shall be manufactured from bituminous coal and shall be of GAC Manufacturer's standard production.

4. GAC shall meet the following requirements for material properties and specifications:

Specification/Property	Value
Sieve Size	8 x 30
Max. retained on No. 8 U.S. Standard Sieve (% by weight)	15
Max. passing through No. 30 U.S. Standard Sieve (% by weight)	5
Minimum Iodine Number (mg Iodine/g Carbon)	900
Minimum Abrasion Number	75
Mean Particle Diameter (mm)	1.5 to 1.7
Effective Size (mm)	0.8 to 1.0
Maximum Uniformity Coefficient	2.1
Minimum Total Surface Area (m^2/g)	900
Pore Volume (ml/g)	0.85 to 0.90
Maximum Moisture Content as Packed (% by weight)	2
Maximum Total Ash (% by weight)	10
Maximum Water Soluble Ash (% by weight)	1.0
Maximum Extractable Phosphate (% by weight as PO_4)	1.0

5. The following test methods shall be used to confirm that the GAC meets the requirements of these Specifications:

Specification/Property	Test Method(s)
Particle Size Distribution Sieve Analysis	AWWA B604, 2.4.1, 4.5
Iodine Number	AWWA B604, 2.6, 4.7
Abrasion Number/Mean Particle Diameter	AWWA B604, 2.5, 4.6
Effective Size	AWWA B604, 2.4.2, 4.5.5
Uniformity Coefficient	AWWA B604, 2.4.3, 4.5.5
Moisture	AWWA B604; 2.2, 4.3
Pore Volume	Mercury/Hellium Displacement Method
Total Surface Area	Nitrogen Adsorption by the BET Surface Area Determination Test
Total Ash	ASTM D2866-83
Water Soluable Ash and Water Extractable Phosphate (PO_4)	1981 Food Chemical Codex Activated Carbon Specification, Water Extractables Test

6. GAC Manufacturer shall collect one random grab sample from each 80,000 pounds (or portion thereof) of GAC delivered to the site. Samples may be collected at point of origin of shipment, but shall be collected from the actual GAC shipped for this Project. GAC Manufacturer shall conduct tests to demonstrate compliance with the specifications set forth in paragraph 2.01.A.4 above, except that Total Surface Area and Pore Volume Tests will not be required. Tests shall be conducted in accordance with the methods set forth in paragraphs 2.01.A.5.

GAC Manufacturer shall submit a certified test report to Engineer within 30 calendar days following delivery of GAC material to Site. Report shall clearly show results of tests, test methods, date of testing, and all other relevant

information and shall be co-signed by the person who performed the tests and a person having corporate responsibility for quality assurance/quality control.

7. GAC Manufacturer shall submit, in addition to Project specific tests required above, complete results of GAC Manufacturer's standard quality assurance/quality control testing for the lot/batch from which GAC for this Project was furnished.

8. Owner and Engineer will sample GAC delivered to the Site and reserve the right to perform independent testing to confirm that GAC meets the requirements of these Specifications.

9. If GAC Manufacturer's testing indicates that delivered products do not meet the requirements of these Specifications, GAC shall be immediately removed and replaced with conforming materials at no additional cost to Owner. If initial testing by Owner indicates GAC does not comply, failed test(s) will be repeated. If second test also fails, GAC will be considered non-compliant and shall be immediately removed and replaced with conforming materials at no additional cost to Owner, and Contractor shall bear cost of second test. If second test passes, GAC will be considered conforming, provided GAC Manufacturer's testing indicates same.

B. Performance and Other Requirements

1. As prepared for potable water delivery, the GAC treated water, sampled from the effluent of a contactor vessel, shall not result in a water with a pH less than 6.5 or greater than 8.5. The pH of the raw water is approximately 7.6.

2. As prepared for potable water delivery, the GAC shall contain no water soluble inorganic or organic substances in quantities capable of producing deleterious or injurious effects upon the health of those consuming the water or that would otherwise render the water that has been treated with GAC unfit for potable use in accordance with Laws and Regulations or that would produce observable aesthetic changes under conditions of normal domestic use.

3. As prepared for potable water delivery, the GAC shall not impart to the water any constituent that, in combination with background concentrations, results in exceedence of the most stringent of any local, state, or federal drinking water standard or other applicable Laws and Regulations.

4. As prepared for potable water delivery, the GAC shall not impart to the water a total phosphorus concentration greater than 3 mg/L above background concentrations as determined by EPA Method 365.1/365.2.

2.02 WATER

Water used during the carbon transfer operations and preparation of carbon for potable use shall be potable water meeting all applicable drinking water standards.

2.03 COMPRESSED AIR

Compressed air used for the carbon transfer operations shall be supplied by the facility compressed air supply system that has been constructed for that purpose. Connections for compressed air piping are shown on the Contract Drawings.

2.04 AUXILIARY CARBON TRANSFER EQUIPMENT

A. Contractor shall furnish all hoses, valves, connectors, and adapters required for conveyance of virgin carbon from the transport vehicle to the contactor vessels. Connections for carbon transfer piping on the vessels are shown on the Contract Drawings.

B. Contractor shall furnish all hoses, valves, connectors, and adapters required for pressurizing carbon transport vehicles for carbon transfer from the vehicle to the contactor vessels.

C. Contractor shall furnish all hoses, valves, connectors, and adapters required to convey wastewater from carbon transport vehicles to sumps or sanitary sewer during carbon transfer operations.

D. Full length carbon transport vehicle (tractor plus trailer) will not fit in carbon service corridor. Depending on weather condition, Owner or Engineer may require tractor to be decoupled from trailer to permit closing of overhead door during carbon transfer. Contractor shall furnish all blocking, jack stands, wheel chocks, and other ancillary equipment required to safely decouple fully loaded tailer without damaged to facility.

PART 3: EXECUTION

3.01 CARBON TRANSFER PROCEDURAL PLAN

The Carbon Transfer Plan shall address the functional requirements of the carbon transfer operation, and shall present the Contractor's

detailed plans and procedures for meeting the functional requirements with the available equipment as outlined in Section 3.02 of these Specifications. Contractor shall not initiate carbon transfer operations prior to submittal of Carbon Transfer Plan to Engineer. Submittal of Carbon Transfer Plan to Engineer is for informational purposes only and in no way limits or modifies Contractor's complete responsibility for equipment and facilities during transfer operations.

3.02 CARBON INSTALLATION

A. Carbon Transfer Functional Requirements

Contractor shall perform carbon transfer in accordance with the following requirements:

1. Carbon transfer shall be conducted by transferring the carbon in a slurry form, without human contact, using the available facility air supply as the motive force.

2. Handling of any spills or releases of carbon shall be the sole responsibility of the Contractor. All spilled material shall be contained and removed from the site. Rinsing of carbon to the facility floor drains will not be allowed.

3. Contactor vessels shall be filled approximately half full of potable water before adding the virgin carbon to provide a suitable cushion as the carbon/water slurry enters the vessel.

4. The Contractor shall operate the contactor bay and other plant valves to prevent cross-contamination and to prevent hydraulic surges from rapid valve movement or other damage. Contractor's Carbon Transfer Plan shall present detailed valve sequencing and positioning instructions suitable for interpretation by a person unfamiliar with carbon transfer.

5. Contractor shall conduct all operations in a manner that will not result in damage to any of the Owner's equipment or property or create a hazard for Owner's or Engineer's staff.

6. All carbon transfer operations shall be accomplished in the presence of GAC Service Subcontractor's trained technician and a representative of Contractor familiar with all technical aspects of the Project and all relevant equipment.

B. Preparation of Carbon for Potable Use

1. Contractor's Carbon Transfer Plan shall present detailed instructions, suitable for interpretation by a person unfamiliar with carbon transfer, that describe how GAC will be prepared for delivery of potable water and meet the functional requirements set forth below.

2. Upon completion of the carbon transfer, the Contractor shall saturate the GAC in the contactor vessel by slowly filling the vessel with water in air upflow mode and then backflushing with potable water to remove air trapped in the carbon during the transfer process, and to remove carbon fines and water soluble ash contained in the GAC.

3. The virgin GAC shall be further prepared by the Contractor by performing at least two cycles of flushing and soaking of the carbon to reduce the solubility of metals and other undesirable constituents that would leach from the carbon during use. The cycle shall consist of a period of soaking of the carbon in stagnant water for a period of at least 24 hours, followed by flushing to waste, in a downflow mode, at least 30,000 gallons of water.

4. Contractor shall conduct all operations in a manner that will not result in damage to Owner's equipment or property or create a hazard for Owner's or Engineer's staff.

5. Once the Contractor is confident that the carbon will meet the performance requirements established in paragraph 2.01 of this Section, the Contractor shall notify the Engineer that the carbon installation for that contactor vessel has been completed. The discharge from the associated contactor vessel may be sampled and analyzed by Owner or Engineer to determine if the discharge meets the requirements of these Specifications.

6. If the start-up verification monitoring indicates that the treated water does not meet the requirements of these Specifications, the Contractor shall backflush, soak and flush as necessary, to correct the problem before testing again. The Contractor shall pay all costs associated with re-testing the effluent, should the initial test results fail.

7. Should Contractor's carbon preparation procedure fail to result in a treated water discharge that meets the requirements of these Specifications, the GAC shall be removed and replaced with

product that can meet the requirements, at no additional cost to Owner.

3.03 SEWER DISCHARGES

All water used for backflushing and downflow flushing to prepare GAC for use, and any other water discharged from contactor vessels prior to Owner's confirmation that GAC is suitable for delivery of potable water, shall be directed to the backwash tank. From there it shall be directed to the sanitary sewer by use of the backwash tank sludge pump. Discharge flowrate to the sanitary sewer shall be controlled and monitored to prevent flow in the sanitary sewer deeper than one-half of the pipe diameter.

3.04 FIELD QUALITY CONTROL

Contractor shall establish and maintain quality control for Work under this Section to assure compliance with the Contract Documents and maintain records of Contractor's quality for all operations, including but not limited to, the following:

1. Materials and products used.

2. Testing to verify compliance with requirements of these Specifications, specifically performance requirements of paragraph 2.01 of this Section.

3. Volumes and flowrates of discharges to the sanitary sewer. Contractor shall provide records to Owner or Engineer if requested.

END OF SECTION 11501

SECTION 11600

PACKAGE IRON REMOVAL SYSTEM

Part 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraph as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to design, furnish, install, and place in satisfactory operating condition a package iron removal treatment system of the horizontal pressure type. The package iron removal system includes five cell (minimum) pressure vessel, pneumatic actuated influent and backwash effluent control valves, face piping, over pressure protection, pneumatic actuated effluent valve, air relief valve and vent piping, backwash rate of flow controller and flow meter, electrical controls, and appurtenances all mounted for installation on a concrete pad.

C. Related Sections

1. Section 03300 - Cast-in-Place Concrete
2. Section 09800 - Special Coatings
3. Section 11211 - Air Compressor System
4. Section 11216 - Submersible Centrifugal Pumps (Backwash Tank)
5. Section 11224 - Deep Well Vertical Turbine Pump and Motor
6. Section 11371 - Chlorination System
7. Section 11900 - Process Piping
8. Section 16950 - Instrumentation and Control

1.02 REFERENCES

A. The following are complete titles of reference cited in this Section:

1. ASME 1987, "ASME Boiler and Pressure Vessel Code, Section VIII Pressure Vessels"

2. AWWA C653-87, "Disinfection of Water Treatment Plants"

3. NSF Standard 61, "Drinking Water System Components-Health Effects"

4. ANSI B16.5 - 1981. "Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys"

5. ANSI B16.11 - 1980. "Forged Steel Fittings, Socket Welding and Threaded"

6. ANSI B18.2.1 - 1981. "Square and Hex Bolts and Screws"

7. ANSI/ASME B1.20.1 - 1983. "Pipe Threads, General Purpose"

8. ANSI/ASME B36.10M - 1985. "Welded and Seamless Wrought Steel Pipe"

9. ANSI/ASME B36.19M - 1985. "Stainless Steel Pipe"

10. ASTM A53-84. "Specifications for Pipe, Steel, Hot Dipped, Zinc Coated Welded and Seamless"

11. Great Lake Upper Mississippi River Board of Sanitary Engineers, "Recommended Standard for Water Works" (Ten State Standards)

1.03 SYSTEM DESCRIPTION

A. Process Summary

The package iron removal system furnished will be used to remove iron and manganese from Well No. 4 raw water. The iron removal process will use pressure aeration and chlorine for oxidation. The filtration process shall be performed in a horizontal pressure vessel with a minimum of five cells. Iron removal effluent will go directly to the distribution system or to the PAH removal system and then to the distribution system. There is no clear well at the facility. The source of the backwash water will be Well 4 with filtered water from cells not being backwashed or used to backwash the cell being backwashed. Only one cell will be backwashed at any given time and the backwashing cycle shall be repeated for each cell prior to putting the iron removal system back on-line. The backwash effluent water will be conveyed to the 100,000-gallon backwash tank. After the iron and manganese precipitates are settled, the supernatant will be recycled to the head of the iron removal system. Settled iron sludge will be discharged to the sanitary sewer. The supernatant recycle flow rate will be approximately 120 gpm.

The package iron removal shall be designed, constructed, and made operational by an approved System Supplier as described in paragraph 1.05 of this Section. The System Supplier shall be responsible for

design of the horizontal pressure filter to meet the performance requirements as established in this Section of these Specifications.

B. Summary of Performance and Design Requirements

1.	Maximum Anticipated Influent Flowrate (during backwash recycle and low pressure)	1,400 gpm
2.	Nominal Design Flowrate	1,200 gpm
3.	Maximum Filter Hydraulic Loading Rate (at Nominal Design Flowrate)	3.0 gpm/ft^2
4.	Minimum Backwash Flowrate (up flow)	15 gpm/ft^2
5.	Maximum Normal Working Pressure	90 psi
6.	Maximum Allowable Working Pressure	150 psi
7.	Maximum Operating Temperatures	150° F
8.	Internal False Bottom Underdrain	20 psi pressure differential either direction
9.	ASME Certified Vessel	
10.	Iron Oxidation by Pressure Aeration and Chlorination	
11.	Conformance with Applicable Requirements of Ten State Standards	

C. Water Quality Data

	Well No. 4	
Date of Sample	1987	08/07/90
pH	7.6	
Alkalinity (as $CaCO_3$)	301	
Total Hardness (as $CaCO_3$)	342 mg/L	
Total Iron (as Fe)	1.31 mg/L	0.97 mg/L
Manganese (as Mn)	0.06 mg/L	0.05 mg/L

D. Iron Removal Filter Effluent Criteria

	Immediately Following Filter Backwashing	Immediately Before Filter Backwashing
Max. Total Iron (as Fe)	0.05 mg/L	0.10 mg/L
Max. Total Manganese (as Mn)	0.01 mg/L	0.03 mg/L
Max. Chlorine Residual	0.5 mg/L	0.5 mg/L

Contractor or System Supplier may conduct treatability testing, at no additional cost to Owner, if System Supplier determines that such testing is required to meet the requirements of these Specifications. System Supplier shall contact Owner and Engineer for access to Well No. 4.

E. Underdrain/Media Support Design Requirements

1. Internal underdrain/filter media support plate shall be designed for a differential pressure of 20 psi in either direction.

F. The Contract Drawings indicate certain required pipe sizes and the general arrangement for the iron removal filter, associated piping, and equipment. Iron removal System Supplier shall have the responsibility for design of the iron removal system components within the battery limits shown on the Contract Drawings. Minor modifications to face piping and filter dimensions will be allowed provided the package iron removal system meets the performance criteria established in this Section of these Specifications. If any modifications outside of the battery limits are deemed necessary by the System Supplier to meet the performance criteria established, Contractor and System Supplier shall consult with the Owner and Engineer before making any change. All such changes will be subject to Owner and Engineer approval.

1.04 SUBMITTALS

A. Test Results/Certificates - Submit the following certificate in accordance with the general requirements as set forth in Division 1 of these Specifications:

1. Iron Removal Vessel ASME Certification

B. Manufacturer's Literature/Data - Submit manufacturer's literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Backwash rate of flow control valve
2. Pressure aerator specifications
3. Control panel information including technical data on all components.

C. Shop Drawings - Submit Shop Drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Package iron filter layout and dimensional data. Note that this submittal is for informational purposes only and no approval of filter system design is required nor will it be provided. Contractor is responsible for ensuring that the supplied package iron removal system meets the requirements of these Specifications.

2. Pressure aerator specifications.

3. Ladder format wiring diagram showing all components, terminal numbering, and interface with other systems.

4. Logic programming of programmable logic controller (PLC) in ladder format with description of each logic operation.

5. Control panel front-panel layout and sub-panel layout drawings.

D. Operation and Maintenance Instructions - Submit operation and maintenance instructions for the following material and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Package iron removal system
2. Pressure aerator
3. Butterfly valves
4. Pressure relief/sustaining valve
5. Backwash rate of flow controller assembly
6. As-built schematic of filter control panel
7. PLC programming manual
8. Hard copy of PLC program in ladder format.

1.05 QUALITY ASSURANCE

A. The package iron removal system as described in this Section of these Specifications shall be furnished by a firm (System Supplier) regularly engaged in the design, fabrication, and installation of such equipment. Qualified package iron removal system suppliers are listed below.

1. General Filter Company, Ames, Iowa.
2. Tonka Filter Company, Maple Plain, Minnesota.
3. CPC-Microfloc, Sturbridge, Massachusetts.

B. All furnished equipment and systems shall conform fully in every respect to the requirements of these Specifications and the Contract Drawings. Equipment which is a "standard product" with the manufacturer shall be modified, redesigned from the standard, if necessary, or shall be furnished with special features, accessories, materials or finishes as may be necessary to conform entirely to the requirements of these Specifications.

C. In order to be approved as an alternate System Supplier, the manufacturer of the proposed alternate system shall be prepared to provide the following information as support material for the request for alternate equipment:

1. A list of ten systems of similar type, size, and design which the company has installed and have been in operation for five or more years. Alternate equipment shall be of the conventional horizontal downflow pressure filtration type with filtration rates as specified in this Section of these Specifications.

2. Reference letters from the owners of the systems identified in (1) above, along with phone numbers of owners and contacts.

3. Evidence of technical capability to design, install, and perform start-up procedures for the complete system.

4. Evidence of manufacturing capability to include:

   a. description of facilities
   b. description of number and types of personnel employed by the manufacturer.

5. Evidence of financial responsibility adequate to complete the project and assure viability of equipment warranty.

6. Standard products catalog and relevant company literature.

7. Evidence that backwashing rate and volume of backwash water generated is similar to conventional pressure filtration systems. Backwash water volume shall not exceed 100,000 gallons per week.

8. Rapid rate filtration systems, gravity flow filtration systems, and systems utilizing proprietary processes or filter media will not be allowed as alternates.

1.06 DELIVERY, STORAGE AND HANDLING

A. All mechanical equipment shall be cartoned or crated to provide protection during transit and job storage. All pipe and electrical connections shall be covered with suitable coverings, caps or plugs.

B. Store all materials and equipment at Site under cover unless specific permission is granted by the Engineer for off-site storage. Store electrical and other equipment in weather-tight areas and maintain temperature of 50°F minimum. Place equipment on wood supports or floors in a manner that will prevent rust and damage. Avoid use of non-vented plastic or canvas shelter which could create a humidity chamber. Cardboard wrappers which become wet shall be removed immediately.

1.07 SEQUENCING AND SCHEDULING

A. Contractor shall be responsible for coordination of Work performed under this Section with other Sections of these Specifications.

B. Contractor and System Supplier shall be responsible for scheduling the installation of the package iron removal system in order to meet the project completion as set forth elsewhere in these Contract Documents.

1.08 WARRANTY

A. Contractor and System Supplier shall warrant the package iron removal system performance for removing iron and manganese to the levels established in paragraph 1.03.D of this Section.

B. Contractor and System Supplier shall be responsible for assuring that the completed package iron removal system performance meets the requirements established in this Section of these Specifications. System Supplier shall be responsible for those design details which are necessary for the Contractor and System Supplier to warrant the system performance. System Supplier shall be solely responsible for the following design details:

1. Influent distribution and backwash water collection system
2. Underdrain/media support system
3. Pressure vessel ASME design
4. Filter surface area

5. Filter cell dimensions and number of cells
6. Filter length and width (subject to available space as shown on Drawings)
7. Pressure aerator and aeration rate
8. Chlorine addition rate (provided less than 0.5 mg/L for chlorine effluent concentration).

The following items are not acceptable design deviations:

1. Nominal filter hydraulic loading rate greater than 3 gpm/ft^2.

2. Backwash hydraulic flow rate in excess of 1,200 gpm.

3. Modifications to plant piping outside of the iron removal system battery limits.

4. Deviation from Ten State Standards for underdrain nozzle spacing.

5. Vessel dimensions which do not allow for a minimum clearance of 4 feet for personnel corridors as shown on the Contract Drawings.

6. Iron removal system effluent chlorine residual concentrations greater than 0.5 mg/L

C. Work under this Section is subject to the warranty and guarantee provisions set forth in the General Conditions.

D. Components failing to perform as specified or as represented by the System Supplier, or proven defective in service during the warranty period, shall be replaced, repaired, or modified to meet the performance and design requirements as established in this Section at no cost to Owner. Contractor shall be responsible for all labor and materials required to place package iron removal system back into service.

PART 2: PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Carbon steel plate for pressurized components of vessels shall conform with ASTM-A516 Grade 70 specification.

B. Carbon steel plate for structural use shall conform with ASTM-A36 specifications. Structural shape dimensions shall conform with AISI standards.

C. Stainless steel plate shall conform to ASTM A240, Type 304 specification.

D. Internal stainless steel pipe shall conform to ASTM A312, Grade TP304 and ANSI/ASME B36.19M specification. Pipe threading shall conform with ANSI/ASME B1.20.1 specifications.

E. Internal pipe fittings shall be AISI Type 304 stainless steel. Fittings shall dimensionally conform with ANSI ASME B16.3 specifications. Fitting threads shall conform with ANSI/ASME B1.20.1 specifications.

F. Stainless steel hardware shall be AISI Type 304. Bolt and nut threads shall conform with ANSI B1.1.

G. Carbon steel nozzles (or manways) shall conform to ASTM A53, Grade B and ANSI/ASME B36.10M specifications. Schedule 80 pipe shall be used unless ASME code requires thicker. Carbon steel nozzle flanges shall conform with ASTM A105 and drilled in conformance with ANSI B16.1, Class 150. Nozzle flanges shall be flat faced.

H. Couplings fabricated into the filter vessel side shall or heads shall be forged steel conforming with ANSI B16.11 specifications. Couplings shall be 3,000 psi rated and shall be threaded in conformance with ANSI/ASME B1.20.1 specifications.

I. Air/vacuum relief valve header piping shall be ASTM A53 Schedule 40 steel pipe. Pipe shall be hot-dipped galvanized in accordance with ASTM B6 specifications.

J. Air/vacuum relief manifold fittings shall be ASTM A197 malleable iron hot-dipped galvanized in accordance with ASTM A153 specifications.

K. Air/vacuum relief valve shall be as specified in Section 11900 of these Specifications.

L. Pressure Aerator

1. Compressed air shall be introduced into the raw water by a pressure aerator capable of diffusing the air for oxidation of the iron and manganese without producing white water conditions. The pressure aerator shall be capable of aerating 1,000 to 1,400 gpm of raw water. Aerator shall allow for adjustment of the air

feed rate to ensure oxidation requirements are achieved under the operating range described above.

2. Aerator chamber shall consist of a welded steel or cast iron, flanged shell section for mounting in the location shown on the Contract Drawings. Chamber shall include internal diffuser system for introducing air under pressure into the flowing water stream. Air diffuser shall be constructed of materials that will not foul or reduce the effectiveness of the pressure aerator performance. Diffuser shall produce fine bubbles and provide for efficient mass transfer of oxygen to the influent raw water. Plant air supply pressure will be a minimum of 120 psig. Maximum water pressure in the influent pipe will be 100 psig. Aerator chamber shall be complete with integral shop mounted condensation trap with internal automatic condensate drain valve, air flow meter, differential regulator, air check valve, 3-way solenoid valve, and control piping.

M. Elliptical manways shall be of the full gasketed type with one or two bolt fasteners for quick opening. Manways shall be 12" x 16" and be designed in accordance with ASME Code Section VIII for pressure vessels. Manways shall be installed above the normal media level for each cell. Two manways shall be installed on the underside of the filter vessel. Manways shall be installed as shown on the Contract Drawings.

N. Filter vessels shall be equipped with a 4-inch diameter flanged drain nozzle and valve. Valve shall be a butterfly valve conforming with Section 11900 of these Specifications. Valve shall be exactly the same as valve furnished elsewhere in the facility.

O. Filter underdrain system shall consist of a rigid structurally supported plate extending over the entire filter length. Collection gallery shall be common to cells. Underdrain nozzles shall be orifices or self-cleaning screened nozzles. Underdrain nozzles shall be of compatible with the underdrain plate material to prevent galvanic corrosion. Nozzle spacing shall be on 12-inch centers. Underdrain system shall be designed to support the filter media and an additional pressure of 20 psi in either direction. Underdrain system design shall provide for even collection of filtered water and even distribution of backwash water. Header lateral underdrains will not be allowed. Orifices and nozzles shall be designed to completely retain the support gravel and filter media with minimal pressure loss.

P. Filter influent distribution system shall be designed to evenly distribute influent raw water over the interior filter surface area and evenly collect backwash effluent water.

Q. Backwash Rate of Flow Controller

1. Backwash rate of flow control valve shall consist of a stainless steel orifice plate flow metering device, pneumatically actuated butterfly valve, differential pressure transmitter, current-to-pneumatic converter, valve positioner, and controls. Valve and appurtenances shall be as specified in Section 11900 of these Specifications.

2. Backwash rate of flow valve shall include a current-to-pneumatic converter and positioner to convert the 4-20 mAdc signal from the filter control panel to 3 to 15 psi signal for modulating control of the pneumatic valve actuator. Converter shall have a pneumatic relay if necessary to meet the actuator pressure and volume requirements.

   The converter shall have an adjustable zero, accuracy of ± 0.5 percent of span, minimum linearity of ± 0.2 percent of span, and repeatability of ± 0.1 percent of span minimum. Converter shall not require a separate source of power. The positioner shall be designed to position the valve at any point from fully open to fully closed with the proper control signal. At 3 psi input signal the valve shall fully close, at 15 psi input signal the valve shall fully open. Positioner shall be fully compatible with all components of the backwash rate of flow control valve assembly.

R. Filter Media

1. The filter shall be provided with a 16-inch support bed consisting of the following layout of gravel:

Layer and Depth	Passing Screen	Retained on Screen
Bottom 4"	1 1/2"	3/4"
Next 4"	3/4"	1/2"
Next 4"	1/2"	1/4"
Top 4"	1/4"	#10

   The gravel shall be free of clay, loam, dirt, calcaneus, or other foreign material and shall consist of round or angular particles with the length of each particle no more than three

times the width. Specific gravity of the support gravel shall be 2.5 minimum.

2. The filter sand bed depth shall be 24 inches. The filter sand shall have an effective size of 0.50 to 0.60 mm and a uniformity coefficient of not more than 1.6.

   Filter media shall be suitable for potable water supply and conform to NSF 61 standards.

S. Pressure sustaining/relief valve shall be flanged and drilled in conformance with ANSI B16.1, Class 125 specifications. Valve body and cover shall be constructed of cast iron meeting or exceeding ASTM A126, Class B. Valve body shall be designed for a minimum 150 psi cold working pressure. Main valve shall be hydraulically operated, pilot controlled and maintain a constant upstream pressure. Pilot control shall be designed to permit flow through the valve when inlet pressure exceeds control setting. Pilot control shall be fully adjustable from 0 to 150 psi. All internal parts shall be removable or replaceable without removal of the valve from the line. Seat shall be resilient synthetic rubber. All materials shall be corrosive resistant. Valve shall be Clayton Model 51G-01, Golden Anderson Model G700-DR, or approved equal.

T. Sampling tap shall be installed on the effluent line of the filter. Sample tap miscellaneous piping, valves, and fittings shall meet the specifications as established in Section 11900.

U. Filter unit shall be equipped with a differential pressure gage and transmitter that will measure the pressure drop through the filter bed. Pressure gage shall include a 6-inch local display and digital remote display to the filter control panel. Differential pressure transmitter shall be a two-wire, 4-20 mAde device with digital display at the filter control panel.

V. Face piping, valves, and fittings shall conform with the specifications established in Section 11900 of these Specifications. Valves shall be exactly the same as those furnished elsewhere in the facility.

2.02 PRESSURE VESSEL

A. Design

1. Iron removal filter vessel shall be designed by a duly Registered Professional Engineer. Vessel shall be designed for

a maximum normal working pressure of 90 psi, maximum allowable working pressure of 150 psi, and a maximum working temperature of 150°F. Vessel design shall conform with Section VIII of the ASME code for pressure vessels. The filter vessel shall be certified and stamped as specified in Section VIII of the ASME code. Vessel shall have flanged and dished heads.

2. System Supplier shall include lift hooks suitable for filter vessel handling during fabrication and installation at the site. Lift hooks shall be designed for the entire filter weight (excluding filter media), internals, and stresses that will be encountered during shipping and handling. Lift hooks shall be permanent fixtures of the vessel shell and be designed to prevent damage to the interior lining system from stresses induced from lifting. Lift hooks shall not interfere with any of the process piping or internals associated with the iron removal filter

3. The System Supplier shall be responsible for assuring that the completed iron removal filter system will function for its intended use and shall warrant the completed vessels as described in Paragraph 1.07 of this Section of these Specifications.

B. Fabrication

1. Iron Removal Filter

a. All joints shall be full penetration butt-welded. Skip welds will not be allowed.

b. All internal welds shall be ground smooth to a minimum 1/4-inch radius. Drawings. All seams shall be welded on both the interior and exterior of the vessel and on both sides of the under drain plate. No sharp edges shall be allowed.

c. All external welds shall be ground smooth and no sharp edges shall be allowed.

d. All internal sharp edges shall be ground smooth to a minimum 1/4-inch radius.

C. Iron Removal Filter Interior Coating System

1. Interior filter surfaces shall be shop prepared to an SSPC-10 (near white metal) blast finish. Interior surfaces shall be shop primed to a minimum of 4 mil dry film thickness.

2. System Supplier may shop apply final coats and touch up in the field or apply final coats in the field. Coating shall be as specified in Section 09800 (SC-8) of these specifications. Total interior coating dry film thickness shall be 10 to 12 mil.

3. Nozzles interior surfaces shall be coated up to and including exterior flange facing.

D. Iron Removal Filter Exterior Coating System

1. Filter exterior surfaces shall be shop prepared to a SSPC-10 (near white metal) blast finish and be shop primed. A minimum of 4 mil dry film thickness of primer shall be applied prior to vessel transport.

2. Contractor or System Supplier shall apply final finishing and touch up in the field after installation or apply final finishing in the field after installation. Coating shall be as specified in Section 09800 (SC-1) of these Specifications. Coating shall be of the same manufacture and lot number as the paint supplied for items of the same color which will be field painted. Touch-up work in the field shall match the applied finish exactly and color variation or finish difference will not be acceptable. Total exterior coating shall be 10 to 12 mil dry film thickness.

3. Structural steel support frame in contact with concrete shall be abrasive blasted to an SSPC-10 (near white metal) finish. Coating shall be as specified in Section 09800 (SC-9) of these Specifications. Total exterior coating system dry film thickness shall be 16 mils.

2.03 FILTER CONTROL PANEL

A. System Supplier shall furnish, a control panel for automatic operation of the filter backwash sequence. The control panel shall be housed in a NEMA 12 floor-standing enclosure. The enclosure shall have a nominal dimensions of 90" high by 24" wide by 24" deep.

B. The control panel shall receive a 120 VAC, 20 Amp. single-phase power supply, and shall contain a high-isolation transformer for protection of all electronic equipment.

C. The panel shall contain a programmable-logic controller (PLC) for automatic control functions. It is the intent of this Specification that the PLC furnished with the filter system control panel be of the same manufacturer and model as the PLC in the plant control panel

specified under Section 16950. The Contractor shall coordinate this requirement with the separate suppliers.

D. The filter system shall include a differential pressure transmitter connected to measure the pressure drop across the filter. The transmitter shall be a two-wire device that receives operating power from a 4-20 mA current loop. The filter control panel shall contain a digital display of differential pressure shall be in inches of water column. Provide a thumbwheel digital set point switch and PLC software to initiate a "high pressure drop" alarm if the differential pressure exceeds an operator-entered value. Provide a front-panel indicating light to be energized when this alarm condition occurs.

E. Automatic backwash shall be manually-initiated by pressing a push button on the front of the filter control panel. Once the operator presses the backwash initiation button, the filter control panel shall check a set of contacts in the plant control panel. If the "permissive" contacts are closed, a backwash procedure may begin. If the contacts are not closed, then energize a front-panel indicating light labeled "Backwash Not Allowed". These conditions are described more fully in Section 16950 of these Specifications.

F. Once the system begins a backwash sequence, close a set of contacts for monitoring by the plant control panel. The contacts will be used to ensure continuous operation of the well pump to provide water throughout the backwash process.

G. The PLC shall automatically control the complete backwash cycle. Source of backwash water will be well water treated by the cells remaining in operation during backwashing of an individual cell. Sequencing proposed is to eliminate the potential for exposing filter to shut off head of well pump. The filter cells shall be backwashed one at a time in the following sequence:

1. Close cell No. 1 influent valve.
2. Open cell No. 1 backwash effluent valve. Close system effluent valve and open system backwash rate of flow control valve simultaneously.
3. Adjustable time delay for backwash period (0 - 30 min.)
4. Close cell No. 2 influent valve.
5. Open cell No. 2 backwash effluent valve.
6. Close cell No. 1 backwash effluent valve.
7. Adjustable time delay, open cell No. 1 influent valve (0 - 100 sec.).
8. Repeat steps 3 through 7 for remaining cells.
9. Backwashing of cell No. 5 complete.

10. Open system effluent valve and close backwash rate of flow control valve simultaneously.
11. Close cell No. 5 backwash effluent valve.
12. Open cell No. 5 influent valve.

H. Provide the following status lights in addition to those specified previously:

1. Power on
2. Normal
3. Backwash

I. During backwash, the filter control panel shall automatically regulate the backwash flow rate through each filter cell.

The filter control panel PLC shall contain the logic for PID control of the filter backwash rate control valve so that the valve maintains a predetermined flow rate. When each cell begins to backwash, the PLC logic shall ramp the flow rate up to the predetermined rate in approximately 30 seconds, to minimize the effects of sudden flow changes through the system. When a cell reaches the end of its backwash period, the PLC logic shall ramp the flow rate down to zero in approximately 30 seconds. The PLC shall be provided with an operator interface that shall permit operation to select backwash flowrate (in gpm) and duration (in seconds). Program the interface station so that all interaction is menu-driven, and does not require the operator to know codes, addresses, etc.

J. Provide a set of alarm contacts for monitoring by the plant control panel. The alarm contacts shall be normally-open and shall close upon any of the following conditions:

1. High differential pressure
2. PLC failure

K. Filter control panel technical requirements.

1. All components within the control panel shall be readily available through two or more unrelated manufacturers. Components and devices that are proprietary to a manufacturer shall not be permitted. Control logic shall be accomplished through the use of general purpose relays, timers, and a programmable logic controller (PLC).

2. The completed panel shall be constructed in accordance with Underwriter's Laboratories Standard UL508, and shall bear a serialized UL508 label.

3. Products used in construction of the panel shall comply with all requirements set forth under Section 16950 - Instrumentation and Control. Refer to Section 16950 for sections applicable to the filter control panel and equipment, including:

   a. Enclosures
   b. Programmable logic controller and operator interface
   c. Indicator, electronic digital
   d. Control relays
   e. Control relays - timing - solid state
   f. Direct current power supply
   g. Terminal strips
   h. Isolation transformer
   i. Indicating lights
   j. System wiring
   k. Differential pressure transmitter
   l. Control switches

2.04 SOURCE QUALITY CONTROL

Products and materials specified under the specific paragraphs of this Section shall be of the same manufacture and be identical and interchangeable with products of the same specifications and size as specified elsewhere in these Specifications. Contractor shall be responsible for implementing quality assurance and quality control for all aspects of vessel fabrication and coating. Owner or Engineer's testing shall not be considered as substitute for Contractor's independent quality control and testing program.

PART 3: EXECUTION

3.01 INSTALLATION

A. Each item shall be furnished complete and installed as shown on the Contract Drawings and in accordance with the manufacturer's recommendations, instructions and directions. All installed equipment shall be properly protected during subsequent construction operation.

B. Install filter unit as shown on the Contract Drawings and be responsible for all leveling and alignment of the filter unit.

C. Contractor shall be responsible for connection of the filter unit nozzles to the process piping as shown on the Contract Drawings. Any deviation in the process piping or iron removal filter installation shall be corrected by the Contractor at no cost to the Owner. This

specifically includes any adjustments in process piping required as a result of fabrication misalignment.

D. The Contractor shall keep premises clean and orderly during installation of this work, remove rubbish periodically and as may be required. Upon completion of this part of the project, remove all dirt, debris, tools, scaffolding, etc., used or resulting from this work.

E. Filter Media

1. System Supplier shall be responsible for placement of the gravel and sand filter media to ensure that underdrain system is not damaged and media is placed in conformance with System Suppliers specifications. System Supplier shall be responsible for preparation of filter media for start-up.

2. The filter media shall then be submerged with water for at least 24 hours, and subsequently hydraulically graded and freed of fines by backwashing at least three (3) times. The top fine material shall then be carefully removed down to the required elevation.

3.02 FIELD TESTING

A. After installation of the filter unit, filter media installation, and connection to the process piping, the filter unit shall be pressure tested to 100 psi and held at the test pressure for a minimum of two hours. Pressure deviations of $\pm$ 2 psi maximum during the test period that cannot be attributed to temperature changes shall be acceptable. Contractor shall use water or air as the testing fluid. Pressure test shall include all process piping connections to the filter unit. Test is not intended for filter unit shell or weld testing.

Contractor shall take the necessary corrective actions to repair or replace defective parts and correct deficiencies and re-test the vessel. Contractor shall be responsible for disposing of all water used for pressure testing. Contractor shall obtain the necessary permits for discharge of the water.

3.03 DISINFECTION

A. After pressure testing, filter unit shall be disinfected in accordance with AWWA C-653. Filter unit shall be dosed with chlorine reagent yielding a minimum 25 mg/L free chlorine residual. The filter shall remain in contact with the chlorine solution for a minimum 24 hours. At the conclusion of the 24 hour disinfection

period, the water shall be tested for free chlorine. If the free chlorine residual is less than 15 mg/L, the disinfection process shall be repeated until a residual of 15 mg/L is maintained in the filter for a period of 24 hours. Contractor shall be responsible for coordinating the filter disinfection with the disinfection of the process piping to ensure that cross-contamination between the two systems does not occur. Appropriate isolation or protective techniques shall be implemented to prevent cross-contamination. Contractor shall be responsible for obtaining the required permits and disposal of water used for disinfection.

B. After the disinfection procedure has been completed, filter unit shall be filled with a minimum 5 mg/L chlorine solution. Free chlorine residual shall be tested daily by the Contractor and if the free residual is below 2 mg/L, chlorine shall be added so that a 5 mg/L solution minimum is attained. This procedure shall continue until the vessel is scheduled for start-up.

C. After disinfection and flushing the water will be sampled and tested for quality, including bacteriological, by the Owner. Contractor shall contact Owner 24 hours in advance when the filter unit is ready for testing. If the water does not meet the bacteriologic quality standard of the Minnesota Department of Health, the Contractor shall perform all operations necessary to disinfect the vessel system or system. All costs associated with the resampling and analysis resulting from failed bacteriologic tests shall be covered by the Contractor. The laboratory used for any analyses of the redisinfected samples shall be of the Owner's choosing.

3.04 INSPECTION, START-UP AND ADJUSTMENT

A. Representative of System Supplier shall inspect the completed installation, make all necessary adjustments, corrections or modifications prior to start-up. Inspections shall include but not be limited to the following:

1. Verify that adequate clearance is available to permit maintenance and repair.

2. Assure that piping, channels and equipment is clean of debris which might clog equipment.

B. Representative of System Supplier shall be responsible for final adjustment and performance testing of the complete package iron removal system. Start-up requirements shall include but not be limited to the following:

1. Calibration of all equipment and valve operations.

2. Verification of filtration cycle and automatic backwash sequence.

3. Final adjustment of all valve opening and closing speeds.

4. Performance testing to verify that package iron removal system meets the criteria established in Paragraph 1.07 of this Section of the Specifications.

5. Chlorine feed rate adjustment and calibration.

6. Filter effluent chlorine residual monitoring.

7. Pressure aerator feed rate adjustments and calibrations.

8. Verification of that filter system over pressure protection valve is completely functional.

C. After completion of start-up, the System Supplier shall provide a written report to the Owner and Engineer outlining any special instructions, and also including test results of treatment performance evaluation with respect to iron and manganese removal.

3.05 OPERATOR TRAINING

A. After start-up is authorized by the Owner, the System Supplier shall furnish a qualified representative for five days to inspect the completed installation, to supervise and to train the operating personnel in the operation. At least three days must be reserved for start-up and adjustment. The days may not be consecutive.

3.06 FIELD QUALITY CONTROL

A. Contractor shall establish and maintain quality control for work performed under this section to assure compliance with contract requirements and maintain records of Contractor's quality control for all construction operations including but not limited to the following:

1. Materials and products used,
2. Fabrication specifications and fabrication operations,
3. Tolerances,
4. Test procedures and results,
5. Filter unit surface preparation and coating application procedures and test results,

6. Installation and alignment procedures.
7. Filter unit lining coating repair or replacement.
8. Performance Requirement Compliance Testing Data and Verification Report.

A copy of the records of inspection, tasks performed, and test results, as well as the records of corrective action taken, shall be furnished to the Owner and Engineer as directed.

B. Contractor shall be responsible for maintaining quality control and quality of workmanship for the installation and connection of the filter unit to the process piping as specified in these Specifications and as shown on the Contract Drawings.

END OF SECTION 11600

SECTION 11900

PROCESS PIPING

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes the furnishing, installing, testing, and adjusting of all process piping materials and accessories as shown on the Contract Drawings.

B. Products furnished but not installed under this Section:

1. Floor pipe sleeve and seal
2. Wall footing pipe sleeve and seal

C. Products installed but not furnished under this Section:

1. Pipe supports and anchor bolts
2. Magnetic flow meter
3. Concrete for wall sleeve encasement
4. Grout for leveling

D. Related Sections

1. Section 02600 - Piped Utilities
2. Section 03300 - Cast-in-Place Concrete
3. Section 03600 - Grout
4. Section 05500 - Metal Fabrications
5. Section 09800 - Special Coatings and Painting
6. Section 11210 - Backflush Booster Pump
7. Section 11211 - Air Compressor System
8. Section 11365 - Fluoridation System
9. Section 11371 - Chlorination System
10. Section 11500 - Contactor Vessels and Internals
11. Section 11600 - Package Iron Removal System
12. Section 15400 - Plumbing
13. Section 16900 - Starters and Motor Control
14. Section 16950 - Instrumentation and Control
15. Section 11216 - Submersible Centrifugal Pumps (Backwash Tank)

1.02 REFERENCES

A. The following are complete titles of references cited in this Section.

1. ANSI B1.1-1982. "Unified Inch Screw Threads"

2. ANSI B16.1-1975. "Cast Iron Pipe Flanges and Flange Fittings, Class 25, 125, 250, and 800"

3. ANSI B16.5-1981. "Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys"

4. ANSI B16.21-1978. "Nonmetallic Flat Gaskets for Pipe Flanges"

5. ANSI B16.22-1980. "Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings"

6. ANSI B18.2.1-1981. "Square and Hex Bolts and Screws"

7. ANSI B18.2.2-1972 (R1983). "Square and Hex Nuts"

8. ANSI B18.22.1-1965 (R1981). "Plain Washers"

9. ANSI/ASME B1.20.1-1983. "Pipe Threads, General Purpose"

10. ANSI/ASME B16.3-1985. "Malleable-Iron Threaded Fittings, Classes 150 and 300"

11. ANSI/ASME B36.10M-1985. "Welded and Seamless Wrought Steel Pipe"

12. ANSI/ASME B36.19M-1985. "Stainless Steel Pipe"

13. ANSI/AWWA C104/A21.4-1985. "Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water"

14. ANSI/AWWA C111/A21.11-1985. "Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings"

15. ANSI/AWWA C115/A21.15-1983. "Flanged Ductile-Iron and Gray Iron Pipe With Threaded Flanges"

16. ANSI/AWWA C151/A21.51-1986. "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or Other Liquids"

17. ANSI/AWWA C110/A21.10-1982. "Fittings 3-inch Through 48-inch for Water and Other Liquids, Gray-Iron and Ductile Iron"

18. ANSI/AWWA C606-87. "Grooved and Shouldered Joints"

19. ASTM A47-84. "Specification for Ferritic Malleable Iron Castings"

20. ASTM A53-86. "Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless"

21. ASTM B88-86. "Specification for Seamless Copper Water Tube"

22. ASTM A153-82 (1987). "Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

23. ASTM A197-79. "Specification for Cupola Malleable Iron"

24. ASTM A126-84. "Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings"

25. ASTM A536-84. "Specification for Ductile Iron Castings"

26. ASTM A307-86a. "Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile"

27. AWWA C504-80. "Rubber Seated Butterfly Valves"

28. AWWA C508-82. "Swing-Check Valves for Waterworks Service, 2-inch Through 24-inch NPS"

29. AWWA C651-86. "Disinfecting Water Mains"

30. AWWA C653-87. "Disinfection of Water Treatment Plants"

31. AWWA C704-70. "Cold Water Meter Propeller Type for Main Line Applications"

32. Mn/DOT 3728-1987. "Bituminous Mastic Joint Sealer for Pipe"

33. U.S. Military MILC-4109, 1986. "Coupling Halves, Low Pressure Air Hose, Quick Disconnect"

34. U.S. Military MILC-27487, 1986. "Coupling Halves, Quick Disconnect, Cam Locking Type"

1.03 SUBMITTALS

A. Manufacturer's Literature/Data - Submit manufacturer's information on products supplied as alternates when the term "approved equal" appears in Part 2 of this section of these Specifications. Information submitted shall be adequate for the Engineer to determine equivalency of the supplied items to those specified. Information shall include, but not be limited to: manufacturer, part or model number, and any options included with the supplied product. Alternate product submittals shall clearly indicate that the product is a proposed alternate.

B. Operations and Maintenance Instructions - Submit operation and maintenance instructions for the following products in accordance with general procedures as set forth in Division 1 of these Specifications:

1. Backflow preventer assembly
2. Pressure sustaining valve
3. Pneumatic actuators and butterfly valves
4. Three-way plug valves
5. Paddle wheel flow meters
6. Propeller flow meters

C. Manufacturer's Literature/Data - Submit, upon request, informational literature/data for the following materials and equipment in accordance with the general procedures as set forth in Division 1 of these Specifications:

1. All butterfly valves and pneumatic actuators
2. Grooved end ball valves
3. 4-inch diameter stainless steel ball valves
4. Three-way plug valves
5. Flanged end swing check valves
6. Backflow preventer assembly
7. Pressure sustaining valve
8. Paddle wheel flow meters
9. Propeller flow meters
10. Sight glasses
11. Safety head assembly
12. Flap valve

D. Test Results/Certificates - Submit the following certificates in accordance with the general procedures as set forth in Division 1 of these Specifications:

1. ASME certification of rupture discs and documentation.

1.04 QUALITY ASSURANCE

A. The products and materials covered in this section shall be new and conform to the specifications for class, type and size as specified in Part 2 of this section.

1.05 SEQUENCING AND SCHEDULING

A. Contractor shall coordinate work performed in this section with the work performed in the related sections. Contractor shall also be responsible for assuring that products and equipment furnished and the installation of these materials are totally compatible both in type and location with materials furnished and installed under related sections.

B. Contractor shall ensure prompt delivery of products and materials necessary for the completion of work performed under this section.

1.06 MAINTENANCE

A. The following extra products or spare parts shall be supplied in addition to the number specified on the Contract Drawings. Spare products shall be identical to those supplied under Part 2 of this section. Spare parts or components shall be identical to those parts or components to be replaced.

1. Gaskets. Ten gaskets for each pipe size.

2. Butterfly Valves. One 6-inch diameter clockwise to close valve. One 6-inch diameter counter-clockwise to close valve. One victaulic 3-inch diameter valve complete.

3. Bronze Body Globe Valves. Two repair kits.

4. Stainless Steel Globe Valves. One 1/2-inch diameter valve complete. Four repair kits.

5. Stainless Steel Ball Valves, Screwed End. Two 1-inch diameter valves complete.

6. Air/Vacuum Relief Valves. Two Buna-N seats, stainless steel float each size.

7. Flanged End Swing Check Valves. One seat O-ring, one renewable seat and cover gasket, one gland packing, one plunger O-ring for each size of valve supplied.

8. Pressure Sustaining Valve. Piston U-cup, liner U-cup, seat ring, indicator packing, vent packing, cover O-ring, top liner O-ring, and lower liner O-ring.

9. Safety Head Assembly. Eight rupture disks of the same type and lot number as specified in Part 2 of this section.

10. Sight Glasses. One sight tube and two gaskets for each size of sight glass.

B. Spare products and parts shall be packaged in a manner suitable for long-term storage at the facility. Packages shall be clearly marked indicating the item, part, size, and quantity. All spare parts shall be delivered to the site and stored in the location designated by Owner before Substantial Completion of the project.

1.07 BASIS FOR COMPENSATION

Compensation for all Work covered by this Section of these Specifications will be included in the lump sum Contract Price bid.

PART 2: PRODUCTS

2.01 STEEL PIPE, THREADED ENDS

A. Schedule 40 seamless Grade A black steel pipe. Steel pipe shall conform with ASTM A53 and ANSI/ASME B36.10 specifications.

B. Pipe may be delivered threaded or threaded in the field. Threads shall conform with ANSI/ASME B1.20.1.

2.02 STEEL PIPE, GROOVED ENDS

A. Schedule 40 seamless Grade A steel pipe shall conform to ASTM A53 and ANSI/ASME B36.10 specifications. Steel pipe shall be hot-dipped galvanized in accordance with ASTM B6 specifications.

B. Grooved ends shall meet ANSI/AWWA C606-87 specifications for cut grooves. Rolled groves or shouldered joints are not acceptable.

2.03 DUCTILE IRON PIPE, THREADED FLANGES

A. Ductile iron pipe with threaded flanges shall conform to all the requirements of ANSI/AWWA C115/A21.15. Pipe barrel shall meet all the requirements of ANSI/AWWA C151/A21.51. Pipe shall be Class 53 minimum.

B. Flanges shall be ductile iron and meet ANSI/AWWA C115/A21.15 specifications. Flanges shall be faced and drilled in conformance with ANSI B16.1, Class 125.

C. Pipe shall be cement-mortar lined in conformance with ANSI/AWWA C104/A21.4.

D. Bolts of the diameter and length specified in Table 15.3 of ANSI/AWWA C115/A21.15 shall be supplied. Bolts shall be carbon steel conforming to the requirements of ASTM A307, Grade B. Bolts shall have hex heads and conform to ANSI B18.2.1. Hex nuts conforming to ANSI B18.2.2 shall be used. Bolt and nut threads shall conform to ANSI B1.1. Plain washers shall conform with ANSI B18.22.1.

E. Gaskets shall be of the ring type constructed of synthetic rubber material suitable for use in pipes containing potable water. Gaskets shall be 1/8-inch thick and conform with the dimensions presented in Table A1.1 of ANSI/AWWA C115/A21.15.

2.04 DUCTILE IRON PIPE, MECHANICAL JOINT

A. Mechanical joint ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.15. Pipe shall be Class 52 minimum.

B. Pipe shall be cement-mortar lined in conformance with ANSI/AWWA C104/A21.4.

C. Mechanical joints and gaskets shall conform with ANSI/AWWA C111/A21.11. Gaskets shall be conductive with copper inserts equal to American Fastite or copper straps welded to the pipe and connected with a silicone bronze bolt. Conductors shall be rated at 600 amps sustained current. Tee-head bolts and hexagonal nuts of low-alloy steel meeting the dimensional requirements of ANSI/AWWA C111/A21.11a shall be supplied. Bolt and nut threads shall conform with ANSI B1.1.

2.05 DUCTILE IRON PIPE, PUSH-ON JOINT

A. Push-on joint ductile iron pipe shall meet the requirements of ANSI/AWWA-C151/A21.5 and ANSI/AWWA-C111/A21.11. Pipe shall be Class 52 minimum.

B. Pipe shall be cement motor lined in conformance with ANSI/AWWA C104/A21.4.

C. Push-on joints and gaskets shall conform with ANSI/AWWA-C111/A21.11 specifications.

2.06 STAINLESS STEEL PIPE

A. Stainless steel pipe shall be seamless AISI type 316L stainless steel schedule 40 pipe. Pipe shall conform with ANSI/ASME B36.19.

B. Pipe may be delivered threaded or threaded in the field. Threads shall conform with ANSI/ASME B1.20.1.

2.07 POLYPROPYLENE LINED PIPE AND FITTINGS

A. Polypropylene lined pipe and fittings shall be as manufactured by Dow Chemical Company or approved equal. Outer pipe shall be steel.

B. Pipe and fitting flanges shall be drilled in conformance with ANSI B16.1, Class 125. Pipe and fittings shall be designed for minimum 150 psi cold working pressure. Joints shall be molded raised face type and require no gaskets for a positive seal.

C. Polypropylene lined fittings shall be cast ductile iron, Class 150.

2.08 COPPER TUBING AND FITTINGS

A. Copper tubing shall be manufactured in accordance with ASTM B88. Tubing shall be Type K hard tempered for exterior and underground service and Type K soft temper for interior service.

B. Copper fittings and solder used for connections shall be designed for a minimum 150 psi cold working pressure and be totally compatible with the copper tubing specified. Copper fittings shall be as specified in Section 15400.

2.09 MALLEABLE IRON FITTINGS

A. Malleable iron fittings shall be manufactured in accordance with ASTM A197 and shall meet all the requirements of ANSI/ASME B16.3.

B. Fittings shall have threaded ends conforming with ANSI/ASME B1.20.1. Fittings shall not be galvanized.

C. Malleable iron fittings used for process piping containing water shall be hot-dip galvanized in accordance with ASTM A153 specifications.

2.10 DUCTILE IRON FLANGED FITTINGS

A. Ductile iron flanged fittings shall conform with ANSI/AWWA C110/A21.10. Fittings shall be designed for a minimum 250 psi cold working pressure.

B. Flanges shall be ductile iron and meet ANSI/AWWA C115/A21.15 specifications. Flanges shall be faced and drilled in conformance with ANSI B16.1, Class 125.

C. Fittings shall be cement-mortar lined in conformance with ANSI/AWWA C104/A21.4.

D. Fasteners and gaskets shall be as specified in Part 2.03 of this section.

E. Ductile iron filler flanges for the Master Flow Control shown on the Contract Drawings shall have an ID equivalent to the adjacent pipe ID and thickness equivalent to the thickness of a standard blind flange.

2.11 DUCTILE IRON MECHANICAL JOINT FITTINGS

A. Ductile iron mechanical joint fittings shall conform with ANSI/AWWA C110/A21.10. Fittings shall be designed for a minimum 350 psi cold working pressure.

B. Fittings shall be cement-mortar lined in conformance with ANSI/AWWA C104/A21.4.

C. Mechanical joints, gaskets, and fasteners shall be as specified in Part 2.04 of this section.

2.12 DUCTILE IRON PUSH-ON JOINT FITTINGS

A. Ductile iron push-on joint fittings shall conform with ANSI/AWWA-C110/A21.10 and ANSI/AWWA-C111/A21.11 specifications. Fittings shall be designed for a minimum 350 psi cold water working pressure.

B. Fittings shall be cement mortar lined in conformance with ANSI/AWWA-C104/A21.4 specifications.

C. Push-on joints and gaskets shall be as specified in Part 2.05 of this Section.

2.13 STAINLESS STEEL FITTINGS

A. Stainless steel fittings shall be AISI type 316 stainless steel of the diameter and type specified as shown in the Contract Drawings. Fittings shall dimensionally conform with ANSI/ASME B16.3. Fittings shall be designed for a minimum 150 psi cold working pressure.

B. Fittings shall be threaded in conformance with ANSI/ASME B1.20.1.

2.14 GROOVED END FITTINGS AND COUPLINGS

A. Grooved end fittings shall be malleable iron conforming to ASTM A47, Grade 32510 specifications. Fittings shall be hot-dip galvanized to ASTM A153 specifications. Grooves shall be square cut in conformance with ANSI/AWWA C-606 specifications.

B. Grooved end couplings shall be constructed of malleable iron conforming to ASTM A47 Grade 32510 specifications. Couplings and gaskets shall conform to ANSI/AWWA C-606 specifications and shall be of the rigid type. Gasket shall be molded EPDM rubber, Grade E and conform to ASTM D2000 Grade 3B A515 A14 B442 specification. Bolts and nuts shall conform to ASTM A183 specification with a minimum tensile strength of 110,000 psi. Bolts and nuts shall be zinc electroplated.

2.15 FLANGED END BUTTERFLY VALVES

A. Butterfly valves shall meet or exceed the requirements AWWA C504 Class 150B. All butterfly valves shall be of the short body flanged end type with flange drilling and facing conforming to ANSI B16.1, Class 125.

1. Valve bodies shall be constructed of ductile iron conforming to ASTM A536 Grade 65-45-12.

2. Valve shaft shall be constructed of AISI Type 304 or Type 316 stainless steel.

3. Valve discs shall be constructed of ductile iron conforming to ASTM A536, Grade 65-45-12. Disc seating edge shall be integrally cast into the disc and shall be constructed of AISI Type 304 or 316 stainless steel or Ni-Resist.

4. Valve resilient seat shall be constructed of synthetic rubber material bonded or vulcanized into the valve body. Retaining ring type seat attachment will not be allowed. The method used for bonding or vulcanizing shall be tested in accordance with

ASTM D429 Method A or B. For Method A, the minimum strength shall not be less than 250 psi. For Method B, the peel strength shall not be less than 75 lb/in.

5. Valve bearings shall be corrosion resistant and self-lubricating and require no maintenance.

6. Valves shall be marked in accordance with AWWA C504 specifications. Fully open and fully closed valve position shall be clearly marked.

7. Valves shall be as manufactured by DeZurik, Pratt, or Kennedy with no substitutions.

B. Operators

1. Valve operators shall be designed as an integral part of the valve and gears shall be of the rack and pinion, traveling nut, or worm gear design.

2. Manual operators for 6-inch and smaller diameter valves shall be of the hand lever type; operators for valves greater than 6-inch diameter shall be of the hand wheel type.

3. The rated torque capability of each operator shall be sufficient to seat, unseat and rigidly hold in any intermediate position the valve disc it controls under the rated working pressure of the valve and velocities of 10 ft/sec for valves 10 inches in diameter or greater and 15 ft/sec for valves under 10 inches in diameter. Valve shall not rattle, flutter or chatter in any position.

4. All operators shall be oriented for ease of operation with position indicator visible from the floor.

5. Operator direction of closing shall be as shown on the Contract Drawings.

C. Pneumatic Valve Actuators

1. Valve actuators shall be a single pneumatic cylinder, suitable for operation over its entire range with an 80 psi minimum supply source. The pneumatic actuator shall be of the totally enclosed design with no external moving parts. The actuator shall be of the rack and pinion or scotch yoke type providing constant output torque. The unit shall be factory tested to ensure proper operation and factory lubricated for a normal

service life. A smooth self-draining body shall be provided to resist moisture. The actuator shall have integral porting to eliminate external tubing. The pneumatic valve actuator shall be double acting (bi-directional). Localized mechanical position indication shall be provided. Standard operation, unless specified otherwise, shall be 0 to 90 degrees reversible for air. The actuator shall be capable of operating in any valve mounting attitude, and capable of being mounted either in line or transverse to the pipeline. The pneumatic valve actuator shall conform to the specifications listed in AWWA C504 standard. An alternative material of construction may be substituted for the cylinder body, end caps, and piston provided the substitute material meets or exceeds the strength, corrosion resistance, and finish of the material specified in AWWA C504.

2. The actuator for the iron removal filter backwash rate of flow controller shall be suitable for modulating use in conjunction with the current-to-pneumatic converter specified in this Section. The actuator shall be designed to fail to the closed position upon loss of air pressure.

3. Iron removal filter control valve actuators shall fail to the normal downflow filtration operation position (influent valves open, effluent valves closed) upon loss of power.

4. The actuator shall be suitable for operation in temperatures ranging from -20° F to 200° F. Maximum supply pressure shall be 100 psi and no pressure regulator shall be required. The actuator design shall have been tested for a minimum 100,000 cycles under full load with no appreciable wear of parts.

5. Travel stops, as required, shall consist of a mounting plate with a stop cam fitted between the base of the actuator and the mounting flange, and shall be externally adjustable through the full 90 degrees of valve travel.

6. Actuator shall have a manual override accessory for operating the valve in the event of a power failure or pressure loss.

7. Actuator shall have adjustable (between 10-100 sec) stainless steel needle valve speed controls for regulating both the closing and opening of the valve and a 4-way solenoid valve for open-close operations. Solenoid valves shall have a manual override button.

8. The well pump No. 4 controlled discharge valve shall have an adjustable limit switch. The switch shall have mounting

hardware that allows it to be mounted so that the switch contacts change state at any valve position. Switch shall have single-pole, double-throw contacts rated at 5 amps at 120 VAC and NEMA 4 enclosure. Initial mounting shall be at 10 percent open position.

2.16 BUTTERFLY VALVES, GROOVED END

A. Grooved end butterfly valve housing shall be constructed of malleable iron conforming to ASTM A47 specifications. Valve body shall be Schedule 40 steel pipe zinc electroplated in conformance with ASTM A164 specifications. Valve shall be rated for 150 psi working pressure and bubble tight shut off at 150 psi.

B. Valve liner shall be molded of Grade E EPDM synthetic rubber and be permanently bonded to the valve body.

C. Valve stem shall be stainless steel Type 316 or 416.

D. Valve disc shall be aluminum bronze or AISI Type 316 stainless steel.

E. Valve operator shall be hand lever type with latch lock at 10° intervals. Valve handle shall be malleable iron conforming to ASTM A47 specification.

F. Grooved ends shall be cut in conformance with ANSI/AWWA C-606 specifications. Ends shall be compatible with grooved end piping and couplings specified in this Section.

2.17 BRONZE BODY GLOBE VALVES

A. Bronze body globe valves shall be designed for a minimum 150 psi cold water working pressure. Valve construction shall consist of teflon disc and provide for tight shutoff at the specified pressure rating.

B. Valve bonnet design shall provide for servicing of valve without removing valve body from line.

C. Valve operators shall be of the hand wheel type.

D. Valve shall be equivalent to Stockham B-13T, Class 125.

2.18 STAINLESS STEEL GLOBE VALVES

A. Valves shall be AISI Type 304 stainless steel.

B. Valves shall be designed for a minimum 150 psi cold working pressure. Valve disc shall be the plug type, and provide for tight shutoff at the specified pressure rating.

C. Valve bonnet construction shall be the union type and provide for valve servicing without removing the valve body from line.

D. Valve operator shall be of the hand wheel or hand lever type.

E. Valves shall be equivalent to Stockham 20-GPNS, Class 200.

2.19 STAINLESS STEEL BALL VALVES, SCREWED END

A. Valve body, stem, insert, and ball shall be constructed of AISI Type 316 stainless steel. Screwed ends shall meet ANSI/ASME B1.20.1.

B. Valve shall be designed for a minimum 2,000 psi cold working pressure. Valve seat shall be of the filled TFE type and provide for tight shutoff at the rated working pressure.

C. Valve operator shall be of the hand lever type.

D. Valves shall be equivalent to Jamesbury Type 3000.

2.20 STAINLESS STEEL BALL VALVES, FLANGED END

A. Valve body and cap, ball, and stem shall be constructed of AISI Type 316 stainless steel. Valves shall be of the full port design. Flange ends shall be drilled and faced as specified for ANSI B16.5, Class 150.

B. Valve shall be designed for a minimum 275 psi cold working pressure. Valve seat shall be of the reinforced TFE type and provide for tight shutoff at the rated working pressure.

C. Valve operator shall be of the hand lever type.

D. Valves shall be Jamesbury Type 6150, ANSI Class 150, or approved equal.

2.21 BALL VALVES, GROOVED END

A. Grooved end ball valve body and end cap shall be constructed of ductile iron conforming to ASTM 536 specifications. Ball shall be rated for 150 psi working pressure.

B. Valve ball shall be constructed of forged carbon steel microfinished nickel plates and polished.

C. Valve stem shall be forged carbon steel, nickel plated.

D. Seal shall be TFE.

E. Valve operator shall be hand lever type constructed of malleable or ductile iron.

F. Grooved ends shall be cut or in conformance with ANSI/AWWA C-606 specifications. Ends shall be compatible with grooved end piping and couplings specified in this Section.

2.22 BRONZE BODY CHECK VALVES

A. Bronze body check valves shall be of the lift type and shall have threaded ends conforming to ANSI/ASME B1.20.1.

B. Check valves shall be designed for a minimum 300 psi, 150^0 F air working pressure and temperature. Valve seat shall be constructed of BUNA-N rubber and be designed for tight shutoff at the working pressure specified.

C. Valves shall be equivalent to Stockham B-322B, Class 150.

2.23 IRON BODY CHECK VALVES

A. Iron body check valves shall be horizontal swing type and shall conform with AWWA C508. Check valves shall have flanged ends drilled and faced as specified in ANSI B16.1, Class 125.

B. Valves shall be designed for a minimum 150 psi cold working pressure. Valve body shall be constructed of cast iron conforming to ASTM A126, Class B or ductile iron conforming to ASTM A536. Valve hinge shaft and pin shall be constructed of stainless steel. Valve seat shall be designed to prevent reversal of flow when inlet pressure decreases below delivery pressure. Valve seating surfaces shall be metal-to-synthetic rubber. Valve seat shall be renewable.

C. The valve seating shall be shockless in operation and be cushioned in order to prevent any water hammering action.

D. Valves shall be marked in accordance with AWWA C508 specifications including year of manufacture.

E. Valves shall be Golden-Anderson Figure No. 250-D or approved equal.

2.24 FLAP VALVE, FLANGED END

A. Valve end shall be flanged and drilled in conformance with ANSI B16.1, Class 125 specifications. Valve body shall be cast iron conforming to ASTM A126-B specifications.

B. Seat shall be resilient and constructed of Buna-N synthetic rubber. Seat shall be bonded to the body and provide for a wide seating surface for the seat machined in the cover.

C. Valve cover or flap shall be constructed of cast iron conforming to ASTM A126-B specifications. Hinge arms will be high-tensile bronze conforming to ASTM B548-CA865 specifications. Hinge pins shall be AISI Type 304 stainless steel. Hinge arms shall have two pivot points each, an adjustable lower pivot with limited rotation and a threaded upper hinge post to adjust flap valve opening sensitivity. A lubrication fitting shall be supplied for each pivot.

D. Flap valve shall be equivalent to Series FA-VC as manufactured by Rodney Hunt.

2.25 AIR/VACUUM RELIEF VALVES

A. Air/vacuum relief valves shall have screwed ends conforming to ANSI/ASME B1.20.1.

B. Valve body, cover, and lever frame shall be constructed of cast iron conforming to ASTM A126, Class B. Float shall be constructed of stainless steel. Seat shall be of Buna-N rubber. All other internal parts shall be constructed of stainless steel or bronze.

C. Valve shall be designed with a large orifice to permit efficient filling or draining and for protection against vacuum and a small orifice for continuous venting of pockets of air as they accumulate.

D. Valves shall be equivalent to APCO 143C and 147C or Golden Anderson Figure 945.

2.26 BACKFLOW PREVENTER ASSEMBLY

A. Valve ends shall be flanged and drilled in conformance with ANSI B16.1, Class 125.

B. Valve body and cover shall be constructed of cast iron meeting or exceeding ASTM A126. Valve shall be designed for a minimum 150 psi cold working pressure.

C. Valve shall be of the pressure type vacuum breaker or reduced pressure principle design. The valve assembly shall be a complete unit consisting of two independently acting spring-activated check valves that provide for drip tight closure against a reversal of flow. Valve shall also include an opening to atmosphere on the discharge side of the second check valve. The opening to atmosphere shall be arranged so that it begins opening at no less than 1 psi positive pressure and is fully open at atmospheric pressure. The check valves shall close prior to the reversal of flow. Check valve springs shall be sufficient to hold shut a minimum of 1 psi in the direction of flow.

D. Valve assembly shall include two shutoff valves for check valve isolation and four test cocks arranged so a test of each check valve can be performed.

E. All internal parts of the check valves and air inlet valve shall be removable and replaceable without removal of the valve assembly from line.

F. All materials shall be corrosion resistant.

G. Valve shall be Clayton Model 27 Pressure-Type Vacuum Breaker Assembly, Hersey Model GCM, or approved equal.

2.27 THREE-WAY PLUG VALVES

A. Three-way plug valves shall have resilient plug facing, tapered seat and plug and be of the specified valve combination number and diameter as shown in the Contract Drawings. Valves shall be designed for positive bi-directional shutoff. Valves shall have flanged ends drilled and faced in conformance with ANSI B16.1, Class 125.

B. Valve body shall be constructed of cast iron meeting or exceeding ASTM A126, Class B. Valves shall be designed for a minimum 125 psi cold working pressure.

C. Valve shall have a resilient plug facing of Neoprene.

D. Valve bearings shall be corrosion resistant and require no lubrication.

E. Valve packing shall be Buna (nitrile-butadiene).

F. Valves shall have double hand wheel actuators. Hand wheels shall be totally enclosed units and be designed for lift, turn, reseat

operation. One hand wheel shall lift the plug while the other shall turn the plug. Hand wheel mounting shall be as shown on Contract Drawings.

G. Valves shall be supplied with plug combination number and port number clearly numbered by means of stamping, engraving, or raised lettering corresponding to valve type as shown on Contract Drawings. Open ports shall be indicated based on operator position (closed port shall be masked). All valve markings and open port indicators shall be clearly visible from floor.

H. Metal surfaces of valve internals shall be coated with NSF standard 61 certified epoxy coating system.

I. Valves shall be DeZurik Figure No. 202 of the specified combination number with materials of construction and options as specified in this section, or approved equal.

2.28 SOLENOID VALVES

A. Solenoid valves ends shall be compatible with well pre-lube and chlorine booster pump piping.

B. Valve body shall be constructed of copper or bronze and designed for a minimum 150 psi cold working pressure. Valve shall be of the globe pattern, full ported, and stainless steel pilot assembly design.

C. No minimum pressure differential shall be required for valve operation.

D. Valve shall be completely serviceable and valve internals replaceable.

E. Valve shall operate from a 120-volt AC power supply. Valve shall be in the normally closed position and open fully upon energizing.

F. Contractor shall furnish and install manual valves, screwed unions, and piping required for solenoid valve bypass. Bypass shall be valved to permit solenoid valve servicing while distribution pipe is under pressure and to permit bypass shutoff during normal operation.

G. Solenoid valve shall be equivalent to ASCO Bulletin No. 8210.

2.29 PADDLE WHEEL FLOW METERS

A. Paddle wheel flow meters shall be complete with flow sensor and analog meter and shall be powered by a 120-volt AC power supply.

Contractor shall be responsible for wiring of analog flow meter from convenience outlet located on the control panel support column. Contractor shall follow all applicable electrical codes for wiring meters.

B. Flow sensor shall be designed for installation into 6-inch diameter ductile iron pipe. Impeller shall be constructed of glass-reinforced nylon. Shaft shall be constructed tungsten carbide. Sleeve shall be constructed of brass over a glass reinforced polyphenylene body. O-ring shall be Viton. Sensor shall be installed in a wet tap assembly that provides for servicing the sensor under normal operating pressure without any down time. Contractor shall provide hardware necessary for removing the sensor while the pipe is under pressure.

C. Flow sensor shall have flow rate range of 1 to 30 fps. Linearity shall be ± 1 percent over full range. Output accuracy shall be ± 1 percent over the full range. Repeatability shall be ± 0.3 percent of full range. Pressure rating shall be 150 psi minimum.

D. AC-powered flow meters shall be totally compatible with flow sensors. Sensitivity shall be ± 0.1 percent of span. Repeatability shall be ± 0.1 percent of span. Meter full scale shall be 1,200 gpm and factory calibrated for 6-inch diameter ductile iron cement mortar lined pipe. Display shall be two line LCD, 7 digits per line with 3/8-inch letters. Flowrate shall be displayed in gpm to the whole unit. Flow indicator shall be housed in a NEMA 12 enclosure. Flow indicator shall also include a mechanical flow totalizer calibrated in units of 1,000 gallons. Flow indicator shall include a mechanical reset for the flow totalizer.

E. Contractor shall furnish and install tapping saddles, if necessary, for flow sensor installation. Tapping saddles shall conform with the specifications in Part 2.35 of this section.

F. Contractor shall coordinate control panel port sizing with metal fabrication to ensure proper fit of indicator. Sensor cable shall be secured to piping with nylon cable ties.

G. Flow sensors shall be Great Lakes Instrument Model No. 1172FO or approved equal. Mounting hardware shall be Great Lakes Instrument Model No. MHF22AO or approved equal. Insertion tool shall be Great Lakes Instrument Model No. DAT20A225H or approved equal. Flow meters shall be Great Lakes Instrument Model No. 675F3C1B2N. Flow meter shall include Great Lakes Instrument's 1000M4G1110 Panel cut-out gasket kit or approved equal.

2.30 PROPELLER FLOW METERS

A. Propeller flow meters shall meet or exceed AWWA C704. Meters shall have flanged ends faced and drilled in conformance with ANSI B16.1, Class 125.

B. Meter casing shall be constructed of cast iron or steel and shall be protected by a corrosion resistant coating or other anti-corrosion treatment. Meter casing shall be designed for a minimum 150 psi cold working pressure and shall be furnished with three straightening vanes. Casing inside diameter shall not be less than nominal pipe size for the meter specified. Casing shall be marked in accordance with AWWA C704 specifications.

C. Meter registers shall read flow rate directly in U.S. gallons and be hermetically sealed. Meters shall be furnished with digit, straight reading totalizer and rate of flow indicator over the normal range. Meter accuracy shall be ± 2 percent of true flow.

D. The meters shall have solid state transmitter head that generates a 4 to 20 mAdc signal proportional with flow from 0 to 1,600 gpm and 0-200 gpm for the 10-inch diameter and 4-inch diameter meters, respectively. Transmitters shall be a two-wire device that derives its operating power from the current loop. The transmitter heads shall sense the meter shaft speed using a magnet and Hall-effect device. Mechanical switch contacts or other similar means shall not be used. System accuracy shall be ± 2 percent of measured flow over the specified range. The remote power supply and flow monitoring equipment are specified in Section 16950.

2.31 SAMPLE VALVES

A. Sample valves shall be polished brass, smooth nosed, and provide for straight-through flow when fully opened. Inside surfaces shall be free of barbs and other casting imperfections; no internal or external nose threads shall be allowed. Valves shall be designed for a minimum 80 psi cold working pressure.

B. Valves shall be equivalent in all respects to Ernst Gage Co. Figure No. 29.

2.32 PRESSURE GAGES

A. Pressure gages shall have a minimum 200 psi pressure rating. Gages shall be of the bourdon tube liquid filled design. Gages shall have 1/2-inch NPT connections.

B. Bourdon tube system shall be constructed of AISI Type 316 stainless steel. Tube shall be drawn C-tube.

C. Dial shall be 4-1/2 inches in diameter and pressure range from 0 to 160 psi.

D. Free standing gages shall be supplied with 1/2-inch NPT lower stem connections. Panel mounted gauges shall be supplied with 1/2-inch NPT back stem connections. Panel mounted gauges shall be supplied with flush mounting rings.

E. Pressure gages shall be equivalent in all respects to Ashcroft Duragage 1279 (4-1/2 inches) S.

2.33 QUICK CONNECT FITTINGS

A. Fittings shall be of the double shutoff "industrial interchange" design and conform to MIL-C-4109 dimensional specifications.

B. Body materials shall be constructed of brass and be designed for a minimum 100 psi water or air working pressure.

C. Seal materials shall be Buna-N.

D. Fittings shall be designed to prevent fluid loss when coupling is disconnected.

E. Quick connect fittings shall be equivalent in every respect to Parker Series 60 Double Shutoff Couplings.

2.34 CAM LOCK FITTINGS

A. Cam lock fittings shall conform to MIL-C-27487 dimensional specifications.

B. Body materials shall be constructed of AISI Type 316 stainless steel and be designed for a minimum 75 psi working pressure.

C. Gaskets shall be Buna-N rubber.

D. Fittings shall be interchangeable with couplings of other manufacturer that meet MIL-C-27487 specifications.

2.35 TAPPING SADDLES

A. Saddle bodies shall be constructed of malleable iron ASTM-A47, Grade 32510 or ductile iron ASTM-A536. Saddles shall be designed for leak-free operation at a minimum 150 psi cold working pressure.

B. Straps shall be carbon steel ASTM-A307, electro-galvanized with dichromate seal.

C. Nuts shall be heavy-hex steel, electro-galvanized with dichromate seal.

D. Washers shall be electro-galvanized carbon steel with dichromate seal.

E. Gaskets shall be Buna-N rubber.

F. Saddles for pipe greater than 8-inch nominal diameter shall be of the double strap type.

G. Saddles shall be equivalent in every respect to Rockwell Model No. 311 (single strap) or Rockwell Model No. 313 (double strap).

2.36 EXPANSION JOINTS/VIBRATION ISOLATION

Expansion joints shall have steel or cast iron flanged ends drilled to ANSI B16.1, Class 125 standards. Expansion joint conduit shall be constructed of neoprene rubber and be designed for a minimum 150 psi cold working pressure.

2.37 SAFETY HEAD ASSEMBLY

A. Safety head assemblies shall include safety head rupture disc, and disc holder for mounting between ANSI B16.1, Class 125 flanges.

B. Rupture discs shall be constructed of AISI Type 316 stainless steel. Rupture discs shall be of the pre-scored, tension-loaded, non-fragmenting type.

C. Rupture disc holders shall be constructed of AISI Type 316 stainless steel and be designed to match the rupture disk.

D. Contractor shall provide safety head assemblies that meet or exceed ASME requirements for pressure relief of the contactor vessels. The maximum normal operating pressure of the contactor vessels will be 90 psi. The maximum allowable working pressure of the contactor vessels shall be 150 psi. The maximum operating temperature shall be 150° F.

The only means of pressure relief of the contactor vessels shall be by means of the safety head assembly.

E. Safety head assemblies shall be supplied complete with ASME certification and documentation submitted.

2.38 SIGHT GLASSES

A. Four-Inch Diameter

1. Sight glasses shall be of the wafer style. Ends shall be constructed of polypropylene. Sight flow indicators shall utilize a double wall construction consisting of a Pyrex glass inner wall and a high impact strength acrylic outer wall. Both inner and outer walls shall be of uniform optical quality and of a high light transmission factor. Sight glasses shall contain Viton O-ring flange seats and provide for leak-free installation with smooth faced ANSI flanges. Four-inch diameter sight glasses shall be designed for a minimum 110 psig cold working pressure and have a sight glass nominal diameter of 4 inches. Sight glass inner wall diameter shall be greater than the inside diameter of the adjacent pipe.

2. Fasteners integral to the sight glass shall be constructed of stainless steel. Fasteners for installing sight glasses between ANSI flanges shall be constructed of stainless steel.

3. Sight glasses shall be Plasto-O-Matic Series GYW400V-PP or approved equal.

B. Ten-Inch Diameter

1. Sight glass shall be flanged ends with flanges drilled in conformance with ANSI B16.1 Class 125. Flanges shall be flat faced. Flanges shall be constructed of carbon steel conforming to ASTM A216WCB specifications. Sight glass shall be borosilicate glass. Gaskets shall be Neoprene conforming to ASTM D735 specifications. Glass retaining hardware shall conform to ASTM A307 specifications. Sight glass pressure rating shall be 20 psi minimum.

2. Sight glass shall be Jacoby Tarbox Model 830-F or approved equal.

2.39 ORIFICE CAPS

A. Contractor shall furnish orifice caps suitable for field installation in the carbon service corridor sump discharge pipe. Orifice caps shall be constructed of AISI Type 304 stainless steel. Plate thickness shall be 3/8-inch minimum. Orifices shall be sharp-edged and machined at a 45 degree angle.

B. Contractor shall furnish orifice caps with orifice diameters of 6, 4, and 2 inches. Orifice size shall be stamped or engraved on each orifice cap.

C. Orifice cap diameters shall be sized to fit snugly in the bell (hub) end of the sump drain pipe. Cap shall not rattle or vibrate when in service but shall be easily removed to allow for substitution of another size orifice cap.

2.40 VENT PIPE SCREEN ASSEMBLY

Vent screen assemblies shall consist of malleable iron screwed unions conforming to the specifications listed in Part 2.09 of this section and a stainless steel 20 mesh screen installed between the union halves. Screen shall be of a diameter to ensure a snug fit when installed, with no openings around the screen perimeter.

2.41 FLOOR PIPE SLEEVE AND SEAL

A. Floor pipe sleeves shall be steel pipe, plain end, 0.375 inch minimum wall thickness and conform with Part 2.01 of this section. Pipe sleeves shall have a steel collar of an O.D. 2 inches greater than the pipe O.D. Collar shall be fillet welded to the pipe sleeve and shall be positioned to ensure positive anchoring in the floor slab. Collar shall be of the same material composition as the pipe sleeve. Sleeve shall be compatible with annular space seal required. Steel sleeve may be saw cut and welded to fit around pipe section flanges. Welds shall be ground smooth on the ID surface to provide for a watertight seal.

B. The annular space between the pipe and pipe sleeve shall be fitted with a mechanical type interlocking synthetic rubber link shaped to continuously fill the annular space between the pipe and steel sleeve. Links shall include bolts that when tightened after the seal assembly is positioned in the sleeve will cause the rubber sealing elements to expand and provide a watertight seal between the pipe and steel sleeve. Seal shall be "Link-Seal" Model No. LS-325-C or approved equal.

2.42 WALL FOOTING PIPE SLEEVES AND SEALS

A. Wall footing pipe sleeves shall be steel pipe, plain end, 0.375 inch minimum wall thickness and conform with Part 2.01 of this section. Pipe sleeves shall have a steel collar of minimum O.D. 2 inches greater than the sleeve pipe O.D. Collar shall be fillet welded to the pipe sleeve and shall be positioned to ensure positive anchoring in the wall footing. Collar shall be of the same material composition as the pipe sleeve.

B. Contractor shall furnish and install steel tie rods for thrust restraint from the mechanical joint elbow below the floor to the second joint outside wall footing. Tie rods shall be of the same diameter as flange bolts of the nominal pipe size. A minimum of four tie rods shall be used. Tie rods shall be coated as shown on the Contract Drawings.

C. The annular space between the pipe and pipe sleeve shall be filled with bituminous mastic joint sealer for pipe conforming to MnDOT Specification 3728. Sealant shall provide for a leak tight seal.

2.43 RETAINING WALL PIPE SLEEVES

A. Retaining wall pipe sleeves shall be of the mechanical joint wall type. Sleeve ID shall allow for passage of the wall penetrating pipe. Sleeve collar OD shall be a minimum 2 inches greater than the sleeve OD. Sleeve shall be constructed of ductile iron. Bell flange shall be tapped.

B. Mechanical joint glands, studs, and gasket shall meet the requirements of Paragraph 2.04 of this Section of these Specifications. Gland and gasket shall be installed on the OD of the penetrating pipe and attached to the bell end of the pipe sleeve. Mechanical joint connection shall form a watertight seal between the pipe and wall opening. Mechanical joint wall sleeve shall be rated for a minimum 50 psi pressure between the opposite sides of the retaining wall.

C. Retaining wall pipe sleeve shall be Model F-1429 mechanical joint wall sleeve as manufactured by Clow Corporation or approved equal.

2.44 PIPE REPAIR SLEEVES

A. Pipe repair sleeve bands shall be AISI Type 304 stainless steel. Lags shall be ASTM 536 ductile iron. Gaskets shall be 1/8-inch thick Grade 60 synthetic rubber. Bolts and nuts shall be galvanized carbon steel.

B. Pipe repair sleeves shall be equivalent to Rockwell Series 240.

2.45 DIELECTRIC UNIONS

A. Dielectric unions shall be used between all copper tubing and ferritic fittings. Unions shall be designed for a minimum 150 psi cold working pressure.

B. Dielectric unions shall be equivalent in every respect to those manufactured by EPCO.

2.46 STAINLESS STEEL TUBING AND COMPRESSION FITTINGS

A. Stainless steel tubing shall be AISI Type 304 or 316 stainless steel tubing of the diameter specified. Tubing shall be rated for a minimum 150 psi cold working pressure. Tubing shall have a Rockwell hardness less than B90.

B. Contractor shall furnish and install AISI Type 304 or 316 stainless steel compression fittings for plumbing of the stainless steel tubing. Fittings shall not be of the flare type. Fittings shall provide for a leak-tight seal at a pressure rating of 150 psi. Fittings shall be designed for repeated disassembly and reassembly.

2.47 SOURCE QUALITY CONTROL

A. Products supplied as specified under the specific paragraphs of this Section shall be of the same manufacturer and be identical and interchangeable with products of the same specifications and size. Products of the same type, but different diameter or size, shall be supplied by the same manufacturer.

B. Contractor shall be responsible for ensuring that the products specified in this section are supplied. Contractor shall maintain records to establish that products supplied meet or exceed referenced standards as specified in this section. Contractor shall supply, when requested, documentation and records sufficient for the Engineer and Owner to determine that the specified products were indeed delivered and installed.

PART 3: EXECUTION

3.01 PIPE SUPPORTS AND ANCHORS

A. General

1. All pipe systems, including valves and fittings, shall be adequately supported and anchored. Hangers, supports and anchors shall be installed as shown on the Contract Drawings or as herein specified.

2. For pipes requiring yokes for restraint, nuts on the underside of the support flange or channel shall be hand-tightened followed by one-half tightening revolution. Corresponding nuts on the top side of the support flange or channel shall be tightened securely. All yokes shall be tightened to provide for positive restraint perpendicular to the support bracket flange while allowing for longitudinal movement as a result of possible thermal expansion.

3. Support intervals shall be as shown on the Contract Drawings.

B. Manifold and Contactor Bay Pipe Supports

1. Pipe support base shall be secured to pier as shown on the Contract Drawings. Contractor may use shims of a size equivalent to the pier plate surface for alignment of the support column. Contractor shall coat the top of the pier plate and bottom of the support column base plate with a bituminous sealant and allow to dry prior to connection.

2. Pipe brackets shall be adjusted so that the support bracket contacts the pipe bearing surface rather than forcing the pipe to the brackets by tightening the yoke. Contractor shall final finish and touch up the pipe supports as specified in Section 09800.

C. Adjustable Pipe Supports

1. The adjustable pipe supports shall be secured to the floor using anchor bolts as shown on the Contract Drawings and as specified in Section 05500. Grout shall be used for leveling as specified in Section 03600.

2. Pipe shall be supported as in the same manner as specified for the manifold loop pipe support.

D. Final Adjustment

Contractor shall adjust all yokes and supports as necessary for restraint of piping systems after the piping systems are in service. Any unrestrained movement or vibration that occurs as a result of flow in the pipes shall be corrected through support adjustments.

3.02 PIPE INSTALLATION

A. Cleaning of Pipe

Remove all foreign matter and dirt from pipe before installing and keep pipe clean after installation. Blow out piping system with compressed air and flush with clean water at system operating pressure as required to ensure a clean piping system.

B. Assembly of Pipe

All equipment and piping shall be installed complete, utilizing competent workmen, so that the complete installation will function properly and reflect a high quality of workmanship. Contractor shall provide all scaffolding and other means of support necessary for the proper installation of the piping systems. Contractor shall follow local and state safety codes for all piping system installation activities. Flange joints shall be installed with flange gaskets as specified and tightened to provide leak-free joints. All threaded joints shall be tightened to provide leak-free joints. Flanges shall be furnished with all bolts of the recommended diameter in place and tightened to the recommended torque. Where tie rods replace flange bolts, two nuts shall be used to draw the flange tight.

C. Lines and Grades

Contractor shall install all piping in a workmanlike manner with vertical pipes plumb and horizontal pipe level and parallel to walls, supports or other structures as shown on the Contract Drawings. Contractor shall be responsible for maintaining pipe center lines and elevations as shown on the Contract Drawings.

D. Pipe Openings in Slabs

Where piping passes through slabs, sleeves for same shall be set plumb and level in the formwork or reinforcing lattice before placement of concrete as shown on the Contract Drawings and as specified in Section 03300. Contractor shall be solely responsible for careful positioning of sleeves to provide the required horizontal and vertical alignment of pipes. Contractor shall ensure that

foreign material does not enter annulus between pipes prior to and after application of joint sealant material.

E. Openings in Walls or Footings

Where piping passes through walls or footings, sleeves for same shall be set plumb and level in the formwork or lattice before placement of concrete as shown on the Contract Drawings and as specified in Section 03300. Contractor shall be solely responsible for careful positioning of sleeves to provide the required horizontal and vertical alignment of pipes. Concrete for encasement or footing shall be placed as specified in Division 3. Contractor shall ensure that foreign material does not enter the annulus between pipes prior to and after application of joint sealant material.

F. Pipe Below Slabs

Pipes below slabs shall be installed, tested and disinfected as specified in Section 02600.

3.03 TESTING

All interior piping shall be pressure tested prior to painting at the pressure indicated. Liquid piping shall be systems tested with water. Air piping systems shall be tested with air. All systems shall be tested for 60 minutes without loss of pressure.

1.	All liquid process piping	150 psi
2.	Contactor bay process piping	150 psi
3.	Air piping	150 psi
4.	Carbon transfer piping	60 psi

3.04 PAINTING

Piping, valves, operators and piping accessories shall undergo the necessary surface preparation and shall be painted as specified in Section 09800.

3.05 DISINFECTION

A. All process piping shall be disinfected in conformance with AWWA C651. Disinfection of process piping shall be coordinated with the disinfection of the contactor vessels and the water treatment plant in conformance with AWWA C653.

B. The method of chlorination shall be by tablets or granules at the dosages specified in Section 5.1 of AWWA C651.

C. The point of application shall be at frequent predetermined intervals, preferably at each pipe joint as the pipe installation process progresses.

D. The process piping shall be disinfected for a minimum of 24 hours. Prior to flushing, the chlorine residual shall be at least 10 ppm as measured, verified, and documented by the Contractor. Piping shall not be flushed until Engineer verifies disinfection of pipe.

E. The Contractor shall be responsible for disposal of highly chlorinated water used for disinfection. Contractor shall be responsible for securing the necessary permits for disposal of the water.

F. After disinfection and flushing, the water will be sampled and tested for quality, including bacteriological, by the Owner. Contractor shall contact Owner 24 hours in advance when individual process piping systems are ready for testing. If the water does not meet the bacteriologic quality standard of the Minnesota Department of Health, the Contractor shall perform all operations necessary to disinfect the process piping system or systems. All costs associated with the resampling and analysis resulting from failed bacteriologic tests shall be covered by the Contractor. The laboratory used for any analyses of the redisinfected samples shall be of the Owner's choosing.

3.06 FIELD QUALITY CONTROL

A. The Contractor shall establish and maintain quality control for work performed under this section to assure compliance with contract requirements and maintain records of his quality control for all construction operations including, but not limited to, the following:

1. Materials and products used
2. Lines and grades
3. Tolerances
4. Test procedures and results

A copy of the records of inspection and tests, as well as the records of corrective action taken, shall be furnished to the Owner and Engineer as directed.

B. The Contract Drawings indicate certain required pipe sizes and the general arrangement for the major piping and equipment. Valves, fittings and other appurtenances furnished shall be of such dimensions to allow for the installation of this piping substantially as shown on the Contract Drawings. Locations of all process piping

and accessories shall be verified in the field by the Contractor. In the event it should become necessary to change the location of any of the work due to interference with other work, the Contractor shall consult with the Owner and Engineer before making any changes and all such changes shall be made without added cost to the Owner. Under no circumstances shall the pipe sizes indicated on the Contract Drawings be changed without the written approval of the Owner and Engineer.

C. The Contractor shall determine and be responsible for the proper locations and character of all inserts for hangers, chases, sleeves and other openings in the construction required for all piping work in this and other sections of these Specifications.

D. The final location of inserts, hangers, etc. required for the process piping installation shall be coordinated with facilities required for other installation to prevent interference.

E. The final length and location of required pipe connections to all process equipment shall be coordinated to meet the requirements and recommendations of the equipment manufacturer.

END OF SECTION 11900

DIVISION 12 - (NOT USED)

DIVISION 13 - (NOT USED)

DIVISION 14 - (NOT USED)

DIVISION 15 - MECHANICAL

15100 MECHANICAL GENERAL PROVISIONS

15300 INSULATION

15400 PLUMBING

15800 HEATING, VENTILATING, AND DEHUMIDIFYING

SECTION 15100

MECHANICAL GENERAL PROVISIONS

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

1.02 SCOPE

A. The work under this Division of the Specifications includes complete plumbing, heating, ventilating and dehumidifying as specified herein for St. Louis Park Well No. 4 Water Treatment Facility. Provide all construction engineering, supervision, labor, material, fixtures, equipment and any and all other items necessary for complete and functioning mechanical installations.

B. The Mechanical Drawings and Division 15 Mechanical Specification Sections listed below constitute the mechanical construction requirements:

Drawings:

Sheet No.	Sheet Title
M1	Main Level Mechanical Plan
M2	Lower Level Mechanical Plan
M3	Mechanical Details
M4	Mechanical Schedules

Specification Sections:

15100 - Mechanical General Provisions
15300 - Insulation
15400 - Plumbing
15800 - Heating, Ventilating and Dehumidifying

C. Related Work

1. Section 01500 - Construction Facilities and Temporary Controls.
2. Section 07600 - Flashing of Roof Penetrations.
3. Section 09800 - Special Coatings.

1.03 REFERENCES

A. The following are complete titles of references cited in this Section:

1. National Electrical Manufacturers Association (NEMA).
2. Institute of Electrical and Electronics Engineers (IEEE).
3. American National Standards Institute (ANSI).

1.04 INSPECTION OF SITE

A. Inspect the site of the proposed work and note the conditions under which the work is to be performed.

1.05 PERMITS AND FEES

A. Obtain all permits required for the performance of the Mechanical Work. Submit complete certified plans and specifications to the city Building Department with the permit application. Obtain all necessary approvals, arrange for inspections as required by the city Inspections Department and obtain required certificates of inspection.

B. Pay all sales taxes, fees, and other costs pertaining to the Mechanical Work. Local building permit charges are set forth in the Instructions to Bidders and Supplementary Conditions.

1.06 APPLICABLE CODES AND STANDARDS

A. Construction shall be in conformance with the latest amended edition of the State Building Code, including requirements of other codes, standards and regulations adopted by reference as a part thereof.

1.07 WORK SCHEDULE

A. Examine the Drawings and Specifications to determine the extent and details of work to be performed.

B. Be responsible for scheduling and arranging all mechanical work for the orderly progress of the project.

1.08 COORDINATION OF WORK

A. Coordinate the mechanical work with work performed under other Divisions.

1.09 MATERIAL AND WORKMANSHIP

A. All work shall be performed by skilled and experienced craftsman using only new, quality materials.

1.10 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated or maintained in fully accessible positions.

1.11 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. The drawings shall not take precedence over field measurements.

B. Lay out work in accordance with the Drawings and coordinate work with other trades.

C. Make reasonable modifications in layout to avoid conflict with the work of other trades or for proper execution of the work without extra charge.

1.12 ELECTRICAL WORK

A. All motor starters will be furnished and installed under Division 16 for all motors furnished and installed under Division 15 unless starter is included as an integral part of the equipment.

B. All electrical wiring will be furnished and installed under Division 16 unless specifically described as a part of the installation under Division 15.

1.13 ELECTRIC MOTORS

A. Furnish electric motors as required for each motor driven unit. All motors must conform with applicable NEMA, IEEE, and ANSI Standards and bear nameplate of manufacturer, with current operating characteristics noted thereon.

1. Horsepower ratings: All electric motors shall be sized to meet the horsepower requirements of the driven unit at design characteristics without loading the motor beyond its nameplate horsepower rating.

2. All motors shall be provided with ball or roller bearings complete with grease cups. Motors shall be mounted on sliding cast iron bases as required.

3. Motors shall be General Electric, Marathon, Baldor, Westinghouse, Gould, or equal.

4. Motors of 1/3 HP and smaller shall be wound to operate from a 115 volt, single phase, 60 cycles, A.C. source and motors 1/2 HP and larger shall be wound to operate from a 208 volt or 460 volt, 3 phase, 60 cycles, A.C. source as indicated. All motors shall operate at 1,750 RPM.

5. All motors shall be totally enclosed fan cooled (TEFC) high efficiency type NEMA Design B and shall have a 1.15 service factor rating. Motors 1 HP and larger shall have at full load a power factor of 85% or greater.

1.14 EQUIPMENT ERECTION

A. Provide all necessary rigging, scaffolding, tools, tackle, labor, etc., necessary for the complete installation of equipment.

B. All equipment shall be installed and connected with best engineering practices and in accordance with the manufacturer's instructions and recommendations.

1.15 CLEAN-UP

A. Prior to final inspection, thoroughly clean all equipment furnished and installed under this contract. Remove all stickers, rust, stains, and other foreign matter or discoloration.

B. Restore to the factory finish all surfaces of mechanical equipment which has sustained damage to the manufacturers prime and finish coats of paint. Materials and workmanship shall be equal to the original finish.

1.16 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Instruct the Owner's designated representative(s) on the proper operation and maintenance of all equipment and systems installed under the mechanical work.

B. Provide 8 hours of general training on completed systems and time for site visits following start-up.

1.17 **WARRANTIES**

A. Guarantee all workmanship and material against defects for at least one year from the date of acceptance, as further set forth in the General Requirements.

END OF SECTION

SECTION 15300

INSULATION

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Provide labor and materials for thermally insulating certain ductwork provided under Division 15 and emergency generator tailpipe exhaust and muffler.

PART 2: PRODUCTS

2.01 GENERAL

A. Insulation shall be Owens-Corning, Manville Corporation, Certain-Teed/St. Gobain, Knauf, or approved equal.

B. All insulating materials shall have fire and smoke hazard ratings as tested by procedure ASTM E-84, NFPA 255 and UL 723 not exceeding:

1. Flame spread 25 and smoke developed 50.

C. Insulation accessories, such as adhesives, mastics, cement, tapes and glass cloth shall have the same component rating as listed above.

2.02 DUCTWORK THERMAL INSULATION

A. Outside air and exhaust air ducts:

1. Rigid fiberglass board, 2" thick, 3 lb. density, vapor barrier jacket with 2" tab.

2.03 EMERGENCY GENERATOR EXHAUST

A. Tailpipe and muffler:

1. Block type hydrous calcium silicate, 10-3/4 lb. per cubic foot density with service rating to 1,200 ^{o} F., 4" thick.

PART 3: EXECUTION

3.01 DUCTWORK THERMAL INSULATION INSTALLATION

A. Outside air duct insulation:

1. Apply insulation to the following:

   a. Combustion air duct from roof penetration.

   b. Dehumidifier reactivation inlet and exhaust ducts from roof penetration to dehumidifier.

2. Secure insulation to metal with welded pins and mechanical fasteners on not over 18" centers leaving no voids at edges. Seal all butt joints with 3" wide joint sealing tape and seal all corner joints with 4" tape. Seal over pin clips with tape patches.

3.02 EMERGENCY GENERATOR EXHAUST INSULATION INSTALLATION

A. Insulate the emergency generator tailpipe exhaust system, including the muffler, from the tailpipe connection at the generator to the discharge outlet outside the building:

1. Secure high ribbed lath to the metal surfaces. Apply insulation blocks over the high ribbed lath with staggered joints. Leave no voids between blocks.

2. Secure with 16-gauge annealed wire or 1/2" wide x 28 gauge galvanized steel bands 12" on center. Provide welded studs, clips and angles for anchoring wire or bands. Apply 1" hex mesh galvanized wire trowelled with a heavy coat of mineral fiber cement. Reinforce rectangular duct corners with metal corner heads. When dry, cover with glass cloth and size with two (2) coats of mastic.

END OF SECTION

SECTION 15400

PLUMBING

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor necessary for complete and functioning plumbing systems. The work consists of the following:

1. Waste and vent piping system for the building including piping, floor drains, cleanouts and connection to the sanitary sewer system outside the building.

2. Waste piping system for the chlorine room, including piping to seepage pit, floor drain, and seepage pit outside the building.

3. Service water piping system including piping, isolation valves, wall hydrants, hose bibbs, backflow preventer, fire sprinkler heads, and service connection to the service water main stubbed into the building.

4. Emergency shower and eyewash station.

5. Duplex sump pump unit.

6. Natural gas piping system including extension from gas meter and connections to gas unit heaters, dehumidifier, and generator.

7. Arranging with the gas supplier and coordinating a natural gas service to the building. Gas service main, meter and regulator for 2 PSIG outlet pressure will be furnished and installed by the gas supplier.

C. Related Sections:

1. Section 15100 - Mechanical General Provisions
2. Section 15800 - Heating, Ventilating and Dehumidifying

3. Section 02600 - Piped Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. Department of Health, Minnesota Plumbing Code, Chapter 4715.
2. Uniform Fire Code.
3. Underwriters Laboratories (UL).
4. National Electrical Manufacturers Association (NEMA).
5. American Gas Association (AGA).
6. National Fire Protection Association (NFPA).
7. Minnesota Uniform Mechanical Code Chapter 1346 (UMC).
8. American Society for Testing and Materials (ASTM).

1.03 SUBMITTALS

A. Test Results/Certificates - Submit the following test results and/or certificates in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Certificates of satisfactory completion of piping tests.
2. Certificate of approval from legally constituted authority having jurisdiction for fire sprinkler system installation.

B. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Provide published pamphlet on the care and maintenance of the sprinkler system, NFPA No. 13-A latest edition.

C. Shop Drawings - Submit Shop Drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Trench drains.
2. Backflow preventer.
3. Wall hydrants.
4. Hose bibbs.
5. Emergency shower/eyewash station.
6. Sump pump unit.

D. Operation and Maintenance Instructions - Submit operation and maintenance instructions for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Sump pump unit.
2. Provide instruction sheets describing operation and proper maintenance of the sprinkler system.
3. Backflow preventer.

1.04 QUALITY ASSURANCE

A. Comply with all requirements of the Minnesota Plumbing Code and Uniform Fire Code.

B. Install all piping in a neat and orderly manner.

1.05 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

1.06 TESTING AGENCY CERTIFICATION

A. All electrical equipment furnished under this Section shall be labeled by a testing agency that is recognized by the State of Minnesota Board of Electricity.

B. The equipment shall be constructed in accordance with the testing agency standard(s) that applies to the approved label.

C. The testing agency label shall apply to the completed assembly. Equipment that utilizes labeled components but does not have a label for the completed assembly is not acceptable.

D. The following testing agency labels are acceptable:

1. Underwriter's Laboratories (UL):

   a. UL508 - Industrial Control Equipment

2. Others as approved by the State Board of Electricity.

PART 2: PRODUCTS

2.01 **PIPE AND PIPE FITTINGS**

A. Furnish and install pipe and fittings required to connect fixtures and equipment.

1. Service Cold Water in building above ground:

a. 3" and smaller sizes: Type L hard drawn copper tubing and wrought copper solder fittings joined using 95-5 Bridgit, or equal, solder.

2. Waste and Vent from central sump inside building underground:

a. Service weight cast iron soil pipe, hub and spigot, asphaltum coated and preformed molded rubber gasketed joint cast iron hub and spigot fittings.

3. Waste from central sump inside building underground (to 5 feet outside the building):

a. Ductile iron pipe conforming to ANSI A21.51/AWWA C151, Class 52. Push joints will be allowed for gravity pipe conveying sewage.

b. Fittings shall be ductile iron and shall conform to ANSI A21.10/AWWA C110, Class 250. Push joints shall conform to ANSI A21.11/AWWA C111.

c. All pipe and fittings shall be furnished with cement mortar lining meeting the requirements of ANSI A21.4/AWWA C104 for standard thickness lining. All exterior surfaces of the pipe and fittings shall have a tar or bituminous seal coating at least 1 mil. thick.

4. Vent in building above ground:

a. Service weight hubless cast iron pipe and hubless cast iron drainage fittings with neoprene gasket couplings and Type 301 stainless steel corrugated gasket shield and stainless steel worm drive clamps.

5. All other waste piping inside building underground including waste from chlorine room to seepage pit:

a. Schedule 40 PVC waste pipe and PVC fittings, solvent joined.

6. Natural Gas:

   a. Black steel Schedule 40 pipe and standard weight malleable iron screwed fittings.

7. Sump Pump Discharge:

   a. Schedule 40 galvanized steel, Standard weight galvanized malleable iron screwed fittings.

8. Fire Sprinkler Piping:

   a. All materials shall be approved by the Underwriter's Laboratories and included in the list of inspected fire protection equipment and materials or approved by an acceptable, appropriate, nationally recognized testing laboratory for use in fire protection systems. Piping systems and components shall be rated for minimum pressure of 175 PSIG, except where noted otherwise. Steel pipe shall be ASTM A120 or A53.

   b. Schedule 40, black steel, threaded, with cast iron fittings.

2.02 UNIONS

A. Make equipment and pipe connections with unions located for quick, easy disconnect. Use dielectric unions for interconnecting copper and ferrous water piping and equipment.

1. Service Water piping:

   a. Dielectric: Steel body and nut with insulating gasket and copper connector, Epco Model FX, FB and EA, or equal.

   b. Copper ground joint union, Chase 402, or equal.

2. Natural Gas piping:

   a. Malleable iron with ground joint brass to iron seat, 300 PSI WOG, Grinnell 463, Stockham 694, or equal.

3. Sump Pump Discharge:

   a. Malleable galvanized iron with ground joint brass to iron seat, 200 PSI WOG.

4. Waste Piping:

a. Transition coupling between cast iron waste and ductile iron pressure pipe shall be Rockwell Clamp and Coupling Products 433 complete with sleeve, followers, gaskets, bolts and nuts.

2.03 VALVES

A. Furnish and install valves required to isolate fixtures, equipment and segments of the following piping systems:

1. Service Water piping:

a. Shut-off - 3" and smaller. Solder end ball valve, 300 PSI WOG, bronze two-piece body, stainless steel ball, extended stem to allow for insulation, lever handle, Teflon seats and seal, Nibco S580, Apollo 70-200 Series, or equal.

b. Check - 2" and smaller. Screwed lift check, 300 PSI WOG, bronze body and trim, 300°F. composition disc, Stockham B322, Crane 27, or equal.

c. Stop and Waste - Solder end, full-flow globe valve, 150 PSI WOG, bronze body, Nibco 726-FF, or equal.

2. Natural Gas piping:

a. Shut-off: Screwed end ball valve, U.L. listed, 600 PSI WOG, bronze two-piece body, chromium-plated ball, lever handle, Teflon seats and seal, Apollo 80-100 Series, or equal.

3. Sump Pump Discharge piping:

a. Shut-off - 2-1/2" and larger. Screwed gate valve, 125 PSI, iron body, brass seat, brass rising stem, Stockham G679, Crane 490, or equal.

b. Check - 2-1/2" and larger. Solder end swing check valve, 125 PSI, bronze body, bronze disc, Crane 37, or equal.

4. Fire Sprinkler piping:

a. Shut-off valve 2" and smaller: 175 PSI bronze, screwed end gate valve, Underwriters' Listed, OS&Y, Stockham Fig. B-133.

b. Drain Valve 2" and smaller: 200# bronze globe, renewable Teflon disc, screwed end, Stockham Fig. B-32.

2.04 PIPE HANGERS AND SUPPORTS

A. Support piping from structure with adjustable hangers:

1. For steel and cast iron piping 2" and Smaller: Grinnell Fig. 269, Fee and Mason Figure 202, Elcen Figure 202.

2. For steel and cast iron piping 2-1/2" and Larger: Grinnell Fig. 260, Fee and Mason Fig. 239, Elcen Fig. 12.

3. For copper tubing 2" and Smaller: Grinnell fig. CT-629, Fee and Mason Fig. 389, Elcen Fig. 389.

2.05 FLOOR DRAINS

A. Furnish and install floor drains where indicated on the Drawings. Floor drains shall be Josam, Jay R. Smith, Wade, Zurn, or Ancon.

1. On Grade Drains: Josam 30000-A cast iron body, bottom outlet, cast iron round adjustable strainer.

2. Chlorine Room: PPS 030, PVC body, bottom outlet, round adjustable strainer.

2.06 TRENCH DRAINS

A. Furnish and install trench drains and trench drain grates where indicated on the Drawings. Trench drains and trench drain grates shall be PolyDrain, or equal.

1. Trench Drain:

a. Precast trench drain constructed of polymer concrete composition complete with built-in 0.6% slope, outlets where indicated and polyseat installation brackets.

2. Trench Drain Grates:

a. Polydrain light duty fiberglass slotted grate constructed of FRP vinyl resin. Provide adequate number of grate lock down devices.

2.07 **CLEANOUTS**

A. Furnish and install Josam, Zurn, Wade or Jay R. Smith or Ancon cleanouts.

1. Floor Cleanouts:

a. Frame and cover threaded for 2" vertical adjustment, cast iron round frame and cover.

2.08 **BACKFLOW PREVENTER**

A. Furnish and install a backflow preventer as shown on Drawings.

1. 2" and Smaller: Watts Series 900-QT, or approved equal, reduced pressure type, with resilient seating ball valves.

2.09 **WALL HYDRANTS**

A. Furnish and install, where indicated on the Drawings:

1. Woodford Model 65, or approved equal, freezeless anti-contamination automatic draining wall hydrants with 3/4" hose nozzle, chrome finished brass casting and wall clamp.

2.10 **HOSE BIBBS**

A. Furnish and install where indicated on the Drawings:

1. Nibco Fig. No. 72, or equal, copper-to-hose, bronze body hose bibb, 3/4" size with vacuum breaker on hose outlet.

2.11 **EMERGENCY SHOWER/EYEWASH STATION**

A. Furnish and install where indicated on the Drawings:

1. Combination emergency shower and eyewash station: Haws Model 8324, or approved equal, with 10" cycolac plastic shower head and cycolac plastic bowl, floor flange and emergency sign.

a. Shower equipped with instant-action ball valve that stays open until manually closed; operated by rigid pull-rod with triangular handle; 1-1/4" IPS water supply.

b. Eyewash equipped with twin Soft-Flo anti-surge heads, ball valve that stays open until manually closed; operated by push plate, 1/2" IPS water supply and 1-1/4" IPS waste.

2.12 GAS PRESSURE REGULATORS

A. Furnish and install on gas service into each unit heater a Maxitrol 325-3 non-venting, 2 PSI to 7" W.C. gas pressure regulator.

2.13 SUMP PUMP UNIT

A. Furnish and install where indicated on the Drawings:

1. Weil Series 1600, or approved equal, duplex submersible sump pumps complete, NEMA 4 liquid level controls, alternator, starters, and control panel.

a. Pump and motor housings shall be water tight cast iron and shall have permanently lubricated double seal ball bearings.

b. Impeller shall be bronze, hydraulically and dynamically balanced.

c. Control panel shall include two (2) safety cut-out switches, two (2) automatic starters, an alternator and control transformer for 460/60/3 electrical service.

d. Alternator shall operate both pumps on an alternating basis and simultaneously if one pump cannot handle the inflow rate.

e. Float switches shall be Series 8230 mercury type complete with galvanized rod and switch mounting plate.

B. Sump pump controls shall include:

1. Level switches for pump stop, start lead pump, start lag pump.

2. Combination starters for each pump including properly sized overload heaters on each phase

3. Fused control transformer for each starter.

4. Alternator that alternates on de-energization.

5. Running time meters for each pump.

6. NEMA 4 control enclosure.

C. The pump controls shall comply with all applicable local and state ordinances as well as NEMA, UL 508 and National Electrical Code requirements.

D. Sump pump unit capacities and characteristics are scheduled on the Drawings.

2.14 FIRE SPRINKLER SYSTEM FOR CHLORINE ROOM

A. Fire Sprinklers

1. Furnish and install side wall, regular brass, automatic closed spray, U.L. approved sprinkler heads.

B. Shut-off valves

1. Furnish and install Kennedy Fig. 66 screwed iron body OS&Y gate valve, 175 P.S.I., U.L. listed and marked. Provide 125 VAC monitoring switch.

C. Water Flow Indicator

1. Furnish and install in the fire sprinkler zone supply pipe a water flow switch with two (2) single pole double throw switches and a pneumatic retard adjustment.

D. Pressure Gauge

1. Furnish and install on the fire sprinkler zone supply pipe an Underwriters' approved 4-1/2" dial type pressure gauge having a maximum limit of not less than twice the normal working pressure at the point where installed.

2.15 STRUCTURES

A. Concrete materials

1. Portland Cement A.S.T.M. C150, Type 1 sand-gravel A.S.T.M. C33. Maximum gravel size shall be 3/4 in., and water shall be potable. Mix design shall be subject to the approval of the General Contractor.

2. Buried concrete shall have a minimum 28 day strength of 3000 PSI.

B. Reinforcing steel.

1. Steel bars: A.S.T.M. A15, A16 and A305.

2. Wire mesh: A.S.T.M. A185.

C. Precast concrete rings and cone.

1. A.S.T.M. C478 or C76, Class I or II. Upper section or neck of cone shall be a special pre-cast shape made expressly for this purpose. Special structures, tee's, increasers, reducers shall be Class III or equal to the class pipe connecting to the structure, whichever is the greatest strength.

D. Castings.

1. Frames: Neenah standard casting No. R-2296 with slot.

2. Covers: Neenah standard casting No. R-1733 with lugs.

3. Steps: Cast aluminum alloy, minimum tensile strength 35,000 PSI. Ultimate tensile strength 40,000 PSI, yield strength 20,000 PSI, elongation 18 percent maximum. Brinell hardness 70.

PART 3: EXECUTION

3.01 EXCAVATION AND BACKFILLING

A. Excavate and backfill inside and outside of the building as required for piping and sump pump basin. All work shall be carefully protected from injury due to frost, water or other causes and any work injured shall be promptly and properly repaired. All underground work shall be inspected and approved prior to backfilling.

B. Backfill around piping shall be done with select granular materials as set forth in Section 02600 of these Specifications.

Backfill up to 2'-0" of cover over piping shall be placed by hand and tamped, being careful not to damage the work. Backfill shall be compacted to densities set forth in Section 02600 of these Specifications.

C. Provide dewatering as required to install mechanical work.

3.02 WASTE AND VENT PIPING INSTALLATION

A. Grading:

1. Pitch horizontal waste piping 1/4" per foot where possible, but in no case less than 1/8" per foot.

B. Traps:

1. Except as otherwise specified, all floor drains shall be installed without "P" traps.

2. The 8" drain from the bottom of the truck trench drain shall be installed as detailed on the Drawings complete with a cast iron "P" trap and cast iron waste to ductile iron pressure pipe transition coupling.

3. Provide PVC "P" trap with cleanout on waste drain from Chemical Room.

C. Cleanouts:

1. Install cleanouts at the foot of each waste line and at changes in direction in lines. The distance between cleanouts in horizontal runs less than 4" size shall in no case exceed 50 feet and 4" and larger shall not exceed 100 feet.

2. Extend floor cleanouts full size to the floor level with outlets fitted with trap screws and countersunk caps.

D. Roof Jackets:

1. Through-the-roof extensions of soil and waste stacks shall be cast iron from below the roof, at least 2 inch size and shall terminate 12 inches above the roof. Encase the extension in a frost proof jacket constructed with a roof flange of sheet lead not less than 4 PSF, suitable for roofing application.

E. Pipe Hangers:

1. Support horizontal hubless cast iron pipe at every joint and sway brace to prevent shear.

2. Support horizontal steel piping using 1/2" diameter rod on maximum 8 foot spacing.

3.03 SERVICE PIPING

A. Gas Piping:

1. Provide dirt pocket, shut-off cock and union in branch connection to each item of equipment. Install piping in accordance with AGA, NFPA and UMC.

2. Provide gas pressure regulators for 2 PSI inlet gas pressure in gas pipe to each unit.

3. Attach a tag to each gas pressure regulator including regulators at dehumidifier and generator, labeling the upstream gas service pressure as 2 PSI.

B. Fire Sprinkler Piping:

1. Install all valve, flow alarm, etc., as required to isolate and alarm the fire sprinkler system.

2. Furnish and install a 120 VAC tamper switch on O.S.&Y. valve.

3. Pitch all piping to drainage points.

4. Provide drain connection including an angle valve, pressure gauge and inspector's test plug.

C. Placement of Valves

1. Install valves at all service connections in all branch lines, at headers, at end of line equipment, and at such points as may be required for sectionalizing purposes.

D. Placement of Unions

1. Install unions at all piping connections to equipment.

E. Threaded Connections:

1. Make all joints in screwed piping with approved joint compound carefully applied to threads only.

2. Coat visible threads on galvanized piping with aluminum paint after assembly.

F. Pipe Sleeves:

1. Provide pipe sleeves where pipes and tubing pass through masonry walls. Sleeves in walls shall be zinc-coated schedule 40 steel pipe.

2. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/4". Seal the annular space between the pipe or tubing and the sleeve as follows:

   a. For pipe and tubing through Chlorine Room walls: 3M Brand fire barrier caulk or putty.

G. Pipe Hangers and Supports:

1. Install pipe hangers and supports as specified herein and/or indicated, conforming to manufacturer's standardization society Specification SP-58. Locate hangers and supports at changes in direction at concentrated loads. Hanger design shall permit vertical adjustment and lateral movement to allow pipe expansion.

2. Support horizontal steel piping as follows:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/4"	3/8"	8 Ft.
1-1/2" & 2"	1/2"	8 Ft.

3. Support horizontal copper tubing as follows:

Nom. Tubing Size	Rod Diameter	Maximum Spacing
Up to 1"	3/8"	6 Ft.
1-1/4" & 1-1/2"	3/8"	8 Ft.

4. Support pipe hangers from structure using appropriately secured attachments.

5. Support pipe hangers from concrete as follows:

   a. Loads to 400 pounds: Light weight concrete inserts, Grinnell Figure 285, Elcen Figure 86, Fee and Mason Figure 2570.

   b. Set inserts in concrete forms, coordinate locations in ample time to permit pouring of concrete as scheduled.

c. In areas where concrete slab will form finished ceiling, take care to have inserts finish flush with concrete slab surface and to make neat appearance.

6. Hanging from one pipe to another is prohibited.

3.04 CONNECTIONS TO MISCELLANEOUS EQUIPMENT

A. Make all service and drain connections to all equipment, whether furnished under this or other sections or by the Owner, including piping and shut-off valves on branches to and from each item of equipment from the service mains or branches.

B. Make allowances for variations in service and drain connections and locations as required for the equipment actually furnished.

C. Equipment furnished under other sections or by others:

1. Gas fired unit heaters (gas).
2. Dehumidifier (gas).
3. Generator (gas).

D. Make drain connection to outside air intake.

3.05 TESTS

A. General

1. All piping systems shall be tested after erection and before concealing or covering. The Contractor shall arrange and pay for all tests of mechanical systems as required by Code and as herein specified. Any materials or workmanship found faulty shall be immediately replaced or repaired and sections or systems retested.

2. Any damage resulting from leakage of piping during the testing or guarantee periods shall be repaired at the expense of this Contractor.

3. Tests shall be made in the presence of the appropriate inspectors or an authorized representative of the Engineer or Owner.

B. Plumbing Piping:

1. Test soil, waste and vent piping tight with air pressure of 5 PSIG for a period of 15 minutes. Final test piping after fixture installation with 1" W.C. air pressure.

2. Test service water piping water tight under 125 PSIG hydrostatic pressure for a period of two (2) hours.

C. Natural Gas Piping:

1. Air test gas piping at 50 PSIG for 24 hours with no drop in pressure or as dictated by local codes or ordinances, if greater.

D. Fire Sprinkler Piping:

1. Test fire sprinkler piping for a period of two (2) hours at hydrostatic pressure of 125 PSIG. All piping, valves, heads, and other components shall be watertight.

E. All piping shall prove absolutely tight under required tests.

F. Provide all gauges, tools, pumps, gas, air or other equipment required for testing.

G. Make operating tests of the plumbing systems.

H. Remedy all defects disclosed as the result of the tests. Repeat as necessary until test results are acceptable.

3.06 DISINFECTING

A. Disinfect the completed water piping system in accordance with Minnesota Health Department recommended procedures.

B. Treat the system with chlorine and flush with clean water. Open and close all affected valves during the disinfecting period. Repeat as necessary to pass required bacteriological tests.

3.07 STRUCTURE INSTALLATION

A. Excavation and backfill shall be as specified in Section 02600.

B. Seepage pit walls shall be pre-cast reinforced concrete rings or cones, pre-cast concrete segmental blocks, radial type blocks or cast-in-place concrete with required reinforcing.

1. Contractor shall have complete control of concreting operations in regard to slump, temperature, handling, additives, rate of pour, approval of form work, approval of steel placement, suitability of weather, etc.

C. Set all frames and rings to the required elevations in a full mortar bed.

END OF SECTION

SECTION 15800

HEATING, VENTILATING AND DEHUMIDIFYING

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor necessary for complete and functioning heating, ventilating and dehumidifying systems. The work consists of the following:

1. Chlorine Room ventilation system including air intake louver and damper, exhaust fan, and ductwork, chlorine scrubber, ductwork and vent stack.

2. Gas fired unit heaters including gas vents and controls.

3. Dehumidifier, ductwork, registers, outside air intake and exhaust air outlet.

C. Related Sections:

1. Section 15100 - Mechanical General Provisions
2. Section 15300 - Insulation
3. Section 15400 - Plumbing

1.02 REFERENCES

A. The following are complete titles of references cited in this Section:

1. Uniform Fire Code (UFC).
2. American Gas Association (AGA).
3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.03 SUBMITTALS

A. Test Results/Certificates - Submit the following test results and/or certificates in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Air handling systems Test and Balance Report.

2. The chlorine scrubber system supplier and the Contractor shall provide specific written certification that the various components of the chlorine scrubber system have been coordinated for physical connection, that the equipment components have been coordinated for operation, size and performance, and that the equipment components have been installed in accordance with the supplier's recommendation.

B. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Chlorine scrubber system.
2. Dehumidifier.

C. Shop Drawings - Submit Shop Drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Chlorine scrubber system.
2. Dehumidifier.
3. Unit heaters.
4. Power roof ventilator.
5. Damper actuator.
6. Gas vents.

1.04 QUALITY ASSURANCE

A. The equipment installations shall be in accordance with the Drawings and Specifications, written instructions of the equipment manufacturers and the Minnesota Mechanical code.

1.05 WARRANTY

A. The Contractor shall guarantee that the chlorine scrubber system will meet the requirements as specified herein when operated in accordance with the supplier's operating instructions.

1.06 BASIS FOR COMPENSATION

A. Compensation for all Work covered under this Section of these Specifications will be included under the lump sum Contract Price bid.

1.07 TESTING AGENCY CERTIFICATION

A. All electrical equipment furnished under this Section shall be labeled by a testing agency that is recognized by the State of Minnesota Board of Electricity.

B. The equipment shall be constructed in accordance with the testing agency standard(s) that applies to the approved label.

C. The testing agency label shall apply to the completed assembly. Equipment that utilizes labeled components but does not have a label for the completed assembly is not acceptable.

D. The following testing agency labels are acceptable:

1. Underwriter's Laboratories (UL):

a. UL508 - Industrial Control Equipment

2. Others as approved by the State Board of Electricity.

PART 2 - PRODUCTS

2.01 CHLORINE SCRUBBER SYSTEM

A. Furnish, install and place in operation where indicated on the Drawings a Powell Fabrication & Manufacturing Model 100C150, or approved equal, chlorine scrubber system including the following:

1. One ejector venturi chlorine scrubber with a reactor system.
2. Caustic soda storage/recycle tank.
3. One caustic soda recycle pump.
4. Mist eliminator.
5. Caustic soda recycle piping.
6. Scrubber system inlet.
7. Caustic soda storage/recycle tank fill and drain piping.

B. The chlorine scrubber system shall be installed to prevent the hazards from a chlorine leak from injuring people and the environment and shall be designed to meet the requirements of the 1988 Uniform Fire Code Section 80.

C. System:

1. All components of the chlorine scrubber system shall be supplied by a single manufacturer and shall be tank mounted.

2. The scrubber system supplier shall have a minimum of 5 years experience in the design and supply of emergency chlorine scrubber systems with five or more installations in the United States.

3. The scrubber system supplier shall have previously field tested the complete system using a minimum of 300 pounds of chlorine during the test. Results from emmission test shall be available.

D. Storage/Recycle Tank

1. The storage/recycle tank shall be a cylindrical, vertical, flat-bottom, flat top, tank capable of holding enough caustic soda to scrub the entire design leak.

2. The storage/recycle tank shall be constructed of premium grade Derakane 411-45 vinylester in corrosion barrier with isophthalic polyester resin in filament winding. A double nexus synthetic veil shall be provided on the inner surface and a BPO/DMA catalyst system with four hour post cure shall be utilized. Minimum dimension shall be 36" high by 72" diameter.

3. The tank shall be designed for a positive pressure of 10 inches water gauge and the weight of a 1.25 specific gravity liquid filled to the top of the tank.

4. All air connections shall be flanged with ANSI 150 pound drilling with a minimum 25 PSI design pressure per ANSI B16.5. All liquid connections shall be flanged and shall have 150-pound drilling with minimum 75 PSI design pressure.

5. The tank shall have a separate liquid level sight gauge with isolation valves. Option V.

6. The tank shall have scrubber mounting flanges.

7. The tank shall have pump mounting flanges.

E. Caustic Soda Recycle Pump

1. The caustic soda pump shall be a top flange mounted sump style pump.

2. The materials of construction shall be CPVC plastic with reinforced teflon bearings on the shaft.

3. Pump motor shall be TEFC, 208 volt, 3 phase, 60 cycle, 3500 RPM, 5 HP.

4. Rated duty of the pump shall be 40 GPM at 85 feet of head.

5. Acceptable Manufacturers: Vanton SGC - 300, or equal.

F. Ejector Venturi Scrubber With Reactor

1. The scrubber shall consist of one ejector type venturi with a field tested reactor system in which the motive liquid (caustic soda solution) induces the air flow draft and produces the scrubbing reaction for the absorption of chlorine in the recycled caustic soda solution.

2. The scrubber shall be a side gas inlet, bottom gas/liquid discharge and top motive liquid inlet.

3. The caustic solution pressure shall be a minimum of 40 PSIG at the inlet to each nozzle.

4. Flow rate of the caustic solution shall be a minimum of 40 GPM to each nozzle.

5. Each venturi/reactor system shall be capable of inducing a minimum of 150 CFM of air or 30 pounds per minute of chlorine gas into the chlorine scrubber system at a negative pressure of 0.5 inch W.C. measured at the venturi gas inlet.

6. Each spray nozzle shall be constructed of Teflon.

7. The reactor shall be mounted below the venturi spray nozzle and shall be constructed of kynar.

8. The venturi/reactor body shall be constructed of fiberglass Derakane 411/45 using the identical specifications as the fiberglass tank.

9. Caustic inlet shall be 3", gas inlet and venturi discharge shall be 6". All connections shall be 150 pound flanged connections.

G. Mist Eliminator

1. The mist eliminator shall be sized to remove entrained droplets from the recycled gas stream and prevent fogging in the outlet vent to atmosphere during operation at full design air flow through the chlorine scrubber system.

2. The mist eliminator shall be vertical, up flow in arrangement with baffled gas inlet, housing drain, flanged body for media removal, and flanged gas inlet and outlet.

3. The body of the mist eliminator shall be made of fiberglass reinforced vinylester resin, Derakane 411-45 with a double nexus veil in the inner corrosion layer and BPO/DMA catalyst system with 4-hour post cure.

4. The mist eliminator media shall be made of Kynar.

5. The mist eliminator shall have top and bottom media support grids made of FRP vinylester resin.

6. The unit shall be designed for a positive pressure of 10 inches water gauge with a 5 to 1 safety factor.

7. Acceptable Manufacturers: York, Koch, or equal.

H. Pump Discharge Piping

1. All pipe and fittings shall be CPVC schedule 40 socket weld or equal.

2. All valves shall be CPVC schedule 40 socket weld ballvalves or CPVC butterfly valves with EPDM seats. Chemtrol or equal.

3. All pipes shall be adequately supported and braced to withstand the loads due to hydraulic thrust created by starting pump with valve wide open.

I. Nozzle Pressure Gauge

1. A pressure gauge shall be provided for the indication of nozzle pressure. It shall be connected to the discharge piping with an isolation valve. The

gauge shall be an Ashcroft 1279ASL 4.5" 100 PSIG gauge with silicone oil fill and Mansfield and Green type SSC chemical seal, or equal.

J. Inlet and Return Air Ductwork

1. All inlet piping shall be fiberglass reinforced plastic (FRP) pipe and duct or PVC Type 1 fume duct and fittings with socket welded joints.

K. Painting

1. All steel (except stainless steel) and iron surfaces shall be protected by paint or coatings applied on all surfaces using Sherwin Williams Tile Clad II epoxy system, or equal.

2. All other equipment shall be provided in the manufacturer's standard color.

L. Environmental Conditions

1. The chlorine scrubber systems will be located indoors in a non-air-conditioned atmosphere that will not be less than 32 degrees F.

M. Operation

1. In the event of a chlorine leak, chlorine detector in the chlorine storage room will sense chlorine gas and:

   a. Activate the chlorine scrubber system.

   b. De-energize the normal ventilation system in the chlorine storage room.

   c. Activate local and remote alarms.

2. Activation of the chlorine scrubber system will:

   a. Start the caustic soda recirculation pump which circulates weak caustic soda through the ejector venturi scrubber with field tested reactor system. The ejector venturi scrubber induces air flow from the chlorine storage room through the chlorine scrubber system duct work.

b. Scrub the contaminated air of gaseous chlorine below the ejector venturi scrubber in the reactor chambers. Neutralize the chlorine by reaction with the weak caustic soda solution producing sodium hypochlorite as an end product.

c. Discharge the dechlorinated air and the scrubbing solution to a caustic soda storage/recycle tank.

d. Pass the treated air through a mist eliminator and to the outside atmosphere.

e. Recycle the liquid discharged from the ejector venturi scrubber after reentering the caustic soda storage/recycle tank until the chlorine concentration in the chlorine storage room is reduced to a level below 1 PPM.

3. After the scrubbing operation is complete, the caustic soda recirculation pump shall turn off, and the ventilation system serving the Chlorine Room shall be re-energized.

4. The caustic soda storage/recycle tank shall be filled manually with caustic at the top of the tank. Dilution water shall be added at the top of the recycle tank to fill the tank to the recommended level. Dilute caustic solution may be purchased at the desired strength and added to the tank without additional dilution.

5. Spent caustic soda shall be transferred to a caustic soda storage tank via the caustic soda recirculation pump.

N. Factory Testing

1. All major system components shall be factory tested for compliance with the construction and functional requirements specified herein, and certification of the results of these tests shall be submitted to the Engineer prior to delivery of the equipment.

2. The scrubber shall be air tested with water at the factory under design conditions continuously for 4 hours. After completion of the test, the vessel shall be thoroughly inspected for evidence of failure.

3. The manufacturer shall record test results. Written certification of the tests shall be presented to the Engineer. The manufacturer shall notify the engineer of the test date at least 14 days prior to commencing testing so that the engineer, at his discretion, may attend the test.

O. Preparation for Shipment

1. Insofar as practical, the chlorine scrubber system equipment shall be factory assembled. The parts and assemblies that are of necessity shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.

2. The caustic soda storage/recycle tank, caustic soda recycle pump, mist eliminator and interconnecting piping shall be integrally mounted on the tank.

P. Submittals

1. The chlorine scrubber system supplier shall submit the following information for approval before equipment is placed in production:

   a. Shop drawings of system showing mounting details, equipment outline dimensions, fitting size and location, operating weights of all equipment and sufficient information to allow the engineer to check clearances, tie-ins, and general conformance with this specification.

   b. Materials of construction of all equipment.

   c. Manufacturer's catalog data, operating literature, specifications, performance data and calibration curves for caustic soda recycle pump, ejector venturi scrubbers, and auxiliary components.

   d. Complete wiring diagrams in sufficient detail to allow installation of the electrical components.

2. Submit design calculations to show:

   a. The pressure in the chlorine storage room never exceeds atmospheric pressure from the beginning of the design leak event to the time the scrubber system shuts off.

b. That the system is capable of withstanding the imposed environmental loads specified.

c. That the unit is capable of withstanding hydrostatic loads of shop tests and the field conditions of being filled to the top of the caustic soda storage/recycle tank.

d. The minimum amount of caustic required to scrub the total amount of chlorine. Calculations shall include nozzle flow rates, chlorine flow and weight percent of caustic from the beginning to the end of the scrub cycle.

e. The amount of caustic reacted during a test cycle of 15 minutes per week assuming no chlorine is absorbed.

f. The maximum temperature of the recycled scrubbing solution during the design leak event.

g. That the recycle pump and recycle piping are adequate to handle the required liquid flow, pressures, and temperatures.

3. Submit operation, and maintenance instruction (O&M manuals). The instructions shall include, but not be limited to:

a. Installation, handling, and storage instructions for the scrubber system components.

b. General descriptions of operating principles and requirements.

c. General descriptions of equipment.

d. Startup, shutdown, and operating procedures.

e. Operating sequence.

f. Test sequence.

g. Periodic inspection and maintenance procedures.

h. Trouble-shooting procedures.

i. Spare parts list.

4. Submit results of full-scale tests conducted with similar equipment and a similar leak event which demonstrates the supplier's ability to provide a scrubber system which meets the performance requirements.

Q. Design Leak

1. The chorine scrubber system shall have the capacity to treat the entire contents of two over-filled 150 pound containers, approximately 352 pounds total.

2. The design leak basis shall be that the entire contents of the container leaks out of the containers within 30 minutes.

R. Performance Requirements:

1. The chlorine scrubber system shall contain the entire leak within the chlorine storage room and the scrubber system.

2. The chlorine scrubber system shall be sized to treat the design leak and reduce the chlorine concentration in the Chlorine Room to less than 1 PPM.

3. The chlorine scrubber system shall be of a single pass basis, recovering the chlorine from the containment room, absorbing it in the system, and venting the inert gases to atmosphere with the chlorine concentration not to exceed 15 PPM as required by the UFC section 80 code.

4. Minimum gas flow rate through the scrubber system shall be 150 SCFM.

5. Caustic soda solution concentration (%NaOH, by weight):

Minimum	20 percent
Maximum	25 percent

6. Chlorine storage room volume basis:

17.2 ft. high x 14 ft. long x 17 ft. wide.

2.02 DEHUMIDIFIER

A. Furnish, install and place in operation where indicated on the Drawings a Bry-Air MVB-60-D Series, or approved equal, dehumidifier unit with flexible connectors, filters, volume dampers, control panel, and all necessary

controls for proper operation of the system. The dehumidifier unit shall be arranged to provide continuous dehumidification with constant outlet temperature and humidity for a given inlet condition. The unit shall be a two compartment desiccant type with process and regenerative sections.

1. Unit shall be capable of sustained operation of either process or react fan without energized react heat for prolonged periods of operation without damage to the humidity transfer media or bed contactor.

2. The dehumidifier shall be of solid desiccant sorption type employing a number of desiccant chambers rotated in a carousel formed by a plurality of modular desiccant beds, each bed not to exceed 4 inches in thickness.

3. Dehumidifier shall be a fully automatic factory assembled package unit complete with reactivation heaters, filters, motors, fans, desiccant bed drive assembly, access panels, volume dampers, weatherproof or dust-tight automatic electrical panel, desiccant beds complete with charge of desiccant installed, and all component auxiliaries as recommended by the manufacturer for safe unattended automatic operation.

4. Unit shall not require desiccant charging, pneumatics, or field erection of fans.

5. The desiccant material shall be absorbent, nontoxic, non-flammable, with no asbestos in desiccant media or desiccant container. It shall have long life with adequate air filtration. Each unit shall be equipped with a positive drive arrangement to insure slip-free rotation at an adjustable rate of speed. The bed drive arrangement shall not contain any belts or other devices inconsistent with good mechanical practice.

6. The process and reactivation sections shall be divided by seals designed for long life. The positive sealing arrangement between process and reactivation sections shall permit independent air flow and shall not require balancing of process and reactivation air flows within the unit. Seals shall be removable and access shall be provided to facilitate inspections.

7. The unit casing shall be substantially constructed of sheet metal panels reinforced as required to provide a rigid housing for the unit. The casing shall be constructed so as to facilitate internal inspection or observation and to allow access for inspection or servicing without disconnecting ducting or electrical wiring. An observation window shall be provided to permit visual inspection of the beds while the unit is in operation. Both reactivation air fan and process air fan shall be factory mounted on the dehumidifier. The reactivation and process air fans shall be arranged so as to provide counter flow air streams.

8. The modular beds shall be designed to permit easy removal from the carousel. Desiccant replacement shall be accomplished by means of a fill hole at the top and an emptying hole at the bottom of each modular bed segment. Desiccant replacement shall be done without vacuuming, removing beds from the unit, disturbing seals or otherwise upsetting a proper mechanical package during the desiccant replacement. To reduce abrasive effects and deterioration, the sector seals shall not come into contact with the perforated bed screens or the desiccant media.

9. Reactivation heat for the dehumidifier shall be direct fired gas. Furnish gas heating section complete with gas pressure regulator designed for 2 PSIG inlet gas pressure.

10. Control panel shall contain factory mounted and wired fan motor starters and auxiliary controls, plus a factory mounted and wired terminal strip within the panel conveniently located on the dehumidifier. Both process and reactivation air fans and motor assemblies shall be factory mounted on a tubular structural steel base common with the dehumidifier. Starting the stopping of the unit shall be sequenced by a humidistat furnished by the dehumidifier manufacturer with provisions made for its connection on the terminal strip of the control panel.

B. Filters

1. All air entering the dehumidifier must be filtered. Filters shall be Duralast, or equal, with minimum 35% efficiency and of a size and capacity as recommended for air shown. Filters shall be installed for front removal. All filters shall be permanent type.

C. Volume Dampers

1. All volume dampers on the dehumidifier shall be of multiblade, opposed blade type with locking quadrants. Dampers shall be factory installed at the outlets of both process and reactivation air fans. The damper shaft exposed at the quadrant shall be notched to indicate position of damper blades.

D. Electrical

1. Unit shall operate on 460 volts, 3 phase, 60 hertz. An integral control transformer shall be provided and installed in the control panel.

2. Control panels shall be factory prewired for the system operation and shall be supplied with fuses, contactors, starters, control transformer, overload protection, and all necessary components to insure continuous automatic operation. Manual-off-auto switch shall be provided on dehumidifier panel.

3. A line voltage humidistat shall be furnished for unit mounting.

E. The dehumidifier shall have 6,000 CFM process air capacity. Reactivation air capacity shall not exceed 33% of the total air flow. Both process air fan and reactivation air fan shall have external static pressure of 1.0" of W.G. and 0.75" of W.G., respectively. Dehumidifier shall be capable of removing 201 lbs/hr moisture per hour with inlet air condition of 75^{O}F dry bulb, 69.5^{O}F wet bulb temperature with 100 grains of moisture per pound of dry air.

2.03 UNIT HEATERS

A. Furnish and install where indicated on the Drawings Reznor, Applied Air Systems, Hastings, or approved equal, indirect natural gas fired, horizontal suspended unit heaters. Each unit heater shall be A.G.A. certified and shall include:

1. Steel cabinet, 10 gauge, with hanger connections and baked enamel finish.

2. Air distribution louvers with four-way adjustability.

3. Aluminized steel heat exchanger.

4. Stainless steel ribbon burners.

5. Blower type fan and fan mounted belt drive motor with overload protection, for 120 VAC electrical service.

6. Gas cock and pilot valve.

7. Complete 24 volt control system including electric spark ignited intermittent pilot with 100% safety shut-off, electronic flame supervision, 24 volt automatic gas valve, transformer, high limit and fan delay controls.

8. Line-voltage thermostat for remote mounting.

B. Unit heaters are based on Reznor Model B50. Each unit heater shall have an input capacity of 50,000 BTU/HR. and an output capacity of 40,000 BTU/HR. circulating 820 CFM with 1/6 HP motor.

2.04 POWER ROOF VENTILATOR

A. Furnish and install where indicated on the Drawings, Greenheck, Acme, Penn, or approved equal, centrifugal roof exhauster, AMCA certified. Ventilator shall have backward curved blade fan, motor, mounting base, detachable hood, discharge baffles, bird screen, vibration isolation, safety disconnect switch and internal wiring post. All exposed parts of units shall be aluminum. Steel supporting parts and other internal steel framework shall be prime coated.

1. Variable pitch V-belt drive or direct drive as scheduled.

2. Single phase motor shall be capacitor start with built in overload protection.

3. Lubrication and belts shall be suitable for low temperature operation.

4. Provide solid state speed controller for direct drive unit and mount on fan housing.

5. Provide electrically actuated dampers and damper actuator. Damper shall be normally closed.

B. Capacities and characteristics are scheduled on the Drawings.

2.05 CONTROL DAMPER

A. Furnish and install where indicated on the Drawings, Cesco, Ruskin, Greenheck, or approved equal, frame mounted rectangular control damper. Damper axle shall be extended for motor actuator attachment.

B. Damper shall be louver size.

C. Damper shall be mounted in the air intake to the Chemical Room.

2.06 DAMPER ACTUATOR AND CONTROL

A. Furnish and install Honeywell, Barber Colman, Robertshaw, or equal, 120 volt electric actuator for damper above of ample output for actuation and shut-off.

1. Damper shall be normally fully closed and shall fully open whenever fan EF-1 is energized.

2.07 FLEXIBLE CONNECTIONS

A. Duct connections to dehumidifier shall be Ventglas, or equal, double neoprene coated, fire retardant fabric.

2.08 GAS VENTS

A. Furnish and install, for all indirect gas fired heaters, Metalbestos Model RV, or approved equal, galvanized steel double wall pipe and fittings including tee, roof thimble, storm collar and stack cap.

2.09 REGISTERS

A. Furnish and install all registers where shown on Drawings and as described herein. Provide registers with opposed blade volume control dampers, key operated.

B. The following schedule indicates Titus catalog numbers as manufactured by Price, Anemostat or J. & J. Register are acceptable.

1. Supply Registers (SR): Titus 272-RS extruded aluminum register with double deflection adjustable vertical face and horizontal rear vanes, 1-1/4" margin, opposed blade damper.

C. Finishes: Registers shall have prime coat finish.

PART 3 - EXECUTION

3.01 DUCT ARRANGEMENT

A. Except where otherwise required by conditions of installation, install all ductwork symmetrical and/or parallel with lines of the structure. Work duct carefully into place without springing or forcing.

3.02 SHEET METAL WORK

A. Provide all sheet metal ductwork in conjunction with the project.

B. Provide offsets, elbows, and transformations in ductwork as required for a complete installation.

C. Construct ducts from zinc coated sheet steel in accordance with SMACNA duct construction standards with gauges and reinforcing as follows:

GAUGE US STANDARD	MAXIMUM SIDE INCHES	TRANSVERSE JOINT	INTERMEDIATE BRACING	CENTERS
26	Up to 12"	"S" Drive or Slip	None	
24	13" to 18"	"S" Drive or Slip	None	
24	19" to 30"	1" Bar Drive	1"x1"x1/8 angles	5'-0"
22	31" to 42"	1" Bar Drive or Slip	1"x1"x1/8 angles	5'-0"
22	43" to 48"	1-1/2" Bar Drive or Slip	1-1/2"x1-1/2"x1/8" angles	4'-0"

D. Cross break sheet metal surfaces of rectangular ducts 18 inches and larger in size.

E. Curved elbows shall have a centerline radius equal to 1-1/2 times the duct width.

F. Square turn elbows shall be fitted with turning vanes conforming to SMACNA standards. Vanes shall be double thickness, fastened to runners and adequately braced.

3.03 DUCT HANGERS AND SUPPORTS

A. Securely anchor all ductwork to the building construction in a manner to be free from vibration and swaying under operating conditions.

B. Hangers shall be galvanized strips or band iron spaced and attached in accordance with SMACNA recommendations.

3.04 CHLORINE SCRUBBER SYSTEM INSTALLATION

A. The chlorine scrubber system shall be installed in the approximate location shown on the Drawings.

B. Install ductwork in the approximate locations shown on the Drawings.

3.05 ACCESS PANEL

A. Fabricate and install duct access panel for access to the motorized damper. Panel shall be located and adequately sized for the purpose. Minimum panel size shall be 18" x 18" or 2" less than the duct size will permit.

B. Attach panels using zinc-plated cam latches, two (2) for sizes to 18" x 18" and four (4) for larger sizes. Seal edges with polyurethane foam.

3.06 FLEXIBLE CONNECTIONS

A. Make duct connections to dehumidifier with fabric connections. Allow 1" slack. Attach with steel clamping bands and adhesive for airtight connection.

3.07 UNIT HEATER INSTALLATIONS

A. Support each unit heater from the structure using angle or channel iron. Maintain maximum clear height beneath the unit.

B. Adjust vertical louvers for air flow parallel to the exterior walls and horizontal louvers for 30^{o} down discharge.

3.08 GAS VENT INSTALLATIONS

A. Terminate gas vent from each indirect gas fired unit heater at height above the roof as indicated on the drawings with a stack cap.

3.09 DEHUMIDIFIER INSTALLATION

A. Install the dehumidifier in the approximate location shown on the Drawings.

3.10 AIR BALANCING

A. Adjust the exhaust air flow for fan EF-1 and the supply air flows from the dehumidifier. Set fan speeds and volume controllers to meet indicated air flows.

B. Submit two (2) copies of a complete test report to the Engineer prior to final acceptance of this project. Submittal data in tabular form shall include:

1. Air volume at each supply air outlet.

2. Air volume for exhaust fan.

3. Electric motor nameplate HP, voltage, phase, amperage rating and running amps for each motor.

3.11 CHLORINE SCRUBBER SYSTEM FIELD TEST

A. Upon completion of installation, the scrubber system shall be tested for conformance with performance requirements and the design calculations.

B. Prior to startup, all equipment shall be inspected for proper alignment, quiet operation, and proper connection.

C. Testing does not require leaking of chlorine in either the chlorine storage room or the chlorine feed room, except to activate the chlorine leak detectors.

D. Field testing shall include measurement of at least the following:

1. Gas flow rate.
2. Caustic strength of the scrubbing solution.

E. The Contractor shall test the unit to demonstrate that all components function properly and that the unit creates air flow as specified.

3.12 CHLORINE SCRUBBER SYSTEM TRAINING

A. Contractor shall provide for 8 hours of training of Owner's designated personnel in the operation and maintenance of the chlorine scrubber system including all components provided under this contract.

B. Training shall consist of both classroom and hands-on sessions conducted at times and locations acceptable to the Owner.

C. Contractor shall designate a person responsible for scheduling and coordinating all training.

3.13 INSTALLATIONS SPECIFIED UNDER OTHER SECTIONS

A. Unless otherwise noted in Division 15, motor starters, starting switches, disconnects and power wiring will be provided under Division 16.

B. Unit heater thermostats will be installed and wired under Division 16.

C. Gas piping connections to each unit heater and dehumidifier will be provided under Section 15400.

END OF SECTION

DIVISION 16 - ELECTRICAL

16010 ELECTRICAL GENERAL PROVISIONS

16100 BASIC MATERIALS AND METHODS

16200 POWER GENERATION AND DISTRIBUTION

16400 ELECTRICAL SERVICE

16500 LIGHTING

16700 SPECIAL SYSTEMS

16900 STARTERS AND MOTOR CONTROL

16950 INSTRUMENTATION AND CONTROL

SECTION 16010

ELECTRICAL GENERAL PROVISIONS

PART 1: GENERAL

1.01 DESCRIPTION

A. All work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. This Section includes general requirements and provisions relating to the electrical work.

1.02 REFERENCES

A. National Fire Protection Association

1. NFPA 70 National Electrical Code (NEC) 1990

1.03 GENERAL

A. The work included in the project shall include the furnishing of all required labor and materials for a complete and operable electrical system as indicated on the accompanying drawings and as required by the project manual inclusive of all appurtenances not specifically shown or covered by the Specifications but required for complete operation of the electrical system as defined in the documents. The work shall also include the testing, adjustment, start-up and troubleshooting of the electrical equipment and the training of the Owner's operating personnel in its operation and maintenance.

B. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the contract documents.

1.04 VERIFICATION OF DRAWINGS

A. The contract drawings indicate the required size of conduit and cable for wiring. The locations of equipment shall be verified in the field by the Contractor. In the event it should become necessary to change the loca-

tion of any work due to interference with other work, consult with the Engineer before making any changes. The Contractor shall determine and be responsible for the proper location and character of all anchor bolts, inserts, hangers, sleeves, etc. for the electrical equipment, unless specifically detailed otherwise.

1.05 NAMEPLATES

A. Each piece of equipment shall have a standard nameplate securely affixed in a conspicuous place, showing the manufacturer, model number and serial number as is applicable. The nameplate of the distributing agent only will not be acceptable.

1.06 QUALITY

A. All work shall be installed by skilled mechanics in a neat and workmanlike manner and shall be approved by the Engineer before final acceptance by the Owner.

B. If equipment is furnished having power and control requirements other than as specified, the Contractor shall make all necessary changes and furnish a complete set of drawings for installing the alternate equipment. The installation shall comply with the requirements of the 1990 edition of the National Electrical Code, local and state codes and ordinances. Where the contract documents call for workmanship or materials in excess of code requirements, the project manual shall take precedence. Electrical equipment and materials shall be Underwriter's Laboratory approved, where U.L. standards for such products exist.

C. All equipment to be installed on the project shall be new and unused.

1.07 GUARANTEE

A. The Contractor shall guarantee the operation of the installation and that the materials and workmanship of the equipment be free from defects for a period of one (1) year from the date of acceptance, providing the equipment has been operated and maintained in accordance with the manufacturer's recommendations. The guarantee shall include all parts and labor necessary to return the system to normal operation. The guarantee on all equipment shall start after formal acceptance of equipment as defined by the General Conditions and after successful completion of start-up procedures.

PART 2: NOT APPLICABLE

PART 3: EXECUTION

3.01 GENERAL

A. The following items shall be included in the work to be done:

1. All work shall be under the direct supervision of a master electrician.

2. Furnish permits as required for electrical construction. Pay all electrical inspection charges for the construction.

3. Furnish and install all power, control, signal and instrumentation conduit and cable.

4. Furnish and install the ground system and complete all grounding connections.

5. Furnish and install lighting fixtures and convenience outlets complete with fixtures, switches, receptacles, cable, conduit and other necessary material.

6. Furnish and install electrical equipment as specified in accordance with the manufacturer's recommendations, instructions and directions. All equipment shall be properly protected during construction.

7. Mount all floor mounted equipment on concrete pads, whether inside or outside buildings, unless shown otherwise.

8. Furnish and install conduit and cable, and other material and electrical equipment control as required for the heating, ventilating, air conditioning equipment, etc.

9. Complete all connections and test operate the equipment in cooperation with the Owner, the Engineer and others working on the project.

10. The Contractor shall furnish and install control devices, instrumentation, all electrical wiring to the proper terminals of all control devices and instrumentation, including devices furnished by others, to obtain successful operation of the equipment.

11. Provide temporary wiring for construction use including ground fault protection in accordance with the 1990 National Electrical Code.

12. Furnish, install and wire the power generation equipment.

3.02 INSPECTION

A. The Contractor shall inspect all the electrical equipment and shall notify the Engineer in writing before the equipment is installed if the equipment appears to be deficient in fit, form or function.

3.03 CONSTRUCTION

A. The Contractor, under this portion of the contract, shall be responsible for all cutting, patching, excavation, backfill, sleeves, chases, openings, etc. for equipment specified in this portion of the contract documents or for cable and conduit and associated electrical equipment that is specified in this portion of the contract documents to serve equipment that is provided by a different portion of these documents. If the Contractor provides equipment that has power and control requirements that are different from those specified, then that Contractor shall be responsible for any additional costs incurred for engineering, construction, and all wiring changes required to make the alternate equipment perform per the intent of the contract documents.

B. All patching, cutting, etc. shall have a finish that is compatible with the final finish of the remainder of the surface and shall meet with the approval of the Engineer.

3.04 CONSTRUCTION WIRING AND LIGHTING

A. The Contractor shall furnish and install complete temporary wiring and lighting for the construction of the project.

B. The wiring shall include power centers for miscellaneous tools and equipment used during construction work located so power is available no more than 100 feet from any working point. The wiring shall be sufficient for the tools, shall maintain grounding continuity, shall have circuit breaker or fuse protection, shall have ground fault protection per applicable codes and regula-

tions. Power shall be provided to temporary heating, ventilating, air conditioning, welding units, and other equipment of the various workers.

C. The Contractor shall make all arrangements with the utility and shall pay the costs of temporary power including costs of installation, maintenance, energy costs, and removal of the system. The Contractor shall not make use of the Owner's service without written permission by the Owner.

D. The Contractor shall provide work light, safety lighting, and security lighting. The lighting shall meet all safety codes and regulations. Lighting shall be not less than 20 footcandles. Additional light shall be installed for hazardous areas, for security applications, and for construction processes where visual acuity is required.

E. All temporary lighting and power shall use U.L. approved devices and all systems shall meet safety requirements of the National Electrical Code and other applicable ordinances.

3.05 FIELD TESTING

A. Field testing shall be performed as specified under the detailed specifications for the specific equipment item and also in accordance with requirements of Division 1 for overall testing.

3.06 INSTALLATION

A. Each item shall be furnished complete and installed in accordance with the manufacturer's recommendations, instructions and directions. All installed equipment shall be properly protected during subsequent construction operations.

B. Oil, grease and other fluids necessary for initial operations shall be provided by the Contractor in quantities and grades recommended by the manufacturer.

C. All material shall be new, undamaged and conform to the latest standards for the applicable equipment.

D. The Contractor shall provide all scaffolding required for the proper installation of this work in conformance with the standards of all local and state safety codes applying to scaffolding.

E. Cooperate with other trades to avoid interferences in the installation of this work. Install all equipment and systems so as not to delay progress of construction and correlate with other trades to avoid delay.

3.07 INSPECTION, START-UP AND ADJUSTMENT

A. The manufacturer or single source supplier of equipment included in each section shall inspect the completed installation, make all necessary adjustments, corrections or modifications prior to start-up as authorized by the Engineer. After start-up, the manufacturer shall make all final adjustments necessary for the intended use of the equipment and certify in writing that the equipment has been properly installed and adjusted and is operating satisfactorily.

3.08 WRITTEN REPORT

A. Upon completion of the requirements of Articles dealing with erection, field testing, and inspection, three (3) copies of a written report shall be submitted to the Engineer confirming completion of all requirements and outlining any special instructions for the operation or maintenance of the equipment in each section. This report shall be signed by the Contractor and the manufacturer or his agent.

3.09 OPERATOR TRAINING

A. Provide the minimum number of hours of operator training as specified in each section on the proper use and maintenance of the equipment. The hours shall not necessarily be consecutive. Time of operator training shall be coordinated with and agreeable to the Owner.

3.10 EXISTING EQUIPMENT

A. Any existing equipment that is removed, abandoned or disconnected shall remain the property of the Owner unless the Owner directs, in writing, that the equipment be surrendered to another party. The Contractor shall dispose of any equipment at the Owner's direction. The disposal of the equipment shall be to an Owner's vehicle or the Contractor shall promptly remove the equipment from the site if the Owner surrenders it to the Contractor.

END OF SECTION 16010

SECTION 16100

BASIC MATERIALS AND METHODS

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor to construct a complete wiring system including conductors, cable, conduit, boxes, fittings, devices, and related equipment.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):

1.	NFPA 70	National Electrical Code (NEC) 1990

B. Underwriter's Laboratories (UL)

1.	UL5	Surface Metal Raceways and Fittings
2.	UL50	Cabinets and Boxes
3.	UL83	Thermoplastic Insulated Wire
4.	UL360	Liquid-Tight Flexible Steel Conduit
5.	UL514	Outlet Boxes and Fittings

C. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250	Enclosures for Electrical Equipment
2.	NEMA WD1	Wiring Devices

1.03 QUALITY ASSURANCE

A. All material shall meet the requirements of the National Electrical Code (N.E.C.), National Electrical Manufacturers Association (NEMA) specifications and local codes and ordinances, and shall be Underwriter's Laboratories listed, where U.L. standards for such products exist.

1.04 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Conductors
2. Signal cable
3. Wire identifiation
4. Conduits, fittings, and boxes (all types specified)
5. Devices

PART 2: PRODUCTS

2.01 CONDUCTORS - COPPER - 600V

A. Conductors shall be of soft drawn, annealed copper, having a conductivity of not less than 98% of pure copper. Conductors shall be NEMA Class B stranded. The conductors shall conform to UL standards.

B. The minimum size for wiring shall be #12 AWG copper, unless shown otherwise. All conductor sizes are based on copper with THWN insulation rated at not less than 75 deg C and suitable for wet and dry locations unless noted otherwise.

C. All circuits shall be installed using wire with 600V insulation, unless wire with a different voltage rating is indicated. The insulation, as a minimum, shall have a conductor rating of not less than 75 deg C in both wet and dry locations. All cable shall have the same type of insulation by the same manufacturer throughout the project.

D. #12 or #10 power conductors may be single strand. Control cable and all other power cable shall be stranded.

2.02 SIGNAL CABLE

A. Conductors shall be not less than 16 gauge, 7 strand min., Class B, tin coated concentric bare copper wire with a 15 mil (nominal) 90 deg. C PVC primary insulation. The conductors shall be shielded with .35x5 mil (min.) 100% coverage aluminum or copper mylar tape shield, or equal, and an 18 gauge strand copper wire drain wire. The outer jacket shall be 20 mils (nominal) 75 deg. C PVC suitable for wet or dry locations. The Contractor shall verify the application of shielded cable with each instrument manufacturer and receive approval for the type he proposes to supply.

2.03 WIRE IDENTIFICATION

A. All power, control, and signal wires that terminate at the motor control center or control panels shall be identified by tags permanently attached to the wire. Each wire shall be tagged at each end, including field terminations. The tags shall bear the terminal numbering assigned by the equipment manufacturer.

B. The wire markers shall be one of the following:

1. Raychem "TMS" with "Permatizer".
2. Brady "Bradysleeve".
3. Thomas & Betts "Shrink-Kon HVM".
4. or equal.

2.04 CONDUITS, FITTINGS, BOXES AND DEVICES

A. The Contractor shall supply conduit, couplings, connectors, junction boxes, fittings and all other required items for a complete raceway system. The conduit fills indicated in the contract documents are based on copper conductors with THWN insulation suitable for 75 deg C insulation in wet or dry locations. The Contractor shall resize conduits for other conductor and/or insulation systems, if approved. The conduit shall be reamed and cleaned and made free of burrs. Exposed conduit runs shall be straight and true with the building lines and elbows, bends and offsets shall be uniform and symmetrical. All conduit runs shall be installed with adequate means for drainage provided at the low points.

B. Rigid Steel Conduit:

1. The conduit used shall be rigid steel (RS or RSC); hot dipped galvanized, including the threads. Unless specified otherwise the conduit shall not be smaller than 3/4". The conduit shall bear the U.L. label.

2. Job site threading need not be galvanized. However, job site threading shall be painted with oil base primer to prevent oxidation of the threads.

3. The use of 'threadless' connectors with rigid steel conduits is not acceptable.

4. Intermediate Metal Conduit (I.M.C.) shall not be acceptable.

C. PVC Conduit - Schedule 80:

1. Where shown, the Contractor shall furnish and install schedule 80 PVC conduit. The conduit shall be supported as recommended by the manufacturer or as required by applicable codes and ordinances, whichever is the more stringent. The conduit shall be composed of high impact PVC and shall be rated for 90 deg C wire. The conduit shall be listed for underground, encased, and exposed applications. The PVC conduit system shall contain fittings for connecting the system to cast junction boxes and other devices as required.

2. Wherever a PVC conduit system is used the Contractor shall furnish and install copper ground conductors. The conductors shall be continuous with no splices or joints unless permitted by the National Electrical Code. The size of the ground conductor shall be as required by the National Electrical Code or as shown on the drawings, whichever is more stringent.

3. The conduit shall bear the U.L. label.

4. PVC conduit is permitted only where specifically shown. All other areas must be wired utilizing rigid steel or as required by the contract documents.

D. Flexible Sections:

1. Unless equipment is factory wired, the conduit system shall be joined to the equipment with waterproof flexible metallic conduit. The conduit shall be cold rolled steel, galvanized strip shall meet the requirements of a one minute Preece dip test. The galvanized flexible conduit shall be covered with 40 mils ± 5 PVC coating. The tensile strength of the PVC shall exceed 1600 psi. The flexible conduit shall be connected to the equipment and conduit system with waterproof, oil proof and dust proof connectors which are designed for use with the flexible conduit installed. All flexible conduit and fittings shall be U.L. approved. The minimum and maximum lengths of flexible connectors shall be sixteen (16) and thirty (30) inches respectively. The flexible conduit shall not be used for grounding equipment. A separate conductor in accordance with N.E.C. Section 250 shall be installed inside the flexible section.

E. Boxes - Cast:

1. Outlet and junction boxes shall be of the weatherproof, galvanized cast, ferrous alloy type with threaded hubs for use with rigid steel conduit. The boxes shall bear the U.L. label.

2. Manufacturer/Style

   a. Crouse-Hinds Type FS
   b. Appleton Type FS
   c. Or Equal

F. Boxes - PVC:

1. Where schedule 80 PVC conduit is required, outlet and junction boxes shall be of high-impact molded PVC construction. Outlet and switch boxes shall be "FS" series with cast hubs. Junction boxes and larger boxes shall be of high-impact PVC molded construction, with cork or neoprene gasket. Boxes shall be as manufactured by Carlon Co., or equal.

2. The boxes shall be sufficiently large for the equipment and number of conductors as dictated by the National Electrical Code.

3. PVC boxes are permitted only where PVC conduit is required.

G. Wiring Devices - Specification Grade:

1. Wiring devices shall be AC quiet, NEMA specification grade, heavy duty unless otherwise specified. All devices shall meet NEMA standard WD 1-3, and shall be listed by the Underwriter's Laboratories. The voltage rating shall be as required for the application. The devices shall have an ampacity of not less than 20 amps.

2. Wall plates shall be stainless steel. Weatherproof wall plates shall be Crouse-Hinds type WLRS and WLRD or equal. All switches, other than lighting switches, shall have an engraved label identifying the function of the switch and switch positions. Labels shall be stainless steel, brass, or engraved laminated plastic, attached with screws.

3. Switches and receptacles shall be mounted 48 inches (nominal) to center above the floor.

4. Where applicable, devices located in hazardous areas or areas where adverse conditions exist, shall meet NEMA and National Electrical Code requirements for those areas.

PART 3: EXECUTION

3.01 UNDERGROUND WORK

A. The Contractor shall be responsible for all excavating, concrete work where applicable, and backfilling. The underground conduit shall be at least 30 inches below the finished grade.

B. Backfill shall be earth or sand tamped into place. The trench shall be filled to the top and the surface restored to a finished condition. All excess earth shall be removed.

3.02 INSTALLATION

A. The Contractor shall furnish, install, wire and start-up equipment as required by the contract documents. The manufacturer's installation recommendations shall be observed and the completed assembly shall meet applicable code requirements.

3.03 CONDUCTOR INSTALLATION

A. Conductors shall be installed using industry accepted techniques as defined by Underwriter's Laboratories, National Electrical Code, and NEMA standards. The Contractor shall use pulling compound where applicable.

B. No splices shall be made in power wiring except in junction boxes. Conductors shall be continuous from outlet to outlet. Wiring shall be terminated as required in the contract documents.

C. No splices shall be made in signal or control conductors. The wiring shall be continuous from device to device.

D. All wire and cable shall be tested for grounds and continuity before the circuit is energized. The Contractor shall assume full responsibility for damage done to the equipment due to circuit grounds or open circuits.

3.04 MOTOR CONNECTIONS - MOTORS LARGER THAN 3 HORSEPOWER

A. Where the wiring system connects to the motor leads in the motor junction boxes, the connections shall be insulated with Raychem Type MCK, or equal, motor connection insulation kits.

END OF SECTION 16100

SECTION 16200

POWER GENERATION AND DISTRIBUTION

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for construction of a standby power generating system, including engine-generator set, battery, battery charger, exhaust piping, and silencer, control panel, and automatic transfer switch.

C. Related Sections

1. Section 15300 - Insulation

1.02 REFERENCES

A. National Electrical Manufacturer's Association (NEMA)

1. MG1 Motors and Generators

B. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code (NEC) 1990

1.03 SYSTEM REQUIREMENTS

A. Engine-Generator Set

1.	Kilowatts (kW) =	15
2.	Kilovolt-Amperes (kVA) =	18.75
3.	Engine Speed (RPM max.) =	1800
4.	Minimum Engine Horsepower =	30
5.	Generator voltage =	120/208V, 3-phase, 4-wire
6.	Fuel type =	Natural gas

B. Motor Starting Capability

1. The engine-generator set shall have sufficient starting kVA to withstand the simultaneous loading listed below. During motor starting, instantaneous voltage dip shall not exceed 25%. The Contractor

shall submit calculations with the shop drawing submittal that confirm the unit's conformance with this requirement.

Loads

a. 5 hp scrubber pump (X-line start)
b. 1kW lighting
c. 1kW miscellaneous loads

2. Provide a larger unit than the specified size if required to meet the motor starting requirements. The use of field "boost", or similar means, is not acceptable.

C. Operation

1. The engine-generator will be operated when the normal source of power is lost. The equipment will be required to operate for whatever length of time the normal power is off. The length of time may vary from a half hour to several days. The unit shall be capable of providing 100% of rated power at 1,000 feet above sea level at 110 deg. F.

1.04 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Engine-generator set and all separate components.

2. Automatic transfer switch.

B. Shop Drawings - Submit Shop Drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Engine-generator set and components including dimension and weight information.

C. Operation and Maintenance Instructions - Submit operation and maintenance instructions for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Engine-generator set including all separate components. Include engine manual with parts list.

2. Automatic transfer switch.

1.05 SUPPLIER

A. It is the intent of this specification that all equipment specified in this Section shall be furnished by a single-source supplier who shall assume system responsibility along with the Contractor.

B. The engine-generator set supplier shall be normally engaged in the assembly, installation, repair, and maintenance of generation equipment. The supplier shall have provided at least twenty (20) systems of equal or greater complexity/size in the last year.

C. The supplier shall be a factory-authorized sales, parts, and service representative of the engine manufacturing company. The supplier shall demonstrate that it has spare parts in stock to service and maintain the engine, and to repair the unit in 48 hours or less for most failures.

D. The supplier shall have a service depot within a 50-mile radius of St. Louis Park, Minnesota.

E. The supplier shall modify or supplement the supplier's "standard products" to meet these specifications. Standard products of a particular supplier that do not meet the functional and technical requirements of the specification are not acceptable.

F. The supplier shall have qualified, trained service personnel on staff who are capable of maintaining and repairing the equipment. The supplier shall be capable of offering an extended service contract after completion of the warranty period, including 24 hour, 7-day per week emergency services.

G. Upon request, the supplier shall submit:

1. List of twenty (20) projects referenced above, including customer's name, contact person, and phone number.

2. Description of service contract capability, including number of personnel, their location, and types of service contract available.

H. The engine-generator set and related components shall be supplied by one of the following companies in full conformance with this Specification:

1. Kohler Company, Kohler, WI.
2. Onan Corp., Minneapolis, MN.
3. or equal.

1.06 GENERAL REQUIREMENTS - ENGINE GENERATOR SET

A. The generating equipment is required to provide not less than the indicated kW at 0.8 power factor after deducting for auxiliaries. A single unit shall provide the entire capacity required. The auxiliaries shall include, but not be limited to, heat exchanger fan, water pumps, exciting equipment, etc.

B. The unit shall consist of an engine generator and accessories, all mounted on a common skid base suitable for mounting indoors, including coolant, oil, filters and all other peripheral equipment. The Contractor shall be responsible for all engine-generator exhaust piping.

C. All components shall be thoroughly tested and inspected and all necessary corrections made before the equipment leaves the factory.

1.07 GENERAL ARRANGEMENT - ENGINE-GENERATOR SET

A. The engine, generator heat exchanger and all components not specifically shown as mounted elsewhere shall be mounted on a unit skid. The skid shall be equipped with rubber vibration dampers. The exhaust silencer and connections shall be furnished with the unit for mounting above the unit.

B. An engine starting battery shall be furnished and shall be suitable for mounting indoors adjacent to the unit. The battery charger shall be wall mounted.

C. All equipment shall be completely piped and wired. Interconnections between separately mounted units shall be made by the Contractor. Terminal blocks shall be provided for all external electrical control connections. Terminal blocks shall be of the barrier type.

1.08 STANDARDS

A. All equipment shall comply with the applicable portions of NEMA Motor and Generator Standards MG-1.

1.09 HANDLING

A. The equipment shall be suitably prepared to insure against damage during shipment, construction and the elements after installation. Storage shall be in a dry, warm (+50 deg. F.) environment with the units covered.

1.10 SAFETY

A. The unit shall be designed to minimize the danger of accidents to operating and maintenance personnel. The manufacturer shall, prior to shipment, verify that all electrical connections are tight and that circuits are isolated, that on-set piping connections are well made, and that standard equipment is included and functions according to design.

B. The following will be considered standard safety items:

1. All rotating exposed components shall have suitable guard covers designed to prevent accidental contact. The guards shall be of substantial construction, securely fastened in place, but removable for maintenance purposes.

2. Insulation shall be provided to cover external hot surfaces of the engine where needed for fire prevention and personnel protection. The exhaust manifold shall have a shield.

3. The electrical system shall be designed so that there are no exposed conductors. The exciter and voltage regulator shall be supplied within metal enclosures to prevent accidental contact. The control panel shall be of the dead front type.

4. The unit shall have two large, legible signs that warn that the unit is automatic starting.

1.11 WARRANTY

A. The equipment shall be furnished free from all defects in design, workmanship and materials, and shall be guaranteed to give successful service under the operating conditions herein specified for a period of not less than one year after being accepted. Any defects, or damage to the equipment because of such defects due to faulty material or workmanship shall be corrected to the satisfaction of the Owner at the expense of the Contractor. The entire set shall be warranted by the manufacturer and supplier of the engine.

PART 2: PRODUCTS

2.01 ENGINE AND ACCESSORIES

A. General Requirements

1. The engine shall be a multi-cylinder, heavy duty, spark-ignition type, suitable for operation using natural gas.

2. The engine shall have sufficient capacity to continuously drive the generator and all accessories and deliver rated electrical power at the generator terminals as specified in the generator section. The engine shall be rated for operation at an elevation of 1,000 feet above sea level.

3. The engine shall be naturally-aspirated.

B. Speed

1. Engine speed shall not exceed the speed defined in the system requirements at normal full load operation.

C. Governor

1. The governor steady state band speed shall not be worse than $\pm$3%.

D. Fuel System

1. The engine shall operate using natural gas as the fuel.

2. Provide solenoid valve and pressure regulator on the serving gas line. Solenoid valve shall be normally-closed, powered open when the engine is running.

3. Gas supply at the engine will be at 7 inches water column nominal pressure.

E. Lubrication

1. The engine lubricating system shall include a strainer, oil pump and oil filter.

2. The lubricating oil shall be continuously full flow filtered by the system. The oil filter shall be equipped with a spring loaded bypass valve to bypass oil and thereby assure a supply of lubricating oil

in case of a clogged oil filter. The lube oil filter system shall remove all particles of 15 microns and larger. The filter element shall be of standard readily available size. The engine shall not be permitted to run at full speed until a minimum pressure is reached.

3. A gear-type lubricating oil pump shall supply oil under pressure to main bearings, connecting rod bearings, pistons, timing gears, cam shaft bearings and valve rocker mechanism.

F. Air Cleaners

1. One or more engine-mounted, dry-type air cleaners for the combustion air shall be provided. Oil bath air cleaners are not acceptable.

G. Cooling

1. The engine shall be air-cooled or water-cooled.

2. Water-cooled units shall comply with the following: The engine cooling system shall include a centrifugal jacket water circulating pump, thermostats and a bypass arrangement, and a unit-mounted water-to-air heat exchanger complete with engine-driven fan. The cooling equipment shall be capable of circulating and cooling the coolant fluid to maintain the engine and lubricating oil at the temperature recommended by the engine manufacturer when the engine and heat exchanger are operating in an ambient air temperature of 95 deg. F. at an altitude of 1,000 feet above mean sea level.

3. The coolant shall be an anti-freeze mixture of 50% ethylene glycol and 50% water, or 60% Downtherm 209 and 40% water, or as otherwise recommended by the manufacturer and shall prevent freezing at temperatures down to minus 35 deg. F.

H. Exhaust System

1. A complete exhaust system shall be provided including exhaust piping, silencer, and flexible connections. All material for the exhaust system shall be of corrosion resisting materials.

2. The silencer shall provide critical grade silencing and shall provide a back pressure within the maximum allowed by the engine manufacturer. Long radius elbows shall be used in the piping and stainless

steel, corrosion resisting, seamless convoluted flexible exhaust connectors shall be provided as indicated. Standard 150# flanges shall be used between all exhaust components.

3. Exhaust system shall be insulated as specified in Section 15300.

I. Starting

1. The engine-generator set shall be capable of starting cold at 40 deg. F. and within 60 seconds be capable of delivering rated electrical output with stabilized voltage.

2. The engine shall be arranged for electric starting and shall be complete with cranking motor, battery, battery rack, battery charger, and controls.

3. The cranking motor shall be of sufficient size to turn the engine over easily and at a speed to provide rapid starting of the engine. The motor shall be capable of providing not less than three 30 second cranking cycles in three minutes without overheating.

J. Battery

1. Battery shall be industrial grade lead-acid type sized for three (3), thirty (30) second consecutive cranking cycles at $40^{o}F$, without significant reduction in cranking speed at the end of the third cranking cycle.

2. Include a corrosion-resistant battery rack and cables as required.

2.02 GENERATOR

A. General

1. The generator shall be of the engine driven, single or two bearing type, self aligning, continuous duty, salient pole, synchronous type with amortisseur windings. The generator enclosure shall be of the drip proof type. Only the line and neutral leads shall be brought out for load connections. The generator insulation shall be NEMA Class F or better. The generator shall be designed so that with a minimum amount of labor all components are completely accessible. The generator drive shall be free from critical torsional vibration within the operating

speed range. The generator shall be warranted by the same manufacturer as the engine. Replacement parts shall be readily available.

2. The generator shall have the following ratings:

Capacity, kW at 0.8 P.F., Continuous Standby	As shown in the General Requirements
Voltage, Volts	As shown in the General Requirements
Phases	3
Frequency, Hz	60
Insulation Class	NEMA Class F
Temperature Rise (above) 40°C. ambient Degrees C.	NEMA Class F

Note: temperature rise requirements shall not be exceeded using both resistance and thermometer measurement techniques.

B. Construction Features

1. The generator stator and rotor shall be built up of high grade silicon steel laminations, precision punched, deburred and individually insulated. Windings shall be insulated for maximum moisture resistance, high dielectric strength, and bonding characteristics. Stator windings shall be wedged securely to prevent vibration and to withstand short circuit stresses. Rotor field windings shall be held securely in place to withstand rotational forces of not less than 125% of rated speed. The generator shall be able to withstand a one minute three phase fault at the generator terminals and a line to ground fault of equal magnitude.

2. Forced ventilation to prevent overheating of any part of the generator and prevent hot spots shall be provided.

3. Bearings shall be shielded and sealed to prevent entrance of moisture and dirt. Bearings shall be designed and lubricated to provide a bearing life of not less than five years based on Curve B-10 of the Anti-Friction Bearing Manufacturer's Association.

4. The terminal box and terminals shall be of adequate size and shall be arranged and coordinated to connect to cable as shown on the drawings.

5. The generator shall have a circuit breaker with rating not exceeding 125% of the generator full-load rating.

C. Excitation

1. The generator shall have brushless excitation with silicon controlled rectifiers to provide alternator excitation. The excitation system shall have the capacity to provide 105% of required excitation at rated load and voltage and shall incorporate circuitry to permit voltage build-up from residual magnetism. Field flashing from a separate source is not acceptable. "Field boosting" for motor starting, etc., will not be permitted.

2. The excitation system shall be of sufficient capacity to produce the maximum excitation required at 0.8 P.F. and 105% of rated voltage.

3. In addition, excitation shall be such that the generator transient voltage deviation shall not exceed 15% upon adding or dropping of rated load from a stabilized initial condition as indicated in test procedures. Rated load shall be considered to be induction motors with NEMA Class F locked rotor characteristics.

4. The generator and excitation system shall be given factory insulation tests in accordance with the latest NEMA standards for such equipment.

D. Voltage Regulation

1. A generator voltage regulator shall be furnished to provide voltage level control, voltage gain, and voltage droop. The regulator shall be of the static magnetic amplifier type. The controls shall be readily accessible for normal operating adjustments. The voltage level control shall have a minimum range of $\pm$5% from rated voltage. The regulator shall be of the volts/Hertz type.

2. Voltage regulation shall be within $\pm$1% of rated voltage from no load to full load. Steady state modulation shall not exceed $\pm$1/4%. Instantaneous voltage deviation shall not exceed +10% - 15% from nominal voltage, when 50% of continuous standby

rating is added to a 50% continuous standby rating at rated power factor. Recovery of stable operation after application of full load shall occur within one second. Voltage regulator adjustment devices shall be located behind a removable access panel. Inrush characteristics shall be as derived from motors with Class F locked rotor characteristics.

2.03 ENGINE CONTROL PANEL

A. General

1. The engine-generator set shall have a unit-mounted control panel. The panel shall have vibration isolators.

B. Equipment

1. The control panel shall include, but not be limited to, engine crank control, engine safety controls, and all engine safety interlocks. In addition, the control panel shall include:

   a. OFF/AUTO/TEST switch.
   b. Reset switch.
   c. Hour meter.
   d. Voltage adjust potentiometer.
   e. Frequency meter.
   f. Voltmeter.
   g. Ammeter.
   h. Ammeter/Voltmeter phase selector switch.
   i. Oil pressure gage.
   j. Water temp. gage.
   k. D.C. Voltmeter.
   l. Red indicating lights for the required failure modes.

2. Safety shutdown shall be provided for overcrank, overspeed, high coolant temperature, low oil pressure.

C. Engine Starting Controls

1. The control panel shall provide the automatic starting sequence for the engine upon receiving a closed contact signal from the automatic transfer switch.

2. The engine starting controls shall provide for automatic remote starting. Closing the remote starting contact shall provide for two 30 second cranking cycles with cranking duration adjustable from 10 to 30 seconds with a "wait" in between. An

isolated contact for remote indication of engine start shall be provided. If the engine does not start after the two cranking cycles, two contacts, one for an alarm and one for a remote interlock, shall close. The controls shall also provide for manual control of cranking.

2.04 BATTERY CHARGER

A. The battery charger shall be of the regulated, constant potential, silicon rectifier type and shall provide an automatic trickle charge for floating the battery and a time clock equalizing charge for periodic maintenance. The charger shall be for operation from 120V 60 Hz source with a 10 Amp minimum output rating. The charger shall be self protected against overloads. The battery charger shall have a potentiometer for setting the "float" voltage and a second potentiometer for setting the "equalize" voltage.

B. Battery charger shall be wall-mounting. The unit shall have voltage and amperage meters.

2.05 AUTOMATIC TRANSFER SWITCH

A. The supplier of the engine generator set shall furnish automatic load transfer equipment. The load transfer equipment shall provide two sets of normally open contacts rated at not less than ten (10) amps at 120 VAC-resistive. The contacts shall close when the generator set shall start and shall open when the generator set is to stop. The load transfer equipment shall run the generator set with the load connected for not less than thirty minutes once the generator has started and for not less than five minutes once normal power is restored. If the generator set fails, the load shall transfer immediately upon restoration of normal utility power. When operating normally, the generator set shall have a thirty (30) second "cool down" period before the transfer equipment stops the engine. Engine start and load transfer shall have two (2) second delay to prevent false operation in case of momentary power dips due to re-closer action, etc.

B. The load transfer equipment shall be suitable for operation on a 120/208 volt-three (3) phase-four wire system. The equipment shall have a minimum rating of 60 amperes. The transfer switch shall be braced for and have an interrupting rating of not less than 25,000 amps, sym. The transfer equipment shall be housed in a non-ventilated NEMA 1 enclosure suitable for wall-mounting. The load transfer equipment shall meet all requirements

of UL 1008 listing requirements and shall bear the UL label. The transfer equipment shall be capable of enduring an overload of six (6) times rated current at .4pF for 50 operations; 2,000 operations at two (2) times rated current. The entire assembly, inside and out, shall be painted with a rust resisting primer and the manufacturer's standard color. Contact assemblies shall have multiple contacts, main contacts, and make-break contacts with arc chutes as required. The entire assembly shall be of dead-front type construction in accordance with all UL and NEMA requirements.

C. The transfer switch shall continuously monitor each phase for an undervoltage, phase loss or phase reversal condition. When the voltage drops more than 10% (max.) from normal for longer than three (3) seconds, or a phase reversal occurs, the control mechanism shall start the engine-generator set and shall transfer the load when normal voltage and frequency occur. The same undervoltage, phase failure and under-frequency sensing circuits shall be provided on the standby source. The use of batteries on the transfer equipment is unacceptable. The transfer breakers shall be both electrically and mechanically interlocked to prevent simultaneous operation. The transfer equipment shall contain a "normal-test" switch. When in the test position, the transfer equipment shall simulate the loss of a phase. When the switch is moved from the "normal" to "test" position, the sense circuits shall detect, and react to a phase loss. The unit shall continue to run and carry the load as long as the switch is in the "test" position. When the switch is returned to the normal position, the unit shall run for the remainder of the thirty (30) minute engine run timer, if any, the remainder of the five (5) minute normal power restored timer, if any time remains, shall re-transfer the load to the utility, shall cool off for thirty (30) seconds, and shall shut down.

PART 3: EXECUTION

3.01 INSTALLATION

A. Provide all fuel piping, starting equipment, exhaust equipment, cooling equipment and all power and control interconnections as indicated and as required by manufacturer.

3.02 **START-UP, REPORT, TRAINING**

A. **The start-up, report and training shall be as defined in the General Conditions.**

B. **The training shall be for not less than four (4) hours on the engine-generator set and accessories.**

END OF SECTION 16200

SECTION 16400

ELECTRICAL SERVICE

PART 1: GENERAL REQUIREMENTS

1.01 DESCRIPTION

A. All work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for construction of the building main service, panelboards and transformers, and coordination of work with the serving utility.

1.02 REFERENCES

A. National Fire Protection Association (NFPA)

1.	NFPA 70	National Electrical Code (NEC)

B. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250	Enclosures for Electrical Equipment.
2.	NEMA PB 1	Panelboards
3.	NEMA ST-20	Dry-Type Transformers for General Applications

C. Underwriter's Laboratories (UL)

1.	UL 67	Panelboards
2.	UL 50	Cabinets and Boxes
3.	UL 1561	Dry-Type General Purpose and Power Transformers

1.03 MAIN SERVICE

A. The Contractor shall coordinate the installation of the new main service. The system voltage and ampacity shall be as shown. It shall be the responsibility of the Contractor to contact the utility serving the project site and coordinate the details of the service entrance.

B. The Contractor shall furnish and install the meter sockets as required by the utility. The utility will furnish and the Contractor shall install the meters and associated current transformers and potential transformers as are required.

C. The Owner will pay utility charges related to providing the new service indicated.

D. The local electrical utility is:

Northern States Power Company
1518 Chestnut Avenue
Minneapolis, Minnesota
Phone: 612/347-9554

1.04 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Panelboards (including schedule of circuit breakers)
2. Transformers

PART 2: PRODUCTS

2.01 PANELBOARDS

A. Unless shown otherwise the bussing shall be suitable for 200 amps, minimum. The number of circuits shall be not less than indicated on the schedules shown on the drawings. Unless shown otherwise, panelboards shall be NEMA 1. All panelboards on the project shall be by the same manufacturer, shall bear the U.L. label and listed as "suitable for use as service equipment" where applicable.

B. Cabinet rough-in boxes shall be code gauge steel, zinc galvanized, on both inside and outside surfaces, with an inturned flange on all sides of the front. The front covers shall be sheet steel, with a rust inhibitor primer and a baked enamel finish for surface mounted panels. The front covers shall be fitted with a door with a continuous butt type hinge concealed and welded to the back of the door. The other three sides shall have door stops. Doors over 48 inches high shall have auxiliary fasteners at the top and bottom. The doors shall have locks with two keys per lock. When the front cover and door assembly is removed, access to the wiring gutters shall be provided. The sub-plate shall be fastened to the panelboard with screws. The entire panelboard shall be of dead-front construction. The trim shall be adjustable.

C. The panelboard neutral shall have solderless connectors numbered not less than the number of branch circuits and available spaces in the panelboard. All spaces shall be connected to alternate phases.

D. Unless otherwise shown, main and branch circuit breakers rated at 208 or 240 volts shall have an interrupting rating of not less than 14,000 amps, r.m.s., sym. Where panelboards and breakers are UL labeled for the application, series rated main and branch breakers may be used. Circuit breakers shall indicate open, closed, or trip conditions by handle position. Circuit breakers shall be quick-make, quick-break with thermal-magnetic trips having long-time and instantaneous tripping characteristics. Multi-pole breakers shall have one handle with internal trip bar with the circuit breaker cases fastened together. Panelboards with breakers with an interrupting rating of 14,000 amps or less, may be plug-in. Other panelboards are to be of bolt-on circuit breaker construction.

E. Where required the panelboards shall contain ground fault interrupting circuit breakers. The breakers shall have an interrupting rating of not less than 10,000 amps, r.m.s., sym. The breakers shall have a sensing circuit capable of tripping the breaker in not more than 30 m.s. at a current inbalance of 5 m.a. The breaker shall contain a sensing circuit test feature.

F. Install closure plates in each space not occupied by a breaker where the knockout has been removed. Accurately list the circuit numbers on the panelboard schedule utilizing a typewriter.

G. Panelboards shall be designated with the panelboard number as shown on the contract documents. The labels shall be of the engraved plastic type with the label being black and white letters. Embossed raised letter type labels are not acceptable. Letters shall be 3/8" high, nominal.

2.02 DISTRIBUTION TRANSFORMERS

A. Transformers shall be dry type suitable for indoor or outdoor service as shown on the drawings. Transformers shall have a basic impulse level of not less than 10 kV. Transformers shall have not less than two 2-1/2% full capacity above normal primary voltage and two 2-1/2% full capacity below normal primary voltage taps. Sound level may not exceed 45 dB determined in accordance with procedures outlined with NEMA and ANSI standards. The transformers shall have a kVA rating as shown on the

drawings. Unless otherwise shown on the drawings, primary voltage shall be 480 volts with a secondary voltage of 120/208 volts, three phase, four wire. The transformers shall have the insulations suitable for NEMA Class H, 150 deg C. The transformer, at full load, shall have a temperature rise not exceeding 80 deg C over a 40 deg C ambient. The transformers shall be U.L labeled for 80 deg C operation.

B. Transformers shall be constructed in accordance with NEMA and UL standards. The transformers shall be finished with one coat of rust inhibiting primer and two finish coats of paint.

2.03 GROUNDING MATERIALS

A. The entire installation shall be grounded in accordance with the National Electrical Code and as otherwise detailed.

PART 3: EXECUTION

3.01 GENERAL

A. The Contractor shall furnish, install, wire and start-up equipment. See Section 16010 for the requirements detailing installation, inspection, start-up, adjustment, report, training, etc.

3.02 PANELBOARDS

A. Panelboards shall be mounted with the top of the panelboard at 72 inches above finish floor.

END OF SECTION 16400

SECTION 16500

LIGHTING

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for construction of indoor and outdoor lighting systems.

1.02 REFERENCES

A. National Fire Protection Assosciation NFPA)

1. NFPA 70 National Electrical Code (NEC)

B. Underwriter's Laboratories (UL)

1. UL 57 Electric Lighting Fixtures

1.03 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Light fixtures including footcandle distribution curves.

PART 2: PRODUCTS

2.01 FIXTURES

A. All fixtures shall bear the seal of the Underwriter's Laboratories (U.L.). The seal shall be for the type of area the fixture is to be located in.

B. On all fluorescent, H.I.D., or other fixtures that utilize ballasts, the entire assembly shall have a power factor of not less than 0.90 at its designated voltage. All ballasts shall be of the type where the starting current does not exceed the operating current. Ballasts on fixtures that are located outside the building en-

velope shall be suitable for starting and operating at -20 deg. F. All fluorescent light fixtures shall have "energy saving" ballasts per applicable Code.

C. All fixtures shall be complete with lamps, starters, diffusers, guards, clips, retainers, etc. in accordance with the drawings, specifications and ordinances governing the installation of the fixtures.

D. All H.I.D. lamps, other than sodium, shall be phosphor coated.

PART 3: EXECUTION

3.01 GENERAL

A. The Contractor shall verify, prior to ordering the fixtures, that the fixture bears the U.L. label and meets the requirements for the location where the fixtures are to be installed.

B. The Contractor shall install fixtures in accordance with the manufacturer's recommendations and shall be mounted carefully and rigidly. The mounting of the fixtures shall be uniform in height and shall present a neat and workmanlike appearance.

C. The Contractor shall examine the contract documents for the ceiling system into which the fixtures will be installed. If additional supporting material, wire, channels, or bars are required for the installation, other than the equipment supplied with the ceiling system, the Contractor, under this Division, shall furnish and install such devices at no change in the contract price.

D. The fixtures shall be connected into the power distribution system per the requirements of the National Electrical Code, the manufacturer's requirements, or the contract documents, whichever is more stringent.

3.02 USE OF LIGHTING FIXTURES FOR CONSTRUCTION LIGHTING

A. If the Contractor uses the project light fixtures for construction lighting, then the Contractor shall furnish and install new lamps at the time of project acceptance.

3.03 CLEANING

A. Clean all lighting fixtures at time of project acceptance.

END OF SECTION 16500

SECTION 16700

SPECIAL SYSTEMS

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for construction of the building telephone systems, and coordination of work with the telephone company.

1.02 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code (NEC) 1990

B. Underwriter's Laboratories (UL)

1. UL 1459 Telephone Equipment

1.03 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Telephones
2. Telephone jacks
3. Telephone cable

1.04 TELEPHONE SERVICE

A. The Contractor shall coordinate the installation of new telephone services to the facility. It shall be the responsibility of the Contractor to contact the telephone company and coordinate the details of the services.

B. Services to be provided are:

1. Telemetry - Extension of the existing dedicated lease-line that currently serves Well #4 into the new facility (for telemetry communication with City Hall).

2. General business service (dial tone).

C. The Owner will pay utilty charges related to providing the specified services.

D. The local telephone company is:

U.S. West Communications
6244 Cedar Avenue South
Richfield, Minnesota 55423
Phone: 612/861-8179

PART 2: PRODUCTS

2.01 TELEPHONES

A. Provide one (1) wall telephone, #2554 type with ivory molded housing, 12 button keypad and 10' coiled cord with handset; ITT, Premier, or equal.

B. Provide one (1) desk telephone, #2500 type with ivory molded housing, 12 button keypad and 6' coiled cord with handset; ITT, Premier, or equal.

2.02 TELEPHONE JACKS

A. Telephone jacks shall be 4-pin modular style with stainless steel cover plate.

B. Jacks at locations for wall telephones shall have two mounting studs for supporting wall phone.

2.03 TELEPHONE CABLE

A. Cable shall be two-pair #22 AWG (minimum) copper with PVC insulation and outer jacket suitable for wet or dry locations.

PART 3: EXECUTION

3.01 WIRING

A. All wiring, connections, terminal blocks, junction cabinets and similar equipment shall be concealed.

3.02 TELEPHONE COMPANY COORDINATION

A. The Contractor shall coordinate all necessary service requests with the local utility and act as the agent for the Owner.

END OF SECTION 16700

SECTION 16900

STARTERS AND MOTOR CONTROL

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for construction of motor starters, motor control centers, and related equipment.

1.02 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA 70	National Electrical Code (NEC)

B. National Electrical Manufacturer's Association (NEMA)

1. NEMA ICS 1	General Standards for Industrial Control and Systems
2. NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies
3. NEMA 250	Enclosures for Electrical Equipment
4. NEMA CP-1	Capacitors

C. Underwriter's Laboratories (UL)

1. UL 845	Electric Motor Control Centers

1.03 GENERAL

A. The Contractor shall furnish and install, complete, motor control centers, starters, control switches, limit switches, etc. as required. All internal buswork and wiring shall be completed by the manufacturer and where connections must be completed between equipment sections in the field, the wiring or buswork, shall be terminated in each section of equipment in a manner to facilitate field connections. The Contractor shall furnish, properly sized and coordinated, connectors for the conductors entering the equipment. All equipment shall

meet the requirements of NEMA and UL standards and the latest edition of the National Electrical Code, where applicable.

1.04 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Motor control centers and all internal and external components, including circuit breakers, starters, overloads, control devices, relays, timers, and components indicated on the Drawings.

2. Field-mounted control devices.

B. Shop Drawings - Submit Shop Drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Motor control centers, including system schematic drawings, component schematic drawings, dimension drawings, layout drawing, and nameplate schedule.

C. Operation and Maintenance Instructions - Submit operation and maintenance instructions for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Motor control centers, including "as-built" schematic drawings.

PART 2: PRODUCTS

2.01 CONTROL DEVICES

A. Where required the Contractor shall supply all control devices including, but not limited to, selector switches, push button switches, limit switches, and indicating lights. All control devices shall be of the heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. Each control device shall be supplied complete with escutcheon and nameplate. Each control device shall have its function permanently marked on the escutcheon. Raised letters on plastic adhesive tape is not acceptable.

B. Furnish and install engraved plastic type label designating equipment served. Embossed raised letter type labels shall not be acceptable. Letters shall be 1/4" high and white in color on a black background.

2.02 MOTOR CONTROL CENTERS

A. Motor control centers shall be of the indoor type, with Class II Type B construction in accordance with the applicable NEMA standards. The motor control centers shall be factory assembled with combination starters, and other components and equipment as shown. The proposed motor control center layouts shall be approved by the Engineer. It is the intent that components and systems identified on motor control center one line diagrams and schematic diagrams be furnished by the manufacturer of the motor control center. Motor control centers shall bear the U.L. label.

B. Ratings

1. The rating of the motor control centers shall be as follows:

Voltage	277/480 Volts
Frequency	60 Hz
Phases	3
Control Voltage	120VAC

2. The current capacity of the main bus shall be as shown on the drawings and the current capacity of the vertical riser bus shall be 300 amps minimum or as required for the application. The momentary capacity of the bus shall not be less than as shown on the Contract Drawings.

C. The motor control center shall be of the unitized metal enclosed type with NEMA Type 1 enclosure. Sections shall be nominally 90 inches high, 20 inches wide and 20 inches deep, joined together to form a rigid, free standing completely dead-front assembly. The motor control centers shall be of Class II Type B construction in accordance with the applicable NEMA standards. The motor control centers shall be arranged and bussed to accommodate removable units and so that units may be mounted front only. Doors and access panels shall be flanged with the corners welded and ground smooth. All metal parts of the frame and all panels shall be painted on all sides. Each section shall be for not more than

6-1/2 space factor utilization. All components shall be mounted inside starter or auxiliary compartments except elapsed time meters, ammeters, switches, and pilot lights which shall be flush mounted in the appropriate cubicle with the devices labeled.

D. A continuous ground bus of copper bar at least 1/4 inch x 2 inches in size shall be provided in a conveniently accessible location. The ground bus shall be provided with solderless lugs for No. 2/0 AWG cable for attachment to the ground grid.

E. Doors and access panels shall be flanged with the corners welded and ground smooth. Sheet metal for each panel shall be not less than .056 inch thick when the panel is not larger than 360 square inches; .067 inch thick when the panel is not larger than 1,000 square inches; and .097 inch thick when the panel is larger than 1,000 inches square. Access panels shall have one fastening device not more than six inches from each of the four corners and fastening devices not more than 24 inches apart along vertical side. Any panel having dimensions not exceeding six inches high may be fastened by two fastening devices, one at the center of each of two opposite sides. Doors shall be secured with not less than two hinges. Hinges shall be located not more than four inches from each end of a door and shall be spaced not more than 24 inches apart. Each leaf of each hinge shall be fastened at not less than two points to the door, and not less than two points to the structure. Each hinged door shall be capable of supporting not less than four times its own weight and not less than thirty pounds without causing permanent deformation to the hinges. Doors shall be provided with snap latches or captive screws. Doors more than 48 inches long shall be fastened with a two-point or three-point latch.

F. Each vertical section shall be furnished complete with a 3-phase main horizontal bus. Power shall be distributed to units in the vertical sections by means of a 3-phase vertical bus. Buses shall be silver plated at all contact points or tin plated on aluminum bus. Bus supports shall be high dielectric strength, with low moisture absorption. All bus work shall be suitably braced to withstand short circuit currents as specified. A full height insulating barrier shall be provided for isolation of the vertical bus from the units. Guide rails or other means shall be provided in the structure for supporting and aligning starter units during removal or replacement. All units shall be easily removable and shall be connected to the vertical bus by means of self-aligning stab-on bus connectors of low resistance

arranged for positive contact with both sides of the bus at all times or by bolting on the larger sizes. A horizontal wiring and bus compartment shall be provided at the top and bottom. In addition, each section shall have a vertical wiring space equipped with cable tie supports for unit wiring. Bus bars shall be sized such that their temperature rise does not exceed 50 deg. C. Unless shown otherwise, minimum bracing shall be 42,000 amps, sym.

G. Starter Units

1. General

a. Starter units shall be of the combination type and shall have short circuit protection for not less than 42,000 amperes r.m.s. symmetrical, provided by motor circuit protectors (MCP) unless otherwise required. Each starter shall have a disconnecting device for all powered conductors entering the starter cubicle. In addition, each disconnecting means shall contain provisions so the disconnecting means can be locked in the off position.

2. Starting Contactors

a. Starting contactors shall be of the magnetically operated type with three bimetallic, or equal, overload relays for each three pole contactor. Each contactor shall be provided with an external manually operated reset pushbutton for the overload relays mounted in the compartment door. Fused individual control transformers with not less than 50% excess capacity for the control circuit shown shall be furnished for each starter. Starting contactors shall be ambient compensated. Overload heaters shall be furnished sized according to the motor nameplate data.

b. Contactor contacts and overload heater thermal elements shall be field replaceable on all starters, size 1 thru size 6.

c. Starters shall be NEMA style devices. IEC-style starters with NEMA horsepower ratings are not acceptable.

3. Short Circuit Protection

a. Short circuit protection shall be provided for each combination starter unit. Protection shall be provided by motor circuit protectors (MCP) unless shown otherwise. Unless otherwise required, the short circuit protective devices shall have not less than 42,000 amperes r.m.s. symmetrical of short circuit interrupting capacity. The devices shall be capable of interrupting any asymmetrical fault associated with the symmetrical rating.

4. Reduced Voltage Starters

a. Where required, reduced-voltage starters shall be furnished. Reduced voltage starting shall be by means of an auto-transformer with taps at 50%, 65% and 80% of line voltage at starting. Transferring to full-voltage operation shall be by the closed transition means. Timers shall be as recommended by the manufacturer of the transformer. Each auto-transformer shall contain a thermal sensor. When the auto-transformer reaches an over-temperature condition, the sensor shall shut the entire starter down. Auxiliary dry contacts, Form C, 120 VAC, 5 amps shall be provided.

H. Branch Circuit Protection

1. Branch circuits served by motor control centers for devices other than motors shall use circuit breakers or fused switches as required.

2. Circuit breakers shall include both instantaneous and long time trip elements.

3. Circuit breakers shall have an interrupting rating equal to the bracing of the bus bars unless indicated otherwise.

4. Fused switches shall include dual element fuses with a rating as required for the application. Fuses shall be as manufactured by Buss, Littelfuse, or equal.

I. Control Relays

1. Control Relays shall be quiet in operation and shall not have less than four contacts. Relays shall be enclosed in NEMA 1 enclosures and shall be mounted

such that they may be removed and installed from the front. Installations where the bus bar compartment must be opened to remove nuts, etc., from mounting screws is not acceptable. Relay operating coils, contacts, etc., shall be designed for continuous operation in atmospheres up to 65 deg. C. Control relay compartments shall be convection cooled. Forced air cooling is not acceptable.

2. General control relays shall be plug-in type with sockets. The relays shall have dust covers, suitable for continuous operation, and shall be rated for not less than 10 amps at 120 VAC, 1.0 pF. The contacts shall be 3/16" diameter silver cadmium oxide or gold flashed.

J. Timing Relays

1. Timing relays shall be either synchronous motor driven or electronic. Pneumatic timing relays are not acceptable. Electronic relays shall include transient protection and shall be suitable for operation simultaneously with circuit breaker operation, etc., without detrimental results to the electronics. The following minimum requirements shall apply:

a. Electronic

Operating Voltage	120 VAC, +10% - 15%
Accuracy	±2% of full scale
Temperature variation	±4% over temperature range
Voltage variation	±2% over voltage range
Overall accuracy	±5%
Contacts	10 Amps at 120 VAC into a resistive load
Operating Temperature	0^{o}C. to 70^{o}C.
Load Life	Not less than 10^{6} operations 50% duty cycle - 120 VAC - 4 Amps - 1.0 pF
Mechanical Life	20 x 10^{6} operations
Transient Protection	2.5 kV for 1 MS
Dielectric	1 kV between terminals and case

b. Synchronous Motor Driven

Operating Voltage	102-132 VAC
Accuracy	±0.5% of full scale
Contacts	10 Amps at 120 VAC - 1.0 pF
Insulation Resistance	50 Meg Ohms
Temperature	-10°C. to 55°C.
Dielectric	2.4kV for 1 sec. across open contacts

2. Electronic relays shall contain transient suppression and shall be capable of withstanding a transient of twice rated voltage for 8 ms. Relays shall be protected against polarity reversal on D.C. units and aborted-cycle effect upon power interruption during a timing cycle. In addition, electronic timing relays shall not use electrolytic capacitors.

K. Phase Sensing Relays

1. Phase sensing relays shall monitor all three phases for correct rotation, phase loss, and an undervoltage condition on any one or all three phases. The relays shall be connected to the buswork by means of three (3) Buss KTK fuses with fuseholders or equal. When a phase reversal or an undervoltage of more than ten (10) percent for longer than two (2) seconds on any phase or all phases occurs, the N.O., N.C. output contacts shall operate. The contacts shall be rated for not less than 3 amps at 120 VAC, 0.8 p.F. The relay shall obtain operating power from the monitored line. A separate source of power shall not be required.

L. Elapsed time meters shall have a minimum of 5 digits and shall read in hours and tenths of hours.

M. Power Factor Capacitors

1. Capacitor cells shall be of industrial grade that meet NEMA CA-1 standards. The capacitors shall not contain any PCB's or other environmentally damaging material. Capacitors shall not be internally fused.

2. Accessories shall include current-limiting fast acting fuses with 100,000 A.I.C. fuses in each of the three legs with neon lamps across the fuses. The fuses shall be removable from outside the capacitor enclosure. The disconnecting device shall open all phases simultaneously. The capacitor shall contain

closed delta discharge resistors per NEC rules and shall contain 180°C. wiring. The neon lamps shall be visible without opening the capacitor compartments.

3. Capacitor enclosures shall be suitable to contain any liquid that escapes as a result of ruptures or leaks. The capacitor shall be fitted with a nameplated stating voltage, KVAR capacity, phases and the type of combustible material in addition to safety information, etc.

N. Nameplates shall be supplied to identify each motor control center compartment, and shall be of the laminated black and white composition type with black face and with engraving extending into the white to give white letters on a black background. Nameplates shall be 3 inches long by 1 inch high with 1/8 inch high lettering for compartments. Nameplate for switches, relays and other accessories shall have 1/8 inch high lettering and shall be sized as required. Nameplates shall be fastened with screws, adhesives only are not acceptable.

O. All control devices including, but not limited to, selector switches, pushbutton switches, limit switches and indicating lights shall be of the heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. All time clocks, timers, switches, relays, etc., shall be permanently labeled.

P. Control wiring shall be of the switchboard type insulated with cross-linked polyethylene and shall not be smaller than #14 AWG. All wiring for external connection shall be terminated on fabricated terminal blocks with lettering strips. All termination strips shall correspond with points called out on shop drawings and field connection diagrams.

PART 3: EXECUTION

3.01 INSTALLATION

A. The installation, inspection, start-up, adjustment, written report, guarantee, and operator training shall be as defined in Division 1 and Section 16010.

3.02 CAPACITOR SIZING

A. Capacitor sizes shown in the Contract Documents reflect the best information available at the time of the design. The Contractor shall confirm the capacitors

identified with nameplate data and manufacturer's application data for the motors actually provided with the equipment.

B. Results shall be tabulated and submitted to the Engineer with record drawings.

C. Required sizes shall be communicated to the manufacturer of the electrical equipment to permit furnishing of the capacitor sizes recommended by the motor manufacturers.

D. Furnish and install engraved plastic type label designating equipment served. Embossed raised letter type labels shall not be acceptable. Letters shall be 1/4" high and white in color on a black background.

3.03 TRAINING

A. Training on the motor control center(s) shall be for four hours, minimum.

END OF SECTION 16900

SECTION 16950

INSTRUMENTATION AND CONTROL

PART 1: GENERAL

1.01 DESCRIPTION

A. All Work included in this Section shall be performed in accordance with the following paragraphs as well as the general requirements set forth in Division 1 of these Specifications.

B. Work covered under this Section includes providing all materials, equipment, and labor for construction of a complete process control and instrumentation system for the facility.

C. Related Sections:

1. Section 11216 - Submersible Centrifugal Pumps
2. Section 11600 - Packaged Iron Removal System
3. Section 11900 - Process Piping
4. Section 16900 - Starters and Motor Control

D. Products Installed But Not Furnished Under This Section:

1. Furnished by Owner - A telemetry panel for communication with the existing City Hall controls.

1.02 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code (NEC) 1990

B. National Electrical Manufacturers Association (NEMA)

1. NEMA 250 Enclosures for Electrical Equipment

C. Underwriters Laboratories (UL)

1. UL 508 Industrial Control Equipment

1.03 GENERAL

A. It is the intent of the contract documents that all equipment specified in this Section of the specification be supplied by one manufacturer or single source supplier. The manufacturer or supplier shall assume full responsibility along with the Contractor for the fur-

nishing, installing and start-up procedures so as to make the system operate per the intent of the contract documents.

B. The work specified in this section includes furnishing, installing, start-up, testing and adjusting of all required equipment, including instruments, wiring, piping, conduits, hardware, accessory equipment, and training to provide a completely operational process instrumentation system.

C. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the contract documents. Each control or instrumentation loop shall have total inaccuracy not exceeding $\pm$3% of the calibrated span.

D. It shall be the responsibility of the manufacturer and supplier of the equipment specified in this section to examine all equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this section or equipment furnished as a portion of another section of this project manual. The manufacturer and supplier of the instrumentation and control system shall be responsible for providing signal converters, buffer amplifiers, isolation devices, etc. to make signal levels, reference to ground, etc. compatible between devices specified in this section and those specified in other divisions and sections of the project manual. The signal conditioning devices shall be at no additional cost.

1.04 SUBMITTALS

A. Manufacturer's Literature/Data - Submit informational literature/data for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. All components indicated on the Drawings and specified in Part 2 of this Section.

2. Enclosures.

3. Field devices and instruments.

B. Shop Drawings - Submit Shop Drawings for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications:

1. Control panel drawings including system schematic drawings, component schematic drawings, dimension drawings, layout drawing and nameplate schedule.

2. Programmable Logic Controller (PLC) program in ladder format. Include verbal description of each rung's function.

C. Operation and Maintenance Instructions - Submit operation and maintenance instructions for the following materials and equipment in accordance with the general procedures set forth in Division 1 of these Specifications.

1. Control panel equipment, field devices and instruments, including "as-built" system schematics.

2. Final copy of PLC program on 8-1/2 x 11" sheets in ladder format.

1.05 SUPPLIER

A. The instrumentation and control system supplier shall be normally engaged in the assembly, installation, repair, and maintenance of municipal water control systems. The supplier shall have provided at least ten (10) systems of similar or larger complexity in the last year.

B. The supplier shall modify or supplement the supplier's "standard products" to meet these specifications. Standard products of a particular supplier that do not meet the functional and technical requirements of the specification are not acceptable.

C. The supplier shall have qualified, trained service personnel on staff who are capable of maintaining and adjusting the system. The supplier shall be capable of offering an extended service contract after completion of the warranty period, including 24 hour, 7-day per week emergency services.

D. Upon request, the supplier shall submit:

1. List of ten (10) projects referenced above, including customer's name, contact person, and phone number.

2. Description of service contract capability, including number of personnel, their location, and types of service contract available.

E. The instrumentation and control system shall be supplied by one of the following companies in full conformance with this specification:

1. Dynamic Systems, Inc.; Minneapolis, MN.
2. Consolidated Electric Company; St. Paul, MN.
2. Or equal. See Division 1.

1.06 SCHEDULING

A. The Contractor shall schedule execution of the installation and start-up of the process instrumentation and control system to meet requirements of the overall project.

1.07 GUARANTEE

A. The Contractor shall guarantee the operation of the system and that materials and workmanship of the equipment be free from defects for a period as defined in the General Conditions of the project manual providing the equipment has been operated and maintained in accordance with the manufacturer's recommendations.

1.08 TESTING AGENCY CERTIFICATION

A. All panels furnished under this Section shall be constructed in accordance with Underwriter's Laboratories (UL) Standard 508 - "Industrial Control Equipment."

B. Each panel shall be shop-inspected by UL, or constructed in a UL-recognized facility. Each completed panel shall bear a serialized UL label indicating acceptance under Standard 508.

1.09 FUNCTIONAL DESCRIPTIONS

A. General

1. Functional descriptions define how each portion of the instrumentation and control system is to operate. The descriptions, in conjunction with the drawings and the minimum technical requirements for products as described in Part 2 of this Section define the minimum requirements for the installation.

2. It is the intent of this specification that all products used to meet the functional descriptions shall be those specified in Part 2 of this Section. Proprietary components shall not be used. When requested by the Engineer, the Contractor shall give evidence that any proposed component is not proprietary by submitting literature on a replacement component sold by a different manufacturer or supplied by a different vendor.

3. Interface devices, buffer amplifiers, control relays and other components required by the supplier to cause the system to function in accordance with the functional descriptions and schematic drawings shall be considered incidental to the project. The supplier shall show such devices and define them in detail during the shop drawing review to confirm that he or she understands the requirements of the design.

4. Under this Section, provide all field-mounted flow switches, temperature switches, pressure switches, flowmeters, and other components shown on the Drawings unless such equipment is indicated to be furnished under another Section.

B. Plant Control Panel - General

1. The Contractor shall furnish and install, complete, a control panel with components for automatic control of the treatment facility. The panel shall be a free-standing unit with nominal dimensions of 90" high by 24" wide by 24" deep.

2. The plant control panel shall contain a programmable logic controller (PLC) which shall be programmed to perform the control logic, timing, sequencing, and interlocking functions described in the following paragraphs.

3. The PLC shall have a panel-mounted operator interface terminal that shall permit an operator to observe and modify software timer values. The supplier shall program the PLC to permit operator changes to only certain timer values determined during startup. The operator interface terminal shall display prompt messages and allow operator inputs of setpoint and alarm values as specified in these functional descriptions.

4. The operator interface shall be programmed such that all interaction with the unit is thru the use of menus and prompting messages. Program the unit so that it does not accept bad values or inputs, such as values outside of the span of a control loop. Units that require the operator to know codes, addresses, or similar information to utilize the operator interface are not acceptable.

C. Well Pump #4 Control

1. Operator will select control mode at "Run-Off-Auto" and "Local-Remote" selector switches. Initiate the well starting sequence described below when the well is called as follows:

   a. "Run" position - Continuous operation.

   b. "Auto" and "Remote" positions - Operate well pump when called by the Aquatrol telemetry panel. If "telemetry fail" input is received from the Aquatrol panel, automatically switch to "local" control.

   c. "Auto" and "Local" positions - Monitor the system pressure transmitter input and control well pump to satisfy local system pressure. Allow the operator to establish "Start Well #4 Pressure" and "Stop Well #4 Pressure" software setpoints thru the operator interface. Call for the well when pressure falls below the start setpoint, and continue calling until pressure exceeds the stop setpoint.

2. Provide software timers on all "start" and "stop" operations and on telemetry failure control transfer to prevent rapid cycling of the well pump.

3. When the well pump is called, initiate the following sequence:

   a. Energize the well #4 prelube solenoid valve for an adjustable time period (3 minutes initial setting).

   b. At completion of prelube, call for well pump #4.

   c. Check "well #4 running" input to confirm pump operation prior to proceeding.

d. Delay to allow air to escape from air relief (30 seconds initial setting) and then energize well #4 controlled check valve solenoid valve.

e. When the call for well #4 ends, continue pump operation and deenergize the well #4 controlled check valve solenoid valve. Monitor the controlled check valve limit switch, and shut down the well pump when the valve is 90% closed.

4. Well #4 Alarms

a. "Well #4 No Flow" - Start software timer when well pump is called to operate, and monitor the "well #4 proof-of-flow" switch input. If flow is not sensed when timer ends, energize alarm and shut down well. Also continuously monitor for flow while well pump is running, and alarm and shut down well if flow is lost.

b. "Well #4 Low Discharge Pressure" - Start independent software timer when well pump is called to operate, and monitor "well #4 low discharge pressure switch" input. If low pressure is sensed when timer ends, energize alarm and shut down well. Also continuously monitor for low pressure condition while well pump is running, and alarm and shut down well if low pressure condition occurs.

c. "Well #4 High Discharge Pressure" - Continuously monitor the "well #4 High Discharge Pressure" switch. If a high pressure condition occurs and lasts longer than a preset time (5 seconds initial setting), then shut down well and alarm.

d. High Level Alarms - Operator selects either "Alarm and Stop Well" or "Alarm Only" mode. If "Alarm and Stop Well" is selected, then shut down well if any of the following alarms occur:

1. Backwash Tank High Level
2. Storm Sewer Sump High Level
3. Lower Level Sanitary Sewer Sump High Level

e. Well pump shutdown for the previous alarm conditions shall be a normal shutdown including automatic closing of the well #4 controlled check valve prior to stopping the well pump.

5. Filter Backwash Interlock - If the well pump is running and the "backwash" input is received from the iron removal filter control panel, then keep the "well called" signal energized for the duration of the backwash cycle, regardless of "local" or "remote" well pump called signals. During backwash, well pump alarms shall remain in service as described above.

6. "Emergency/Pump To Waste" - If the operator selects this mode, control of the well pump, the prelube system, and the check valve will be a manual operation. Inhibit PLC control of the prelube solenoid valve, the controlled check valve, and related well pump alarms. Do not call for the well pump to operate under any condition when this mode is selected.

D. Iron Removal Filter Control Interface

1. Coordinate signals that interface the plant control panel with the filter control panel specified in Section 11600.

2. Energize a "Backwash Permissive Start" output to the filter control panel when all of the following conditions occur:

   a. Backwash tank level is below the "backwash enable" float switch level and:

   b. The supernatant pump and sludge pump are not running, and:

   c. Well pump #4 is running, and:

   d. There are no alarms related to well pump #4.

3. Backwash will be manually-initiated by the operator at the Section 11600 filter control panel. During backwash, a set of contacts in the filter control panel will close to keep the well pump running (See functional description for Well #4).

E. Chemical Feed Equipment Control

1. Chemical Booster Pumps

   a. Monitor both "prechlorination proof-of-flow" switch and "effluent proof-of-flow" switch inputs. If either flow switch detects flow, then start one of the two chemical booster pumps.

b. Operator will select "#1 only" or "#2 only" or "alternate" mode for pumps. In the "alternate" mode, alternate the pump called each time flow is sensed.

c. Provide software timers to prevent rapid cycling of the pumps.

d. Failure Alarms - Monitor "running" input on each chemical booster pump. If a pump is called and a "running" signal is not received in 5 seconds, initiate the pump's alarm output. When a pump failure occurs in the "alternate" mode, call for the other chemical booster pump and monitor its operation in the same manner. If both pumps fail, stop the well pump in its normal manner. If the selected pump fails in the "#1 only" or "#2 only" mode, initiate the respective alarm and shut down the well in its normal manner.

2. Chlorination

a. Energize the "prechlorination required" output when all of the following conditions occur:

1. Prechlorination proof-of-flow switch senses flow, and:

2. Well pump #4 is running.

b. Energize the "postchlorination required" output when all of the following conditions occur:

1. Effluent proof-of-flow switch senses flow, and:

2. Well pump #4 is running.

3. Fluoride

a. Fluoride feed pumps will have a constant feed rate, and shall be connected as indicated on the Drawings to operate with the "postchlorination" sequence listed above.

F. Filter Aerator Control

1. Energize the filter aerator output when all of the following conditions occur:

a. Well pump #4 is running and:

b. "Prechlorination" proof-of-flow switch detects flow.

G. Backwash Tank Supernatant Pump and Sludge Pump Control

1. At the end of an iron removal filter backwash, the filter control panel contacts will open. Initiate a software timer (adjustable in hours from 1 to 100) to allow sludge in the backwash tank to settle.

2. Then, call for the supernatant pump to operate only when the well pump is running and flow is detected. Continue operation of the supernatant pump concurrent with the well pump until the backwash tank level recedes to the "supernatant pump off" float switch.

3. Then, call for the sludge pump to operate continuously until the backwash tank level recedes to the "backwash pump off" float switch.

4. Pump Failure Alarms - Monitor "running" inputs for the supernatant pump and sludge pump. If either pump is called to operate, and a "running" signal is not received in 5 seconds, initiate the associated alarm output.

H. Power Monitor

1. Monitor the "power monitor" input from the motor control center. When the input deenergizes, stop calling for all motors, close the controlled check valve, and reset alarms that are generated by the PLC.

I. Power Restoration

1. The plant control panel shall automatically resume operation of the facility when power is lost and then restored. Manual resetting of the PLC or other components is not acceptable.

J. Low Plant Air Pressure Alarm

1. Initiate an alarm at the annunciator system when the "low plant air pressure switch" contacts close.

K. Building Temperature Alarms

1. Initiate the associated alarm point(s) when one or more of the building alarm thermostat contacts close.

L. Chlorine Leak Alarm

1. Monitor auxiliary contacts in the chlorine leak detector (specified in Section 11371) and initiate the associated alarm point.

M. Annunciator System

1. The plant control panel shall contain an annunciator system with individual points as shown on the Drawings.

2. When an alarm occurs, the associated window shall flash and the alarm horns shall sound. When the "acknowledge" pushbutton is pressed, the horns shall be silenced, and the alarm window(s) shall stay lit until the alarm condition is corrected.

3. If an alarm condition is corrected prior to pressing the "acknowledge" pushbutton, the window shall stay lit.

4. Each alarm point shall have a set of auxiliary contacts rated 5 Amps at 120 VAC. The contacts shall be normally-open, shall close on an alarm condition, and shall stay closed until the "acknowledge" pushbutton is closed.

5. Alarm points generated by the PLC shall remain energized until the PLC receives the "alarm reset" input signal.

N. Building Security

1. The plant control panel PLC shall contain logic for a building security system.

2. When the security switch is turned "on", delay 30 seconds and then begin monitoring the door limit switch circuit. If the circuit is then opened, delay 30 seconds and then energize the security alarm output to the telemetry system if the switch has not been turned "off".

3. The 30 second delays are to allow the operator to enter and leave the building without initiating the security alarm.

O. Flowmetering

1. Well Pump #4 Flow (FM-1):

   a. Monitor propeller flowmeter specified under Section 11900. The flowmeter is specified to have a 4-20mAdc, two-wire transmitter head with corresponding flow range of 0 to 1600 gallons per minute. Coordinate the signal interface with Section 11900 equipment.

   b. Display flow in gallons per minute, integrate and totalize flow in gallons times 1000.

   c. Record flow in gallons per minute on a circular chart recorder. Chart recorder shall have 7-day revolution.

2. Supernatant Return Flow (FM-2)

   a. Monitor propeller flowmeter specified under Section 11900. The flowmeter is specified to have a 4-20mAdc, two-wire transmitter head with corresponding flow range of 0 to 200 gallons per minute. Coordinate the signal interface with Section 11900 equipment.

   b. Display flow in gallons per minute, integrate and totalize flow in gallons times 1000.

3. Sludge Discharge Flow (FM-3)

   a. Furnish and install a magnetic flowmeter suitable for iron sludge applications. The flowmeter shall be a four (4) inch unit with anticipated flow range of 0 to 200 gallons per minute.

   b. The magnetic flowmeter shall have an integral transmitter that shall generate a 4-20mAdc signal proportional with flow.

   c. The plant control panel shall indicate flow in gallons per minute and integrate and totalize flow in gallons times 1000.

P. System Pressure Transmitter (PT-1)

1. Furnish and install a pressure transmitter in a NEMA 12 wall-mounting enclosure. The enclosure shall contain a shutoff valve, bulkhead fitting, and bleed line with valve, routed to the enclosure exterior.

2. The enclosure shall have a volume chamber and two pressure snubbers to minimize the effects of pressure transients on the measured signal.

3. Nominal pressure range shall be 0 - 150 p.s.i.g.

4. The pressure shall be displayed at the plant control panel, and input to the PLC and telemetry panel.

1.10 OWNER-FURNISHED TELEMETRY PANEL

A. The Owner will furnish a telemetry panel for installation by the Contractor. The panel will be a wall-mounting unit.

B. The panel will be furnished at no cost to the Contractor.

C. Under this contract, the Contractor shall mount the panel, and make all wiring terminations.

D. The panel will be supplied by Aquatrol Corporation under a separate contract with the Owner. Start-up services, training, and warranty on the panel will be provided under the separate contract.

E. Notify the separate supplier of project schedule and coordinate inspection by Aquatrol prior to energizing panel circuitry. Work cooperatively with the separate supplier and assist in minor wiring changes during start-up procedure.

F. Drawings showing panel terminal numbering will be furnished to the Contractor during construction.

G. The Contractor, under this Section, shall be responsible for coordination between the telemetry panel and equipment provided under this Section.

PART 2: PRODUCTS

2.01 ENCLOSURES--CONTROL PANELS

A. Enclosures for control panels shall meet the following minimum requirements:

1. Steel frame, steel panels, NEMA 12 unless otherwise specified

2. 90 inches high, 24 inches deep, multiples of 24 inches wide.

3. Panels shall be flanged, corners welded and ground smooth

4. All inside and exterior surfaces treated to prevent oxidation and painted. White on interior, manufacturer's standard color on exterior.

B. All components labeled per shop drawing nomenclature.

1. Engraved labels attached with screws.

C. All wiring terminated on barrier type terminal strips. Terminal strips shall be labeled with engraved plastic labels.

1. Labels shall be attached with two part epoxy adhesive.

2. 600 volt terminal strips

3. Ring or spade type crimp connectors

4. Wiring laced using plastic wire ties.

5. Wiring held down with straps attached to enclosure with screws.

6. Separate power, control and signal conductors.

7. Power wiring: #14 AWG, stranded, 600V copper minimum

8. Control wiring: #18 AWG, stranded, 600V copper minimum

9. Signal wiring: shielded, 300V, copper minimum. See Section 16100.

10. Provide 15 amp, 10000 AIC breaker on power circuits using #14 wire.

11. Connections to instruments via terminal strip or connectors. Soldering wires to terminal strips not acceptable.

2.02 CIRCULAR CHART RECORDER

A. Nominal size, 16 inches wide, 18 inches high, 5 inches deep, gasketed door, shatterproof window, NEMA 12.

B. 10-1/2 inch minimum, 12 inch maximum circular chart, 1 revolution per seven days.

C. 120 VAC, 60 Hz supply. Operating temperature, 0 - 50°C. Relative humidity, 35 - 90% non-condensing.

D. Minimum technical requirements:

1. Accuracy: ± 0.5% of calibrated span

2. Repeatability: ± 0.3% of calibrated span

3. Hysteresis: ± 0.3% of calibrated span

E. Legend and scale in engineering units (GPM).

F. 4-20 mAdc isolated input(s), 100 ohm load maximum.

G. Fiber-tipped disposable pens.

2.03 INDICATOR, ELECTRONIC DIGITAL

A. Flush mounted with red light emitting diode (LED) 0.43 inch high (minimum) numerals, 120 VAC, 60 Hz source.

B. Unit shall use integral dual slope A/D conversion. Legend, read out and engineering units shall meet application requirements.

C. Minimum technical requirements:

1. Input impedance: 50 megohms

2. Overvoltage protection: ± 20 volts

3. Accuracy: ± 0.5% ± 1 digit

4. Operating temperature: 0 - 50°C

5. Temperature coefficient: ± 50 ppm/°C

6. Normal mode rejection: 40 dB

7. Common mode rejection: 60 dB

8. Current to voltage conversion resistor

a. Metal film 1/4 watt minimum, 1% tolerance, 50 PM temperature coefficient

2.04 ELECTRONIC FUNCTION MODULES

A. 120 VAC source with regulated power supply.

B. Minimum technical requirements:

1. Accuracy: ± 0.5% of calibrated span

2. Response time: 100 milliseconds to 90% of step change

3. Repeatability: ± 0.25% of calibrated span

4. Deadband: ± 0.05% of calibrated span

5. Output ripple: 0.05% p-p into 750 ohm load

C. 4-20 mAdc isolated input, 250 ohms maximum.

D. 4-20 mAdc isolated output, 1250 ohms, maximum

E. Variable point at which function module effects input

1. Multi-turn pot, 0% to 100% of input range

2. Zero, slope, increase/decrease adjustable

F. Frequency response: 3dB down at 50 Hz, maximum

G. Operating temperature, 0 - 50°C; relative humidity, 35 - 90%, non-condensing.

2.05 ELECTRONIC INTEGRATOR

A. 120 volt, 60 Hz source with regulated power supply.

B. Zero drop out from 0% to 10% of calibrated span.

C. NEMA 1 enclosure

D. Minimum technical requirements:

1. Accuracy: ± 0.50% of calibrated span

2. Stability and drift: ± 0.50% of calibrated span, total.

E. Pulse output; dry contacts, 3 amps, 120 VAC, Form C, 250 millisecond operation.

2.06 TOTALIZER

A. Six digit unit, flush mount, non-resettable.

B. 120 volt, 60 Hz source.

C. Count coil (if DC) shall have transient suppression reverse-biased diode, 600 PIV.

D. Minimum technical requirements

1. 50% duty cycle

2. 16 counts per second, minimum

3. Maximum pulse length, 5 minutes

2.07 MAGNETIC FLOWMETER

A. Electro-magnetic induction type producing AC signal proportional to flow.

B. Wafer-style flowtube for installation between two pipe flanges.

C. 316 stainless steel conical raised electrodes.

D. Applicable with either AC or pulsed DC operation, 120 volt, 60 Hz operation.

E. Minimum operating temperature, 0 - 60°C; relative humidity 20% to 100%, condensing.

F. Transmitter shall be mounted on flowtube. Magnetic flow-to-current converter shall be of the solid state feedback type. Unless specifically required to be of a particular type the converter may be either of the AC or pulsed DC type.

G. Output shall be 4-20 mAdc linear with flow into load of 0 to 1000 ohms, minimum, isolated signal.

H. Operating source shall be 120 volts, 60 Hz, $\pm$ 3 Hz.

I. Pulsed DC type shall include automatic zero.

J. Minimum technical requirements:

1. Accuracy: ± 1.0% of calibrated span

2. Repeatability: ± 0.25% of calibrated span

3. Supply effect: ± 0.25% of calibrated span for ± 10% power supply variation

4. Temperature: ± 0.50% of calibrated span over rated range.

K. NEMA 4X construction.

L. Manufacturer.

1. Fischer-Porter
2. Foxboro
3. Or equal.

2.08 FLOAT SWITCHES

A. Polypropylene with encapsulated mercury switch.

B. Contact rating: 3 amps, 120 VAC, resistive.

C. Operating differential: 1 inch, nominal.

D. Extra flexible cord.

E. Suitable for Class 1, Division 2, Group D environment.

F. Free-hanging or fixed as indicated on Drawings.

2.09 CONTROL SWITCHES

A. Electronic Circuits

1. Selector, momentary pushbutton or momentary selector as required. Positions as required for application.

2. Heavy duty, oil-tight type, contacts as required.

3. Gold Flashed contacts; initial resistance, 0.01 ohms; 0.5 amps at 120 VAC, resistive.

B. Control Circuits

1. Selector, momentary pushbutton, or momentary selector as required. Positions as required for application.

2. Heavy duty, oil-tight type, contacts as required.

3. Contact rating shall conform to NEMA A-600 designation.

2.10 CONTROL RELAYS

A. Plug-in type with dust cover, socket and locking spring when relay mounted horizontally.

B. Coil: continuous operation at 120 VAC ± 10%

C. Contacts, 3 pole, double throw, minimum

1. 10 amps, make-break, 120 VAC, resistive

2. Insulation resistance: 1000 megohms at 500 VDC

3. Dielectric: 2000 VAC, 60 Hz.

D. Operating time

1. 35 milliseconds (nominal) energization

2. 100 milliseconds (nominal) de-energization

E. Mechanical life: 10^6 operations

F. Temperature: 0° to 70°C.

2.11 DIRECT CURRENT POWER SUPPLY

A. Series pass semiconductor type, adjustable with ± 1.0% regulation, no load to full load from all causes, total.

B. Operating source: 120 VAC, 60 Hz.

C. Output protection: current limiting and "crowbar" circuit. Fuses not permitted.

D. At initial operation power supply loading shall not exceed 50% of rating under any condition.

E. Convection cooled.

2.12 LIGHT BOXES

A. 1-1/2" x 3" x 3" deep, nominal

B. Two lamps per box, 100 mA at 28 VDC, nom.

C. Power supply for light boxes:

1. Adjustable 24.0 volts to 28.0 volts, minimum adjustment.

2.13 TERMINAL STRIPS

A. Barrier type, 9/16 inch spacing nominal

B. 2.5 kV RMS rating

C. Include engraved labels

2.14 ISOLATION TRANSFORMER

A. Minimum technical requirements:

1. Regulation: 4%

2. Dielectric strength: 2.5 kV

3. Efficiency: 96%

4. Insulation: Class H

5. Overload: 200% full load for 30 minutes

6. Common mode attenuation: -140 dB

7. Transverse mode attenuation: -30 dB/decade

8. Coupling: .001 pF

B. NEMA 1 enclosure

2.15 ANNUNCIATOR SYSTEM

A. Include light boxes front panel mounted.

B. Operates from either normally open or normally closed contacts

C. Lamp test feature

D. Sequence: As described in functional descriptions.

E. Common alarm contacts

1. Form C, 120 VAC, 3 amps, resistive

F. Auxiliary alarm contacts for each alarm point with function as described in functional descriptions.

2.16 ENCLOSURES--REMOTE COMPONENT ENCLOSURES

A. NEMA 12

B. Subpanel for components

C. 14 gauge steel with 12 gauge steel door minimum

D. Stainless steel hinges and hardware

E. Treated for oxidation resistance, painted with baked enamel paint, manufacturer's standard color on exterior, white interior.

F. Doors flanged with stiffeners for rigidity

2.17 INDICATING LIGHTS

A. Nominal 1-inch diameter, opaque colored lens.

B. Press-to-test feature.

C. Heavy-duty, oil-tight.

2.18 PROOF-OF-FLOW SWITCHES

A. Tap-mounted switch assembly that monitors for flow/no-flow condition in a pipe by sensing force against a paddle extending into the flow stream.

B. Paddle field-trimmed for pipe size and flow rate. Adjustable sensitivity.

C. All wetted parts shall be brass or stainless steel.

D. 1-1/4" NPT male threads for installation in a standard pipe tap.

E. Switch contacts rated 7 Amps at 120 VAC, resistive, minimum.

F. NEMA 1 enclosure.

G. Manufacturer:

1. McDonnel & Miller series FS7-4.

2. Or equal.

2.19 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Programmable logic controller capable of performing relay logic, timing, counting, sequencing, mathematical, logical, and comparison of analog values functions.

B. 4K word, minimum, random access CMOS memory (RAM). Electrically-erasable programmable read-only memory (EEPROM).

C. Auto start-up after power failure. Retain program and timer values so that PLC starts-up where sequence was left at time of power failure.

D. Scan 1000 word program in less than 0.1 seconds.

E. Inputs/outputs as indicated on Drawings. Optically-isolated inputs.

F. Programmable in ladder logic format from both a hand-held programmer and from manufacturer-supplied IBM-compatible software that allows off-site programming on a personal computer. (Hand-held programmer and programming software are not required to be furnished to the Owner.)

G. Password protection on programming.

H. Modular style, with seven-slot rack for input/output modules. Provide modules as required by schematics plus 20% spare inputs/outputs of all signal types.

I. Provide panel-mounting operator interface with 80-character display and alpha-numeric membrane keypad. Operator interface shall function as described in the functional descriptions in this Section.

J. Manufacturer

1. Allen Bradley Model SLC500 with options specified or equal products by Square D Company, General Electric, or Westinghouse.

K. It is the intent of this Specification that the PLC furnished under this Section be of the same manufacturer as the PLC in the filter control panel specified in Section 11600. The Contractor shall coordinate this requirement with the separate suppliers.

2.20 PRESSURE SWITCHES

A. NEMA 1 enclosure with SPDT mercury contacts rated 3 Amps at 120 VAC, minimum.

B. Five to 150 PSI adjustable range with visible calibrated dial.

C. Brass construction, brass Bourdon tube, Delrin bushed movement.

D. Repeatability - ±1% of full scale.

E. Manufacturer

1. Mercoid Corporation: Chicago, Illinois

2. Or equal.

2.21 PRESSURE TRANSMITTER

A. Electronic two-wire style generating 4-20 mAdc signal, linear with pressure, into 1000 ohms, isolated.

B. 316 stainless steel diaphragm. Span and zero adjustments.

C. Two wire device deriving operating power from 4-20 mAdc loop.

D. Process temperature, -40° to 250°F; ambient temperature, -20° to 200°F.

E. Accuracy: ± 0.5% of calibrated span.

F. Manufacturer:

1. Fischer-Porter
2. Foxboro
3. Or equal

2.22 TEMPERATURE ALARM THERMOSTATS

A. NEMA 4X enclosure with external bulb and SPDT contacts.

B. 40 to 100°F. adjustable range with calibrated scale in increments of 2°F.

C. Chromalox #WCRT-100, or equal.

2.23 DOOR SECURITY LIMIT SWITCHES

A. NEMA 4 enclosure with SPDT contacts rated 10 Amps at 120 VAC.

B. Two-inch lever arm with spring return.

C. Square D Class 9007, or equal.

PART 3: EXECUTION

3.01 FABRICATION

A. All components and subassemblies shall be mounted to the sub-chassis with tapped holes, and sub-chassis shall be attached to the chassis with bolts or screws. Adhesives are not acceptable.

B. Front panel labels shall be attached with screws.

C. Internal components and labels shall be attached with screws.

3.02 INSTALLATION

A. Supplier shall define to Contractor dimensions, space requirements, access requirements for instrumentation devices. The Contractor shall be responsible for flanges on the process piping, flange spacing, alignment, bolt hole configuration, bolts, etc. The Contractor shall install the meters, furnish and install all pressure taps, manifolds, etc.

3.03 SUPPLIES

A. Supplies and materials sufficient for full operation for one-year period shall be furnished in addition to materials required for initially placing the system in operation. Furnish 10% extra lamps, but not less than 2 of each type for each type used. Supplies shall include chart paper, ink pens, and other expendable items.

3.04 CALIBRATION, ADJUSTING AND TESTING

A. All instruments shall be shipped with adjustment points sealed with a small amount of paint and with a tag or other written document verifying factory calibration.

B. Devices requiring field calibration shall be calibrated in the presence of the Owner's representative, documented, and adjustments subsequently sealed with a small amount of paint.

C. Prior to start-up, all instruments, gauges, and installed control systems installed under the contract shall be tested and adjusted to the satisfaction of the Engineer. The testing and adjustment shall be made only by a qualified manufacturer's representative.

3.05 PLC PROGRAMMING SERVICES

A. Program the programmable logic controller (PLC) as required by functional descriptions.

B. Supplier shall program unit using manufacturer's personal computer program.

C. Submit record copy of program after system start-up. Program shall be printed on 8-1/2" x 11" pages in ladder format. Each rung shall have a verbal description of its function.

D. Supplier shall provide a competent programmer who shall attend all start-up procedures at the facility and shall make minor program changes in the field to facilitate start-up.

3.06 LABELING

A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.

B. Labels shall be engraved laminated plastic with 1/4" high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.07 START-UP SERVICE

A. When the equipment is ready to start-up, a skilled instrumentation engineer or technician shall complete troubleshooting and start-up, at the Owner's and Engineer's discretion, to place the entire instrumentation system into satisfactory operation. The engineer or technician will make the necessary inspection of the completed installation, make the necessary final field adjustments, and instruct the operating personnel in the proper care and use of the equipment. The start-up service shall be as defined in Section 16010.

3.08 CALL-BACK SERVICE

A. The manufacturer or supplier shall include in his bid the cost of sending a service engineer or technician to the job site for two separate days during the first year after start-up. During each trip he should be prepared to calibrate or check the calibration of any components, re-program the PLC system, and provide general assistance in the field of instrumentation techniques and procedures. The specified days shall be at the discretion of the Owner and the Engineer. The trips shall be at no additional cost to the Owner.

3.09 TRAINING

A. The training shall be for not less than 8 hours on the instrumentation and control system at a time selected by the Owner.

END OF SECTION 16950