Oak Creek Water and Sewer Utility Oak Creek, Wisconsin Water Treatment Plant and Low Lift Pump Station Standby Power



For Construction

March 21, 2011

Design Firm Registration No. 184-000450

Clark Dietz Project No. 00130014



Oak Creek Water and Sewer Utility Oak Creek, Wisconsin

BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS

For the construction of the

Water Treatment Plant and Low Lift Pump Station Standby Power



March 21, 2011

Clark Dietz Project No. 00130014

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NOTICE TO BIDDERS

OWNER	The Oak Creek Water & Sewer Utility Commission hereby gives notice that sealed proposals will be received at the office of the Utility at 170 W. Drexel Avenue, Oak Creek, Wisconsin, 53154.
PROJECT	The work, officially known as Water Treatment Plant and Low Lift Pump Station Standby Power, consists of the following:
	 A. Provision and installation of the following: Modifications to heating water system Modifications to potassium permanganate system Modifications to natural gas system Modifications to chain link fence Modifications to mezzanine Excavation, grading and reseeding Electrical work Piping and insulation Remodeling of existing building
	 B. Installation of the following Owner provided equipment: 1. Natural gas standby generators 2. Medium Voltage Transfer Switchgear 3. Low Voltage Automatic Transfer Switch 4. Pad mounted oil filled transformer 5. Motor control center 6. Panelboard
TIME	Proposals must be received by the office of the Utility, 170 W. Drexel Avenue, no later than 10:00 a.m., March 2, 2011, at which time and place the proposals will be publicly opened and read aloud.
CONTRACT DOCUMENTS	Plans, specifications, and bidding documents may be obtained at the office of the Utility at 170 W. Drexel Avenue, Oak Creek, Wisconsin, 53154. A non-refundable fee of \$100.00 will be required for each set of Bidding Documents payable to Oak Creek Water and Sewer Utility. Mail requests for Bidding Documents shall require an additional amount of \$10.00 to cover the costs of postage and handling. Monies for the bidding documents and postage and handling are not refundable. Plans, specifications, and bidding documents may also be obtained at the following web site <u>http://www.water.oak-creek.wi.us/</u> by selecting "Public Contracts".
STATUTORY PROVISIONS	The Contract letting shall be subject to the provisions of Section 62.15, 66.0901, 66.0903 and 779.16 Wisconsin Statutes. The minimum wage scale to be paid on this project shall be in accordance with the prevailing minimum wage as determined by federal or state law, whichever applies, and such wage is incorporated by reference, as it may be amended from time to time. If the United States Department of Housing and Urban Development or State of Wisconsin, Department of Workforce Development has issued a wage rate determination, then it shall apply.

PRE-BID	A pre-bid conference will be held prior to the Bid opening on 15 th day of
CONFERENCE	February, 2011, at 10:00 a.m. at the Oak Creek Water and Sewer Utility, 9325
	South Fifth Avenue, Oak Creek, Wisconsin 53154, to familiarize Bidders with
	this project.

- BID GUARANTEE A certified check or bank draft payable to the Oak Creek Water & Sewer Utility, or a satisfactory bid bond, in an amount not less than 5% of the bid shall accompany each bid as a guarantee that if the bid is accepted, the bidder will execute and file the proposed contract and bond within 10 days after the award of the contract. In case the bidder fails to file such contract and bond within the time set by the Utility, the check or bid bond shall be forfeited to the Utility as liquidated damages pursuant to SS.62.15 (3).
- EQUAL The Oak Creek Water and Sewer Utility hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, minority business enterprises will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the ground of race, color, sex, or national origin in consideration for an award.
- BID REJECTION The Utility Commission reserves the right to reject any and all bids, waive any informalities in bidding, or to accept the bid or bids, which best serves the interest of the Oak Creek Water & Sewer Utility.
- BIDNo bid shall be withdrawn for a period of 30 days after the scheduled opening ofWITHDRAWALthe bids without the consent of the Utility Commission.

BIDDINGPlans, specifications and bidding documents shall be available at the Utility atDOCUMENTS170 W. Drexel Avenue, Oak Creek, Wisconsin, 53154, on February 4, 2011.AVAILABILITY170 W. Drexel Avenue, Oak Creek, Wisconsin, 53154, on February 4, 2011.

Published by the authority of the Utility Commission these 10th, 17th, and 24th days of February 2011.

END OF SECTION

SECTION 00 21 15

INSTRUCTIONS TO BIDDERS

1. PROPOSAL FORMS

No bid will be considered which is not submitted on forms furnished by the Utility Engineer.

2. BIDDER

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the PROJECT shall apply to the contract throughout.

3. PRIOR EXAMINATION OF CONTRACT DOCUMENTS AND WORKSITE

Bidders shall inform themselves of the conditions under which work is to be performed by examining the contract documents, site, ground conditions and obstacles to be encountered in the field, and by such other means necessary. After proposal submittal, the Utility will not accept a claim that there was any misunderstanding as to the quantities, conditions, nature of the work, or extra compensation for items the Contractor failed to inform himself of prior to bidding.

4. INADEQUACIES AND OMISSIONS

Any verbal information obtained from or statement made by representatives of the engineering department at the time of the examination of the contract documents or the site for the purpose of bidding, which apparently corrects or in any way amends the contract documents shall be invalid. The Oak Creek Water and Sewer Utility will not be responsible for such verbal information or statements.

Bidders shall bring any inadequacies, omissions, or conflicts to the Utility Engineer's attention at least seven days before the due date of bids. Prompt clarification will be immediately supplied to all bidders by addenda, and each addendum shall be acknowledged on the proposal form. Failure to so request clarification of any inadequacy, omission or conflict will not relieve the contractor of responsibility. The signing of the contract will be considered as implicitly denoting that the contractor has a thorough comprehension of the full intent and scope of the specifications and drawings.

All questions about the meaning or intent of the Bidding Documents are to be directed to Clark Dietz, Inc., 125 West Church Street, Champaign, IL 61820. All questions shall be in writing either faxed to 217.373.8923 to the attention of Steven Myers or emailed to <u>steve.myers@clarkdietz.com</u>.

5. SUBCONTRACTORS

Bidders shall be required to submit a list of subcontractors with their proposal in accordance with Section 66.0901(7), Wisconsin Statutes, 1979-1980 and subsequent amendments.

This list of subcontractors shall not be added to nor altered without the written consent of the Utility Engineer. The Utility Engineer may reject proposals if the list of subcontractors and the class of work to be performed is omitted. The omission shall be considered inadvertent or a

Clark Dietz, Inc. 00130014

Instructions to Bidders 00 21 15-1 representation that the bidder will perform the work himself. If such an omission is inadvertent, the bidder shall provide the list of subcontractors within two working days from the date and time of the bid opening.

6. TIME OF PERFORMANCE

The bidder shall complete the work within the Days to Achieve Substantial Completion and Final Payment specified in Section 00 52 15.

The bidder should make due allowance for all probable difficulties which may be encountered.

In the event of failure to complete the work within the time stated or otherwise specified, liquidated damages will be assessed as provided in Section 00 52 15.

7. PROPOSAL GUARANTY

The Oak Creek Water and Sewer Utility requires either a bid bond or a certified check of at least 5% of the bid.

8. REQUIREMENTS FOR SIGNING PROPOSALS

- A. The full name and business address of each bidder must be entered on the proposal submitted. The proposal shall be signed in the space provided by written signature of the person or persons properly authorized to sign it.
- B. A proposal submitted by an individual shall be signed by the bidder or by an authorized agent.
- C. A proposal submitted by a firm or partnership shall be signed by a member or by an authorized agent; if by joint adventurers, the proposal shall be signed by each of their authorized agent(s).
- D. Proposals which are signed by an attorney-in-fact for individuals, firms, partnerships or joint adventurers shall have attached a power-of-attorney evidencing authority to sign the bid.
- E. A proposal submitted by a corporation shall be signed by an authorized officer or agent of such corporation. Such corporation must be licensed to do business in the State of Wisconsin before a proposal to do the work can be received. If a foreign corporation, the state under which it is incorporated must be named.

9. SUBMISSION OF PROPOSAL

The proposal and the proposal guaranty shall be placed in an envelope or in separate envelopes and shall be sealed. On the envelope or envelopes shall be plainly written the PROJECT NUMBER, DATE OF OPENING BIDS, NAME OF BIDDER, AND THE TYPE AND LOCATION OF THE WORK. Such envelope(s) shall be addressed and delivered to the office of the office of the Utility before the time specified in the Notice to Bidders for opening bids.

10. WITHDRAWAL OF PROPOSAL

A bidder may withdraw a proposal, provided the Clerk receives a written request prior to the deadline for accepting proposals. The proposal will be returned to the bidder unopened.

11. BID PRICES

Bid price must be written out in words and also entered in figures. In case of variation, the written price will prevail.

12. DOUBLE BIDDING

Two proposals under different names will not be accepted from one firm or association.

13. RIGHT TO ACCEPT OR REJECT BIDS

The Utility reserves the unqualified right to reject any or all bids at its sole and absolute discretion, or to reject any or all bids where the Utility Engineer has determined that the contractor or bidder has unbalanced his bid and unit prices. The Utility further reserves the unqualified right to waive any irregularities in any bid, or to accept any bid which will best serve the interests of the Utility. The Utility also reserves the unrestricted privilege to reject any unit prices for additions to or deductions from the scheduled amount of work as given in the bid, if the same are considered excessive or unreasonable, or to accept any or all such unit prices which may be considered fair and reasonable.

The bid openings are open to the public, and no awards will be made immediately upon opening bids nor until the bids opened can be compared, scheduled, and reviewed by the Utility Commission. The contract shall be awarded by Utility Commission action and the bidder to whom the award is made will be notified at the earliest possible date.

14. PERFORMANCE GUARANTY

The performance of the contract must be assured by a surety bond executed by the successful bidder in the full amount of the contract. Such bond must also be executed by a surety company.

15. CONTRACT EXECUTION

Within ten days from the date of receipt of the contract forms from the Utility Attorney, the successful bidder shall sign four copies of the contract form, attach the performance guarantee of the approved licensed surety, and deliver to the office of the Utility. The contract, when signed by the Utility, and approved as to form and execution by the Utility Attorney, shall be a part of the contract documents. When all parties have signed the contract, the Utility will refund the proposal deposit to the successful bidder.

In case of failure to have delivered such properly executed copies of the contract within ten days, or such extension as the Utility Commission only may deem reasonable, bidder will be considered as having abandoned his proposal. Bidder will be considered in default to the Utility to the full amount of the bid deposit. It will be understood and agreed by the party submitting the proposal that such bid deposit represents the damages to which the Utility will be subjected by reason of the bidder's default in acceptance of contract, or failure to either properly execute the contract forms or deliver within the specified time of such extension.

16. STARTING WORK BEFORE NOTIFICATION

No work shall be performed under the contract and no materials or equipment shall be delivered to the site of the work prior to the date in the Utility Engineer's written Notice to Proceed.

17. REFUND OF BID DEPOSIT TO UNSUCCESSFUL BIDDERS

The bid deposit of all except the two lowest bidders will be refunded after the Utility Commission has determined the lowest responsible bidder. The remaining bid deposit will be refunded upon execution of the contract.

END OF SECTION

SECTION 00 41 13

BID PROPOSAL

_____, 2011

To: The Oak Creek Water & Sewer Utility

Re: Bid Proposal

In conformity with the notice to bidders, the undersigned bidder, having examined the site of the work and the contract, submits the following proposal for furnishing the material, equipment, labor and everything necessary for the completion of the work listed hereunder, and agrees to execute the proposed contract and furnish the required bond for the completion of said work.

The undersigned bidder deposits herewith a certified check payable to the order of the Oak Creek Water & Sewer Utility, or an approved bid bond, in the sum designated in said notice, and hereby agrees that in the event the undersigned bidder shall fail to execute the contract with surety bond thereto and return the same to the Utility within ten calendar days after transmittal by the Utility, then said certified check shall be retained by and become the property of the Oak Creek Water & Sewer Utility as fixed and liquidated damages or the penalty as provided by said bond shall be recovered as liquidated damages.

It is further understood that construction on this contract shall commence and be completed as specified in the Contract Documents.

This proposal submitted by:

Bidder	Address
Phone	City, State, Zip Code
Operating as: Sole Trader Partners	hip Corporation
Under the laws of the State of	
By:	(Signature)
	(Title)

ADDENDUM RECEIPT: We acknowledge the receipt of Addenda _____ inclusive.

SWORN STATEMENT OF BIDDER

PURSUANT TO SECTION 66.0901 (7) WISCONSIN STATUTES

I, being duly sworn at ______ (City), ______ (State), on oath, do hereby state on behalf of said bidder that I have examined and carefully prepared this proposal from the plans, specifications, the work site including surface and underground conditions, and other contract documents and have checked the same in detail before submitting this proposal; and that this sworn statement is hereby made an integral part of this proposal.

By:

(Signature)

(Title)

Subscribed and sworn to before me this _____ day of _____, 20____.

Notary Public, _____ County

State of _____

My commission expires:

Affix corporate seal below.

INFORMATION ON SURETY (please fill out completely)

Firm	
Address, City, State, Zip Code	
Attorney-in-fact	
Address, City, State, Zip Code	

INFORMATION ON SUBCONTRACTORS

The undersigned bidder will employ, subject to the approval of the said owner, the following subcontractors. This list shall not be added to nor altered without the written consent of the owner. A bid shall not be invalid if the list of subcontractors and the class of work to be performed has been omitted. The omission shall be considered inadvertent or a representation that the bidder will perform the work himself. If such an omission is inadvertent, the bidder shall provide the list of subcontractors within two working days from the date and time of the bid opening.

NAME	ADDRESS		CLASS OF WORK	
	-			
TOTAL LUMP SUM AMO	UNT \$			
		DOLLARS AND		CENTS.
(in words)				
	END	OF SECTION		
Clark Dietz, Inc.			Bid	Proposal

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00 41 13-3

SECTION 00 43 13

BID BOND FORM

KNOW ALL MEN BY THESE PRESENT. that the undersigned, we. (1)___, as Principal, and (2) ___, as Surety, are hereby and firmly bound unto The Oak Creek Water and Sewer Utility Commission, as Owner, in the penal for the payment of which, well and truly to sum of (4)be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns. Signed, this _____ day of _____, 2011.

The condition of the above obligation is such that whereas the Principal has submitted to The Oak Creek Water and Sewer Utility Commission a certain Bid, attached hereto and hereby made a part hereof to enter into a contract in writing, for the Work described as: Water Treatment Plant and Low Lift Pump Station Standby Power.

NOW, THEREFORE,

- (a) If said Bid shall be rejected, or in the alternate,
- (b) If said Bid shall be accepted and the Principal shall execute and deliver a contract, in the Form of Agreement attached hereto (properly completed in accordance with said Bid), and shall furnish a bond for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid,

then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid; and said Surety does hereby give waive notice of any such extension.

(1) Contractor

- (2) Surety IMPORTANT Surety companies executing BONDS must hold certificates of authority as acceptable sureties (31CFR223) and be authorized to transact business in the state where the project is located.
- (4) Percent of the Contract specified in Section 00 21 15, Instructions to Bidders.

Clark Dietz, Inc. 00130014 IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

		Surety
	Principal	
By Attorney-In-Fact	SEAL By	SEAL
	Title	
	Attest:	
	Secretary	

END OF SECTION

ISSUE DATE: 1/31/2011	
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PROJECT:

WATER TREATMENT PLANT & LOW LIFT PUMP STATION STANDBY POWER
OAK CREEK CITY, MILWAUKEE COUNTY, WI
Determination No. 2011003/1

PROJECT OWNER:	REQUESTER:
MIKE SULLIVAN, UTILITY ENGINEER OAK CREEK SEWER & WATER UTILITY 170 W DREXEL AVE OAK CREEK, WI 53154	MIKE SULLIVAN, UTILITY ENGINEER OAK CREEK SEWER & WATER UTILITY 170 W DREXEL AVE OAK CREEK, WI 53154
ADDITIONAL CONTACT:	
	NOTE: The Requester must provide a copy of this Project Determination and enclosures to the Project Owner and Additional Contact.

The department received an application for prevailing wage rate determination for the above-captioned project. The department conducted a survey to determine the prevailing wage rate for the trade(s) or occupation(s) needed to complete the project. The survey's findings appear in the attached project determination.

If you believe that the wage rate for any trade or occupation does not accurately reflect the prevailing wage rate in the city, village or town where the project is located, you may ask the department to conduct an administrative review of such wage rate. You must submit this request in writing within 30 days from the date indicated above. Additionally, your request must include wage rate information from at least three similar projects in the city, village or town where the proposed project is located and on which some work has been performed by the contested trade(s) during the current survey period and was previously considered by the department in issuing the attached determination. See DWD 290.10 of the Wisconsin Administrative Code and either s. 66.0903(3)(br), s. 66.0904(4)(e), or s. 103.49(3)(c), Stats., for a complete explanation of the administrative review process.

Enclosures

It is hereby ordered that the prevailing wage rates set forth in the attached project determination shall only be applicable to the above referenced project. This order is a **FINAL ORDER** of the department unless a timely request for an administrative review is filed with the department.

ISSUED BY:

Equal Rights Division Labor Standards Bureau Construction Wage Standards Section PO Box 8928 Madison, WI 53708-8928 (608)266-6861

Web Site: http://dwd.wisconsin.gov/er/

PREVAILING WAGE RATE DETERMINATION Issued by the State of Wisconsin Department of Workforce Development Pursuant to s. 66.0903, Wis. Stats. Issued On: 1/31/2011

DETERMINATION NUMBER:	201100341
EXPIRATION DATE:	Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2011. If NOT, You MUST Reapply.
PROJECT NAME:	WATER TREATMENT PLANT & LOW LIFT PUMP STATION STANDBY POWER
PROJECT LOCATION:	OAK CREEK CITY, MILWAUKEE COUNTY, WI
CONTRACTING AGENCY:	OAK CREEK SEWER & WATER UTILITY
CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm.
OVERTIME:	 Time and one-half must be paid for all hours worked: over 10 hours per day on prevailing wage projects over 40 hours per calendar week Saturday and Sunday on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25; The day before if January 1, July 4 or December 25 falls on a Saturday; The day following if January 1, July 4 or December 25 falls on a Sunday.
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whevenever such pay is applicable.
APPRENTICES:	Pay apprentices a percentage of the applicable journeyperson's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.
ELECTRONIC CERTIFIED: PAYROLL REPORTS:	Every contractor working on this project MUST file monthly certified payroll reports in an electronic format that meets the Wisconsin Department of Workforce Development's reporting requirements. These certified payroll reports must be filed by the 7th of the month following the month in which the contractor performed work on this project at the following website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project**. A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

- 1. January 1.
- 2. The last Monday in May.
- 3. July 4.
- 4. The first Monday in September.
- 5. The 4th Thursday in November.
- 6. December 25.
- 7. The day before if January 1, July 4 or December 25 falls on a Saturday.
- 8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.

(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.

(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.

2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.

3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages. 5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

	SKILLED TRADES			
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
101	Acoustic Ceiling Tile Installer	31.38	18.16	49.54
102	Boilermaker	31.09	23.75	54.84
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$1.95 6/06/2011	35.53	15.92	51.45
104	Cabinet Installer	28.31	14.91	43.22
105	Carpenter Future Increase(s): Add \$2.65 on 6/6/11	31.68	18.41	50.09
106	Carpet Layer or Soft Floor Coverer Future Increase(s): Add \$2.65 on 6/6/11	31.68	18.41	50.09
107	Cement Finisher	29.72	15.23	44.95
108	Drywall Taper or Finisher	28.17	15.39	43.56
109	Electrician	31.10	20.39	51.49
110	Elevator Constructor	40.46	23.33	63.79
111	Fence Erector	22.50	3.65	26.15
112	Fire Sprinkler Fitter	36.82	19.03	55.85
113	Glazier Future Increase(s): Add \$2.10/hr on 6/1/2011; Add \$2.15/hr on 6/1/2012.	32.25	15.94	48.19
114	Heat or Frost Insulator	33.28	21.37	54.65
115	Insulator (Batt or Blown)	17.11	17.69	34.80
116	Ironworker Future Increase(s): Add \$2/hr on 6/6/2011.	31.31	21.79	53.10
117	Lather	31.38	16.11	47.49
118	Line Constructor (Electrical)	31.66	13.94	45.60

<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
119	Marble Finisher	29.40	14.31	43.71
120	Marble Mason	34.58	14.92	49.50
121	Metal Building Erector	13.00	6.86	19.86
122	Millwright	28.30	23.06	51.36
123	Overhead Door Installer	17.25	3.00	20.25
124	Painter Future Increase(s): Add \$2.10/hr on 6/1/2011; Add \$2.20/hr on 6/1/2012. Premium Increase(s): Add \$.20/hr for paperhanging; Add \$.35/hr for bridge, iron and drywall; Add \$.75/hr for spraying and sandblasting; Add \$.60/hr for EIFS work; Add \$1.00/hr for lead based paint removal.	28.47	16.74	45.21
125	Pavement Marking Operator	25.65	13.10	38.75
126	Piledriver Future Increase(s): Add \$2.65/hr on 6/6/11. Premium Increase(s): Add \$.65/hr for Piledriver Loftsman; Add \$.75/hr for Sheet Piling Loftsman.	28.11	23.76	51.87
127	Pipeline Fuser or Welder (Gas or Utility)	29.85	17.34	47.19
129	Plasterer	29.31	15.83	45.14
130	Plumber	37.42	17.02	54.44
132	Refrigeration Mechanic	34.41	17.59	52.00
133	Roofer or Waterproofer	28.85	14.60	43.45
134	Sheet Metal Worker	37.20	16.41	53.61
135	Steamfitter	37.21	19.04	56.25
137	Teledata Technician or Installer	24.65	15.17	39.82
138	Temperature Control Installer	35.81	16.98	52.79
139	Terrazzo Finisher	29.40	14.31	43.71
140	Terrazzo Mechanic	29.40	14.31	43.71
141	Tile Finisher	15.05	9.43	24.48
142	Tile Setter	29.95	15.64	45.59
143	Tuckpointer, Caulker or Cleaner Future Increase(s): Add \$1.95 06/06/2011	34.30	15.47	49.77
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY BASIC RATE	HOURLY FRINGE	
<u>CODE</u>	TRADE OR OCCUPATION	<u>OF PAY</u> \$	<u>BENEFITS</u> \$	<u>TOTAL</u> \$
146	Well Driller or Pump Installer Future Increase(s): Add \$1.60/hr on 6/1/11. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	24.22	14.80	39.02
147	Siding Installer	36.60	15.48	52.08
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	26.88	13.71	40.59
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	27.66	0.00	27.66
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.00	8.50	25.50
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.44	0.00	25.44
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21
	TRUCK DRIVERS			
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
201	Single Axle or Two Axle	21.42	5.62	27.04
203	Three or More Axle	26.62	17.81	44.43
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	26.62	17.81	44.43
	LABORERS			
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
301	General Laborer Future Increase(s): Add \$2.25/hr on 6/1/2011. Premium Increase(s): Add \$.11 for mortar mixer, fork lift operator, air and electric equipment and power buggy operators; Add \$.22 for jackhammer operator, certified welder, gunite machineman.	27.17	15.01	42.18

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY	HOURLY	
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	BENEFITS	<u>TOTAL</u> \$
302	Asbestos Abatement Worker	23.25	13.91	37.16
303	Landscaper Future Increase(s): Add \$1.00/hr on 6/1/2011; Add \$1.00/hr on 6/1/2012: Add \$1.00/hr on 6/1/2013; Add \$1.00/hr on 6/1/2014.	13.80	15.10	28.90
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water) Future Increase(s): Add \$1.00/hr. on 6/1/2011	18.74	14.93	33.67
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	15.00	3.09	18.09
314	Railroad Track Laborer	12.50	3.96	16.46

HEAVY EQUIPMENT OPERATORS SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY	
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	BENEFITS	<u>TOTAL</u> \$
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under).	33.24	17.61	50.85

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY	HOURLY		
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	BENEFITS \$	<u>TOTAL</u> \$	
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	32.32	16.75	49.07	
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13	
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Premium Increase(s): Add \$.50/hr for friction crane, lattice boom or crane certification (CCO). On Sunday & holidays, pay two times the hourly basic rate.	37.45	19.45	56.90	
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	33.35	19.33	52.68	
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	32.20	18.69	50.89	

HEAVY EQUIPMENT OPERATORS EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK

<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$2.10/hr on 6/1/11 Premium Increase(s): Crane Operators with CCO certification add \$.50/hr. Cranes with boom length over 200 ft. not exceeding 300 ft. OR lifting capacity over 200 ton not exceeding 300 ton add \$.50/hr. Over 300 ton OR 300 ft. add \$.01/hr. per foot OR ton whichever is greater. On Sunday & holidays, pay two times the hourly basic rate.	38.06	18.10	56.16
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Towe Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add \$2.10/hr on 6/1/2011. Premium Increase(s): Crane Operators with CCO certification add \$.50/hr. On Sunday & holidays, pay two times the hourly basic rate.	37.56 r	18.10	55.66
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add \$2.10/hr on 6/1/11. Premium Increase(s): Crane Operators with CCO certification add \$.50/hr. On Sunday & holidays, pay two times the hourly basic rate.	37.06	18.10	55.16

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY BASIC BATE		
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	BENEFITS \$	<u>TOTAL</u> \$
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$2/hr on 6/1/11. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	36.47	18.10	54.57
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	29.82	17.96	47.78
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$2/hr on 6/1/11. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	29.44	18.10	47.54

514 Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment).

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY	HOURLY	
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	BENEFITS \$	<u>TOTAL</u> \$
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add \$1.60/hr on 6/1/2011.	30.21	16.85	47.06
516	Fiber Optic Cable Equipment Future Increase(s): Add \$1.75/hr on 2/1/11.	24.39	15.45	39.84

Determination No. 201100341

SEWER, WATER OR TUNNEL CONSTRUCTION

Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

	SKILLED TRADES				
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$	
103	Bricklayer, Blocklayer or Stonemason	34.58	14.92	49.50	
105	Carpenter	31.38	16.03	47.41	
107	Cement Finisher	24.00	18.63	42.63	
109	Electrician	32.53	18.34	50.87	
111	Fence Erector	22.50	3.65	26.15	
116	Ironworker Future Increase(s): Add \$2/hr on 6/6/2011.	31.31	21.79	53.10	
118	Line Constructor (Electrical)	31.66	13.94	45.60	
125	Pavement Marking Operator	25.65	13.10	38.75	
126	Piledriver Future Increase(s): Add \$2.65/hr on 6/6/11. Premium Increase(s): Add \$.65/hr for Piledriver Loftsman; Add \$.75/hr for Sheet Piling Loftsman.	28.11	23.76	51.87	
130	Plumber	34.45	15.50	49.95	
135	Steamfitter	31.65	15.04	46.69	
137	Teledata Technician or Installer	24.09	14.48	38.57	
143	Tuckpointer, Caulker or Cleaner	33.35	14.47	47.82	
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22	
146	Well Driller or Pump Installer	24.22	14.80	39.02	
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	26.88	13.71	40.59	
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	27.66	0.00	27.66	
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.00	8.50	25.50	
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.44	0.00	25.44	
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21	

	TRUCK DRIVERS			
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
201	Single Axle or Two Axle	21.42	5.62	27.04
203	Three or More Axle	17.03	12.89	29.92
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.89	17.96	49.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	17.03	12.89	29.92
	LABORERS			
CODE	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
301	General Laborer Future Increase(s): Add \$1.67/hr on 6/6/2011; Add \$1.73/hr on 6/4/2012. Premium Increase(s): Add \$1.92 for bottomman; Add \$2.03 for concrete manhole builder, bracer, jointman, or pipelayer; Add \$4.83 for blaster. Add \$2.00 for all tunnel work under 15 Ibs. compressed air; Add \$2.00 for 0-30 lbs. compressed air; Add \$3.00 for over 30 lbs. compressed air.	26.65	15.01	41.66
303	Landscaper	13.40	14.50	27.90
304	Flagperson or Traffic Control Person	19.83	15.65	35.48
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	12.50	0.00	12.50
314	Railroad Track Laborer	12.50	3.96	16.46

HEAVY EQUIPMENT OPERATORS SEWER, WATER OR TUNNEL WORK

<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. of Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	r 33.59	17.75	51.34
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skic Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	32.81	17.75	50.56

<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Roted or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$2.5/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	31.86	17.75	49.61
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chair Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	30.81	17.75	48.56

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY	
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	<u>BENEFITS</u> \$	<u>TOTAL</u> \$
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	29.41	17.75	47.16
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler. Future Increase(s): Add \$1.90/hr on 6/6/2011; Add \$2.05/hr on 6/4/2012. Premium Increase(s): Add \$.25/hr for operating tower crane. On Sunday & holidays, pay two times the hourly basic rate except pump/generator operators when employed on non-productive projects.	29.41	17.75	47.16
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	35.05	18.08	53.13
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	32.20	18.69	50.89
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	32.20	18.69	50.89

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LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION

Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES				
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$
103	Bricklayer, Blocklayer or Stonemason	34.58	14.92	49.50
105	Carpenter	31.38	16.29	47.67
107	Cement Finisher	27.12	16.07	43.19
109	Electrician	31.10	20.39	51.49
111	Fence Erector	22.50	3.65	26.15
116	Ironworker Future Increase(s): Add \$2/hr on 6/6/2011.	31.31	21.79	53.10
118	Line Constructor (Electrical)	31.66	13.94	45.60
124	Painter	27.82	15.39	43.21
125	Pavement Marking Operator	23.46	9.45	32.91
126	Piledriver	28.11	21.16	49.27
133	Roofer or Waterproofer	28.85	13.60	42.45
137	Teledata Technician or Installer	24.09	14.48	38.57
143	Tuckpointer, Caulker or Cleaner	33.35	14.47	47.82
144	Underwater Diver (Except on Great Lakes)	32.31	14.91	47.22
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	26.88	13.71	40.59
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.21	14.30	42.51
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.68	16.16	40.84
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	22.92	11.87	34.79
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	29.06	15.39	44.45

TRUCK DRIVERS					
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$	
201	Single Axle or Two Axle	21.42	5.62	27.04	
203	Three or More Axle	13.00	13.60	26.60	
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.89	17.96	49.85	
205	Pavement Marking Vehicle	20.85	11.02	31.87	
206	Shadow or Pilot Vehicle	21.42	5.62	27.04	
207	Truck Mechanic	13.00	13.60	26.60	
	LABORERS				
<u>CODE</u>	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$	<u>TOTAL</u> \$	
301	General Laborer	23.34	17.30	40.64	
303	Landscaper	22.00	5.20	27.20	
304	Flagperson or Traffic Control Person	17.19	15.32	32.51	
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	15.00	3.09	18.09	
314	Railroad Track Laborer	12.50	3.96	16.46	

HEAVY EQUIPMENT OPERATORS CONCRETE PAVEMENT OR BRIDGE WORK

CODE	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked <u>TRADE OR OCCUPATION</u>	HOURLY BASIC RATE <u>OF PAY</u> \$	HOURLY FRINGE <u>BENEFITS</u> \$		
				<u>TOTAL</u> \$	
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	31.97	16.96	48.93	

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY	
<u>CODE</u>	TRADE OR OCCUPATION	OF PAY \$	<u>BENEFITS</u> \$	<u>TOTAL</u> \$
542	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate. For "Airport Pavement or State Highway Construction" project type only, add \$1.50/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	32.57	18.10	50.67
543	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.	30.97	16.98	47.95
	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY	
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<u>CODE</u>	TRADE OR OCCUPATION	OF PAY	BENEFITS	TOTAL
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (WIth or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	₽ 32.32	¥ 16.75	49.07
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.85/hr on 5/31/2011. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	30.97	16.75	47.72
546	Fiber Optic Cable Equipment.	22.79	15.30	38.09
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	35.05	18.08	53.13
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	35.05	18.08	53.13
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	32.20	18.69	50.89
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	32.20	18.69	50.89

HEAVY EQUIPMENT OPERATORS ASPHALT PAVEMENT OR OTHER WORK

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY	HOURLY	
CODE	TRADE OR OCCUPATION	OF PAY \$	BENEFITS \$	<u>TOTAL</u> \$
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	31.97	17.35	49.32
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.	30.42	17.05	47.47
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.52	17.75	49.27

	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY	HOURLY	
<u>CODE</u>	TRADE OR OCCUPATION	BASIC RATE OF PAY \$	BENEFITS \$	<u>TOTAL</u> \$
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.52	17.75	49.27
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.95/hr on 6/1/11; Add \$2/hr on 6/1/12; Add \$2/hr on 6/1/13; Add \$1.75/hr on 6/1/14. Premium Increase(s): On Sunday & holidays, pay two times the hourly basic rate.	31.52	17.75	49.27
556	Fiber Optic Cable Equipment.	22.79	15.30	38.09
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Issue No. 52 Page 1 of 1

Consolidated List of Debarred Contractors Prepared and Issued By State of Wisconsin Department of Workforce Development

January 1, 2011

elements of such contractor that are engaged in construction business activities, until the debarment is terminated. The name of each debarred contractor "effective date" through the "termination date" indicated for that contractor. Questions regarding this list should be addressed to Julie Eckenwalder, Equal determined or established for a state or local public works project. No state agency or local governmental unit may knowingly solicit bids from, negotiate Rights Division, P. O. Box 8928, Madison, WI 53708 or call (608) 266-3148. Deaf, hearing or speech-impaired callers may contact the department by with or award any contracts to or approve or allow any subcontracts with a debarred contractor, including all divisions, affiliates or other organizational must remain on this list for a period of three (3) years from the termination date indicated below. The contractor is, however, only "debarred" from the This list has been prepared in accordance with the provisions of s. 66.0903(12) and s. 103.49(7), Stats. and Chapter DWD 294 of the Wisconsin Administrative Code. All contractors on this list were found to have committed a "debarable offense" related to certain labor standard provisions. calling its TDD number (608) 264-8752.

5

Name of Contractor	Address	Effective Date	<u>Termination</u> Date	<u>Cause</u> Code	<u>Date of</u> <u>Violation(s)</u>	Limitations/Deviatior
Custom Heating & Air LLC	283 Tony Lane Green Bay, WI 54304	12/1/06	11/30/09	1, 2 and 4	2003 to 2004	None
D. C. Nevels Trucking, Inc. orD. C. Nevels Trucking	3246 North Sherman Blvd. Milwaukee, WI 53216	6/1/05	5/31/08	1, 2 and 4	2000- 2002	None
Joseph Stoller Company	N8426 Hwy 42 Algoma WI 54201	2/1/2007	1/31/2010	1 and 2	2004 and 2005	None
<eiver, david<="" td=""><td>See Custom Heating & Air LLC</td><td>12/1/06</td><td>11/30/09</td><td>1, 2 and 4</td><td>2003 and 2004</td><td>None</td></eiver,>	See Custom Heating & Air LLC	12/1/06	11/30/09	1, 2 and 4	2003 and 2004	None
Vevels, Betty	See D. C. Nevels Truckng, Inc.					
Vevels, Donald	See D. C. Nevels Trucking, Inc.					
Stoller Enterprises LLC	N8426 Hwy 42 Algoma, WI 54201-9552	2/1/2007	1/31/2010	1 and 2	2005 to 2006	None
Stoller, Joseph	See Joseph Stoller Company					
Stoller, Patrick J.	See Stoller Enterprises LLC				ð	
Cause Code: 1 = Failure to I	² ay Straight Time 2 = Failure to	Pay Overtime	3 = Kick	back	4 = Payroll Re	cords.

ERD-10908-P (R. 01/03/2011)

AGREEMENT

THIS	AGREEMENT is by and between
	(hereinafter called Owner)
and _	
	(hereinafter called Contractor).
Owne	r and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:
1.	WORK
1.01	Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:
	A Dravision and installation of the following:

- A. Provision and installation of the following:
 - 1. Modifications to heating water system
 - 2. Modifications to potassium permanganate system
 - 3. Modifications to natural gas system
 - 4. Modifications to chain link fence
 - 5. Modifications to mezzanine
 - 6. Excavation, grading and reseeding
 - 7. Electrical work
 - 8. Replacement of PLC
 - 9. Piping and insulation
 - 10. Remodeling of existing building

B. Installation of the following Owner provided equipment:

- 1. Natural gas standby generators
- 2. Medium voltage transfer switchgear
- 3. Low voltage automatic transfer switch
- 4. Pad mounted oil filled transformer
- 5. Motor control center
- 6. Panelboard

2. THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Oak Creek Water and Sewer Utility Oak Creek, Wisconsin Water Treatment Plant and Low Lift Pump Station Standby Power

3. ENGINEER

- 3.01 The Project has been designed by Clark Dietz, Inc., who is hereinafter called Engineer and who is to act as Owner' representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.
- 4. CONTRACT TIMES
- 4.01 Time of Essence
 - A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- Days to Achieve Substantial Completion and Final Payment 4.02
 - A. All of the Work shall be substantially completed within 230 days after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within 260 days after the date when the Contract Times commence to run.
- 4.03 Liquidated Damages
 - A. Contractor and Owner 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 paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner \$2,000.00 for each calendar day that expires after the time specified in paragraph 4.02 for Substantial Completion, plus additional Engineering costs as set forth in paragraph SGC-12.06 of the Supplementary Conditions, until the Work is complete.
 - B. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner \$1,000.00 for each day that expires after the time specified in paragraph 4.02 for completion and readiness for final payment, plus additional Engineering costs as set forth in paragraph SC-14.10 of the Supplementary Conditions, until the Work is completed and ready for final payment.

5. CONTRACT PRICE

Owner shall pay Contractor for completion of the Work in accordance with the Contract 5.01 Documents an amount in current funds as follows:

Lump Sum: For all Work, a lump sum of:

(use words)

6. PAYMENT PROCEDURES

- 6.01 Submittal and Processing of Payments
 - A. 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.
- 6.02 Progress Payments; Retainage
 - A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer each month during performance of the Work as provided below. All such payments will be measured by the schedule of values established in paragraph 2.07.A of the General Conditions or, in the event there is no schedule of values, as provided in the General Requirements.
 - B. Progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, in accordance with paragraph 14.02 of the General Conditions:
 - 90% of Work completed (with the balance being retainage). If the Work has been 50% completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, Owner on recommendation of Engineer, may determine that as long as the character and progress of the Work remain satisfactory to them, there will be no retainage on account of Work subsequently completed, in which case the remaining progress payments will be in an amount equal to 100% of the Work completed less the aggregate of previous retainage and payments previously made. At 50% completion, or any time thereafter, when the character and progress of the Work is not satisfactory, additional amounts may be retained, but in no event shall the total retainage be more than 10% of the value of the Work completed.

6.03 Final Payment

A. Upon final completion and acceptance of the Work in accordance with paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said paragraph 14.07.

7. CONTRACTOR'S REPRESENTATIONS

- 7.01 In order to induce Owner to enter into this Agreement Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents (including the Addenda listed in Article 8) and the other related data identified in the Bidding Documents including "technical data".
 - B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, performance, and furnishing of the Work.

- C. Contractor is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and performance of the Work.
- D. Contractor has carefully studied all reports of explorations and test of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in paragraph 4.02 of the General Conditions.
- E. Contractor has obtained and carefully studied (or assumes responsibility for having done so) additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents to be employed by Contractor, and safety precautions and programs incident thereto.
- F. Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for performance of the Work at the contract price and within the contract times and in accordance with the other terms and conditions of the Contract Documents.
- G. Contractor acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicted in the Contract Documents with respect to Underground Facilities at or contiguous to the site. Contractor has obtained and carefully studied (or assumes responsibility for having done so) all such examinations, investigation, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site or otherwise which may affect costs, progress, performance or furnishing of the Work or which related to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto. Contractor does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the performance and furnishing of the Work in accordance with the time, price, and other items and conditions of the Contract Documents.
- H. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- I. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.
- J. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- K. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

8. CONTRACT DOCUMENTS

- 8.01 Contents
 - A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to 7, inclusive);
 - 2. Performance Bond (pages 1 to 2, inclusive);
 - 3. Payment Bond (pages 1 to 2, inclusive);
 - 4. General Conditions (pages 1 to 41, inclusive);
 - 5. Supplementary Conditions (pages _____ to ____, inclusive);
 - 6. Specifications as listed in the table of contents of the Project Manual;
 - 9. Drawings, not attached hereto, consisting of a cover sheet and sheets listed in the Index of Drawings inclusive, with each sheet bearing the following general title: Water Treatment Plant and Low Lift Pump Station Standby Power;
 - 10. Addenda (numbers _____ to ____, inclusive);
 - 11. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed;
 - b. Work Change Directives;
 - c. Change Order(s);
 - B. There are no Contract Documents other than those listed above in this Article 8.
 - C. The Contract Documents may only be amended, modified, or supplemented as provided in paragraph 3.04 of the General Conditions.

9. MISCELLANEOUS

- 9.01 Terms
 - A. Terms used in this Agreement will have the meanings indicated in the General Conditions.
- 9.02 Assignment of Contract
 - A. No assignment by a party hereto of any rights under or interests in the Contract 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 moneys 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

Clark Dietz, Inc. 00130014

consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

- 9.03 Successors and Assigns
 - A. 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 to all covenants, agreements, and obligations contained in the Contract Documents.

9.04 Severability

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

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 on ______, 2011 (which is the Effective Date of the Agreement).

Attest: (CONTRACTOR) (Signature) (Signature) Address for giving notices: (Typed Name and Title) (If Contractor is a corporation, attach evidence of authority to sign.) CONTRACTOR'S License No. (If required by state or municipal law) Attest: (OWNER) (Signature) (Signature) Address for giving notices: (Typed Name and Title) (If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement.)

END OF SECTION

PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):

CONTRACT Date: Amount: Description (Name and Location):

BOND Bond Number: Date (Not earlier than Contract Date): Amount: Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL Company:	SURETY	
Signature: (Seal)		(Seal)
Name and Title:	Surety's Name and Corporate Seal	
	Ву:	
	Signature and Title	
	(Attach Power of Attorney)	
(Space is provided below for signatures of additional parties, if required.)		
	Attest:	
	Signature and Title	
CONTRACTOR AS PRINCIPAL Company:	SURETY	
Signature: (Seal)		(Seal)
Name and Title:	Surety's Name and Corporate Seal	
	By:	
	Signature and Title	
	(Attach Power of Attorney)	
	Attest:	
	Signature and Title:	

EJCDC No. C-610 (2002 Edition)

Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

- 3. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
 - 3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and
 - 3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and
 - 3.3. Owner has agreed to pay the Balance of the Contract Price to:
 - 1. Surety in accordance with the terms of the Contract;
 - 2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

4. When Owner has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:

- 4.1. Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or
- 4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
- 4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or
- 4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:
 - After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
 - 2. Deny liability in whole or in part and notify Owner citing reasons therefor.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

FOR INFORMATION ONLY – Name, Address and Telephone Surety Agency or Broker Owner's Respresentative (engineer or other party) 6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

- 6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;
- 6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of Surety under Paragraph 4; and
- 6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or nonperformance of Contractor.

7. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Owner or its heirs, executors, administrators, or successors.

8. Surety hereby waives notice of any change, including changes of time, to Contract or to related subcontracts, purchase orders, and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within two years after Contractor Default or within two years after Contractor ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

- 12. Definitions.
 - 12.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.
 - 12.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
 - 12.3. Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.
 - 12.4. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

PAYMENT BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):

CONTRACT Date: Amount:

Description (Name and Location):

BOND Bond Number: Date (Not earlier than Contract Date): Amount: Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL		SURETY	
Company:			
Signature:	(Seal)		(Seal)
Name and Title:		Surety's Name and Corporate Seal	
		Ву:	
		Signature and Title	
	0 11: 1	(Attach Power of Attorney)	
(Space is provided below for signature parties, if required.)	s of additional		
		Attest:	
		Signature and Title	
CONTRACTOR AS PRINCIPAL		SURETY	
Company:			
Signature:	(Seal)		(Seal)
Name and Title:		Surety's Name and Corporate Seal	
		Ву:	
		Signature and Title	
		(Attach Power of Attorney)	
		Attest:	
		Signature and Title:	

EJCDC No. C-615 (2002 Edition)

Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, the American Institute of Architects, the American Subcontractors Association, and the Associated Specialty Contractors.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

- 2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

- 4. Surety shall have no obligation to Claimants under this Bond until:
 - 4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
 - 4.2. Claimants who do not have a direct contract with Contractor:
 - 1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
 - Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
 - 3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:

- 6.1. Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
- 6.2. Pay or arrange for payment of any undisputed amounts.
- 6.3. The failure of Surety to timely discharge its obligations under this Paragraph or to dispute or identify any specific defense to all or any part of a claim shall not be deemed to be an admission of liability by the Surety as to such claim or otherwise constitute a waiver of the Contractor's or Surety's defenses to, or right to dispute, such claim.⁽¹⁾
- (1) Paragraph 6.3 is not part of original EJCDC Document No. C-615 and has been added by Owner.

FOR INFORMATION ONLY – Name, Address and Telephone Surety Agency or Broker: Owner's Representative (engineer or other party): 7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

- 15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
- 15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By





PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE a practice division of the NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN COUNCIL OF ENGINEERING COMPANIES

AMERICAN SOCIETY OF CIVIL ENGINEERS

This document has been approved and endorsed by



The Associated General Contractors of America



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Construction Specifications Institute

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American Council of Engineering Companies 1015 15th Street, N.W., Washington, DC 20005

American Society of Civil Engineers 1801 Alexander Bell Drive, Reston, VA 20191-4400

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda--*Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment--*The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*--The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents--*The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements--*The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements. 9. *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 Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. Contract Documents-- Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*--The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*--The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*--See Paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *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.

19. *Engineer*--The individual or entity named as such in the Agreement.

20. *Field Order*--A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

22. *Hazardous Environmental Condition--*The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

23. *Hazardous Waste--*The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*-Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens--*Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*--The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed--*A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*--The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. PCBs--Polychlorinated biphenyls.

31. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils. 32. *Progress Schedule*--A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material--*Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Schedule of Submittals*--A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

40. *Schedule of Values*--A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

41. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. *Site--*Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

43. *Specifications--*That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain

administrative requirements and procedural matters applicable thereto.

44. *Subcontractor*--An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

45. Substantial Completion--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.

49. Underground Facilities--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *Work*--The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

52. Work Change Directive--A written statement 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 subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive 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 Times.

1.02 Terminology

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.

B. Intent of Certain Terms or Adjectives

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered", "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the "reasonable," "suitable," adjectives "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. Day

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. Defective

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents, or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or

c. 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 14.04 or 14.05).

E. Furnish, Install, Perform, Provide

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

A. The Contract Times 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 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 Before Starting Construction

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 Initial Acceptance of Schedules

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. 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 labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 Reference Standards

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the 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 in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or

responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

1. Contractor's Review of Contract Documents Before Starting Work: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. Contractor's Review of Contract Documents During Performance of Work: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

> a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

> b. the provisions of any Laws or Regulations applicable to the performance of the Work

(unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:

1. 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 or Engineer's consultants, including electronic media editions; or

2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaption by Engineer.

B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 Electronic Data

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 Availability of Lands

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment. A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. Limited Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 Differing Subsurface or Physical Conditions

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

> a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

> b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 Underground Facilities

A. 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, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents,

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. 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, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument 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 or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. Limited Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents. consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06. G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, employees. agents. consultants. partners. and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. 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 of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall 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 Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

C. If the surety on any bond furnished by Contractor is declared 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 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 Licensed Sureties and Insurers

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection

from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available 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. 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; and

6. 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.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claimsmade basis, remain in effect for at least two years after final payment.

> a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 Property Insurance

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious collapse, mischief. earthquake, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, (other than caused by flood) and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. 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, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, 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.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. 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.

5.07 Waiver of Rights

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, agents, partners, employees, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, employees, agents, partners. consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for: 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. 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 .

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 Acceptance of Bonds and Insurance; Option to Replace

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract

Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 Partial Utilization, Acknowledgment of Property Insurer

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any 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 canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 Supervision and Superintendence

A. Contractor shall supervise, inspect, 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. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign 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 or received from the superintendent shall be binding on Contractor.

6.02 Labor; Working Hours

A. 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.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 Services, Materials, and Equipment

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, 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 performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 Progress Schedule

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below. 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 Substitutes and "Or-Equals"

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. "Or-Equal" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,

3) it has a proven record of performance and availability of responsive service; and

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times, and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

b) whether or not use of the proposed substitute item 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 other work on the Project) to adapt the design to the proposed substitute item; and

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified , and

b) available engineering, sales, maintenance, repair, and replacement services;

4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. Engineer's Evaluation: Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. Engineer's Cost Reimbursement: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 Concerning Subcontractors, Suppliers, and Others

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner'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 individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued . No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor

2. shall anything in the Contract Documents 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 individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. 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.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an approagreement between Contractor and priate the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer,, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. 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.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, employees, agents, consultants partners, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to 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.

6.08 Permits

A. 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. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the 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.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.
6.10 Taxes

A. 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.

6.11 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas 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 adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, employees, agents, partners, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents. D. *Loading Structures:* 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.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show 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 completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 Safety and Protection

A. Contractor shall be solely 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:

1. all persons on the Site or who may be affected by the Work;

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

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.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property 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 other 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.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform 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 , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

D. Contractor's duties and responsibilities for safety and for 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 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 Hazard Communication Programs

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor 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 or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 Shop Drawings and Samples

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals , any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents

with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for 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.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures

1. 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.

6.18 *Continuing the Work*

A. 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 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or

EJCDC C-700 Standard General Conditions of the Construction Contract. Copyright © 2002 National Society of Professional Engineers for EJCDC. All rights reserved. 00 72 15 - 24 arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage 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 but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A 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, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 Delegation of Professional Design Services

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 Related Work at Site

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

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

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 Legal Relationships

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 Replacement of Engineer

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 Furnish Data

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 Pay When Due

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 Lands and Easements; Reports and Tests

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 Insurance

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 Change Orders

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 Inspections, Tests, and Approvals

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 Undisclosed Hazardous Environmental Condition

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 Evidence of Financial Arrangements

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. 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 will not be changed without written consent of Owner and Engineer.

9.02 Visits to Site

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site 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 generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 Project Representative

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 Authorized Variations in Work

A. 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 Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by 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 Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment , a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 Shop Drawings, Change Orders and Payments

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 Determinations for Unit Price Work

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the 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 decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 Decisions on Requirements of Contract Documents and Acceptability of Work

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, 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.

9.09 Limitations on Engineer's Authority and Responsibilities

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 Authorized Changes in the Work

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall

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B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 Unauthorized Changes in the Work

A.Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 Execution of Change Orders

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; 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 6.18.A.

10.04 Notification to Surety

A. 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 Times) 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. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 Claims

A. Engineer's Decision Required: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. Notice: Written notice stating the general nature of each Claim, shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 Cost of the Work

A. Costs Included: The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. 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 11.01.B.

1. Pavroll 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. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. 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' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

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 pavments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

Payments made by Contractor 3. to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and

Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any 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 and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

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.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. 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.

c. 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, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the 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.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.

e. 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.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have

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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.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety 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 branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

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.

4. 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.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall

be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

A. 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 performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances

1. Contractor agrees that:

a. the cash 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

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. 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.

11.03 Unit Price Work

A. 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 unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

EJCDC C-700 Standard General Conditions of the Construction Contract. Copyright © 2002 National Society of Professional Engineers for EJCDC. All rights reserved. 00 72 15 - 31 B. 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 subject to the provisions of Paragraph 9.07.

C. 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.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. 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

2. there is no corresponding adjustment with respect any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 Change of Contract Price

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. 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 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 Change of Contract Times

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 Delays

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times , or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E 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.

13.04 Uncovering Work

A. 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.

B. 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.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 Owner May Stop the Work

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to 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, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 Correction or Removal of Defective Work

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 Correction Period

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed 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, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

- 1. repair such defective land or areas; or
- 2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom. B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. 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.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution 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 the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. 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, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 Owner May Correct Defective Work

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, 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 or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or 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, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, 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. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

A. The Schedule of Values established as provided in Paragraph 2.07.A 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.

14.02 Progress Payments

A. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (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 and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications

1. Engineer will, within 10 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.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally 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 9.07, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

> a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

> b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

c. there are other items entitling Owner to a set-off against the amount recommended; or

d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action. 3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 Contractor's Warranty of Title

A. 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.

14.04 Substantial Completion

A. 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.

B. Promptly after Contractor's notification, , 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.

C. If Engineer considers the Work substantially complete, Engineer will 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 14 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 14 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.

D. 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, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing 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.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 Partial Utilization

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions.

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

2. 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.

3. 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 Paragraph 14.04 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.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 Final Inspection

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly 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 complete such Work or remedy such deficiencies.

14.07 Final Payment

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

b. consent of the surety, if any, to final payment;

c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) 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. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance

1. 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 as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations

EJCDC C-700 Standard General Conditions of the Construction Contract. Copyright © 2002 National Society of Professional Engineers for EJCDC. All rights reserved. 00 72 15 - 38 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 for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment 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 for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and , will be paid by Owner to Contractor.

14.08 Final Completion Delayed

A. 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 (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, 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 5.01, 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.

14.09 Waiver of Claims

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

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 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 Owner May Suspend Work

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive 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 granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 Owner May Terminate for Cause

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure 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 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. 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),

2. 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 3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. 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.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 Owner May Terminate For Convenience

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work; 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 Contractor May Stop Work or Terminate

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. 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

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 Computation of Times

A. 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.

17.03 Cumulative Remedies

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto 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. 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.

17.04 Survival of Obligations

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 Controlling Law

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 Headings

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 00

SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.1 SUPPLEMENTARY CONDITIONS

A. These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract 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.

1.2 ARTICLE 1 – DEFINITION AND TERMINOLOGY

- A. SGC-1.
 - 1. The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract have the meanings assigned to them in the General Conditions.
- 1.3 ARTICLE 2 PRELIMINARY MATTERS
 - A. SGC-2.02.
 - 1. Under paragraph 2.02. Copies of Documents, modify the first sentence to read "up to six printed or hard copies" rather than "ten".
 - B. SGC-2.03.
 - 1. Under paragraph 2.03. Commencement of Contract Time; Notice to Proceed, delete the last sentence.
 - C. SGC-2.07.
 - 1. Under paragraph 2.07., Initial Acceptance of Schedules, add "and OWNER" to each mention of "ENGINEER".

1.4 ARTICLE 5 - BONDS AND INSURANCE

- A. SGC-5.01.
 - 1. At the end of paragraph 5.01.A., add the following: "In the event of the failure to perform as required by the Contract, the surety shall act within 10 days of notification by the Owner to comply with the conditions of the Performance and Payment Bonds".
- B. SGC-5.04.
 - 1. The limits of liability for the insurance required by paragraph 5.04. of the General Conditions shall provide the following coverages for not less than the following amounts or greater where required by Laws and Regulations:

(a)	5.04.A.1. and 5.04.A.2.	Worker's Compensation, etc, under paragraphs 5.04.A.1.
and 5.04.A.2. of the General Conditions:		eral Conditions:

	(1)	State:	Statutory	
	(2)	Applicable Federal (e.g., Longshoreman's)	Statutory	
	(3)	Employer's Liability	\$500,000 each employee	
(b)	5.04.A.3, 5.04.A.4, 5.04.A.5. Contractor's Liability Insurance under paragraphs 5.04.A.3. through 5.04.A.5. of the General Conditions which shall also include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Contractor:			
	(1)	General Aggregate (Except Products - Completed Operations)	\$3,000,000	
	(2)	Products - Completed Operations Aggregate	\$1,000,000	
	(3)	Personal and Advertising Injury (Per Person/Organization)	\$1,000,000	
	(4)	Each Occurrence (Bodily Injury and Property Damage)	\$1,000,000	
	(5)	Excess Liability		
		General Aggregate Each Occurrence	\$5,000,000 \$1,000,000	
(c)	5.04.A.6 Automobile Liability:			
	(1)	Bodily Injury:		
		\$500,000 Each Person \$1,000,000 Each Accident		
		Property Damage:		
		\$500,000 Each Accident or		
	(2)	Combined Single Limit (Bodily Injury and Property Damage)	\$1,000,000 Each Accident	

- C. SGC-5.04. Contract Endorsement
 - 1. Oak Creek Water and Sewer Utility, and its officers and employees, are to be named as additional insured on a primary and non-contributory basis. Additionally, provide an endorsement from your insurance carrier confirming the Oak Creek Water and Sewer

Utility is additional insured, including the provision of legal representation in the defense of claims asserted against the Oak Creek Water and Sewer Utility.

(a) The Contractual Liability coverage required by paragraph 5.04.B.4. of the General Conditions shall provide coverage for not less than the following amounts:

(1)	General Aggregate	\$3,000,000
(2)	Each Occurrence (Bodily Injury and Property Damage)	\$1,000,000

D. SGC-5.05.

1. Entirely delete paragraph 5.05. and substitute the following:

5.05. Owner's and Contractor's Liability Insurance:

A. CONTRACTOR shall purchase and maintain protective liability insurance with Owner named as an additional insured on Contractors certificate of insurance as will protect CONTRACTOR and OWNER against claims which may arise from operations under the Contract Documents. Limits of coverage shall be as follows:

1.	Bodily Injury Liabi	lity:
	\$1,000,000	Each Occurrence
	\$2,000,000	Annual Aggregate
2.	Property Damage Liability:	

\$500.000	Each Occurrence
\$500,000	Annual Aggregate
\$500,000	1 milian 1 1551 cgute

E. SGC-5.06. Property Insurance

The Contractor shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall;

- 1. Include the interests of the Owner, the Contractor, Subcontractors, the Engineer, the Engineer's Consultants and any other persons or entities identified in Article 5.04 B.1 each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;
- 2. Be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and Work in transit and shall insure against at least the following perils: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such perils as may be specifically required by the Supplementary Conditions;
- 3. Include expenses incurred in the repair or replacement of any insured property (including

but not limited to fees and charges of the engineers);

- 4. Cover materials and equipment in transit for incorporation in the Work or stored at the site or at another location that was agreed to in writing by the Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by the Engineer;
- 5. Allow for partial utilization of the Work by the Owner;
- 6. Include testing and start-up; and
- 7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by the Owner, the Contractor, and the Engineer with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.
- 8. The policies of insurance required to be purchased and maintained by the Contractor in accordance with this paragraph 5.06 shall comply with the requirements of GC-5.06C."

1.5 ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES:

A. SGC-6.02. Labor, Working Hours

Add the following to Article 6.02.:

- 1. No night work requiring the presence of an Engineer or Owner's Resident Project Representative will be permitted, except in case of great emergency, and then only to such extent as is absolutely necessary, and with written approval of the Engineer, provided that this clause shall not operate in case of a crew organized for regular and continuous night work, and on such work which, in the opinion of the Engineer, can only be performed satisfactorily at night.
- 2. No weekend work will be permitted except with the written consent of the Engineer and to such extent as he may judge to be necessary.
- 3. Any work necessary to be performed after regular working hours, or on weekends and legal holidays, shall be performed without additional expense to the Owner.
- 4. Additional Field Engineering and Observation: The attention of the Contractor is directed to the following provisions covering payment of field engineering and observation costs of this project. The proposal form and contract form on this contract include the time for substantial and final completion and acceptance of all work covered in the contract. Owner's Resident Project Representatives will be supplied, as required, for not more than one 8-hour shift on weekdays totaling not more than 40 hours per week during this period by the Engineer at no cost to the Contractor. However, for any work in any week in excess of 40 hours during this period, and for each week day that the work remains uncompleted and unaccepted beyond the number of days allowed in the contract, the cost of Resident Engineers and Observers regularly assigned on this contract will be paid by the Contractor at no additional cost to the Owner. The cost of such Owner's Resident Project Representatives will be computed on the basis of One Hundred Fifty Dollars

(\$150.00) per hour, such amount to cover actual payroll cost plus all travel and overhead items.

- 5. The Engineer shall submit an itemized billing of such additional services to the Owner and the Contractor at the time of the next progress pay estimate period. Once the costs are agreed to, costs will be accumulated (if applicable) and will be incorporated into the final project change order.
- 6. The final project change order will be executed prior to release of retainage.
- B. SGC-6.05.
 - 1. Under paragraph 6.05.A.1, in the first sentence, change "In the Engineer's sole discretion..." to read "In the Engineer's sole discretion with the Owner's consent...".
 - 2. Under paragraph 6.05.C, in the third sentence, change "Engineer's will ne the sole judge..." to read "Engineer and Owner will be sole judges...".
- C. SGC-6.06.
 - 1. Under paragraph 6.06.B., add "The CONTRACTOR shall identify all Sub- contractors, major suppliers and other persons or organizations who will provide principal items of material and equipment."

1.6 ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

- A. SGC 12.01
 - 1. Under paragraph 12.01C.2.c., Add the following: "except, the maximum total allowable cost to the Owner shall be the Cost of the Work plus a maximum collective aggregate fee for Contractor and all tiered Subcontractors of 20 percent;"
- B. SGC 12.04. through 12.06.

Add the following paragraphs:

"12.04. Commencing Work

A. The date of beginning and the time for completion of the Work are essential conditions of the Contract and the Work embraced shall be commenced on a date specified in the Notice To Proceed."

"12.05. Rate of Progress

A. The CONTRACTOR shall proceed with the Work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the Contract Time for the completion of the Work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the Work."

"12.06. *Liquidated Damages*

A. Should contractor fail to perform the work within the periods of time stipulated in the Agreement, either for substantial completion or internal project milestones, Contractor shall pay to Owner, as liquidated damages for delay and not as a penalty but as fixed liquidated damages due owner resulting from the failure to complete the work either substantially or fully within the time specified, the sum of stipulated in the Agreement per calendar day including Sundays and Holidays, that the work shall remain uncompleted unless the contract time is extended by Owner. Failure to achieve an internal milestone that also leads to a failure to achieve substantial completion within the stipulated time shall incur separate liquidated damages for both the internal milestone and the substantial completion. In addition to the liquidated damages, CONTRACTOR shall be liable for all additional costs for ENGINEER's services beyond substantial or final completion date. OWNER will deduct these costs from any monies due or that may become due CONTRACTOR as surety and pay ENGINEER for said services."

1.7 ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION:

- A. SGC-14.02.B.1., 14.02.B.2., 14.02.B.3., 14.02.B.4. and 14.02.B.5.
 - 1. Insert "and/or Owner's Resident Project Representative" wherever Engineer is found.
- B. SGC-14.02.B.5.e
 - 1. Insert "e. Upon review of the Record Drawings at the Pay Meeting, the contractor has failed to keep up to date Record Drawings.
- C. SGC-14.02.C.1
 - 1. Change "Ten days" to "Twenty days" in the first sentence.
- D. SGC-14.02.C.1
 - 1. Add the following to the end of the sentence ",provided Owner receives approved application by the 25th of each month."
- E. SGC-14.02.D.1
 - 1. Add "e. Liability for liquidated damages incurred by Contractor as set forth in the Agreement."
- F. SGC-14.07.
 - 1. Under paragraph 14.07.B.1., Review of Application and Acceptance, after "Engineer" add "and/or Owner's Resident Project Representative."
- 1.8 ARTICLE 15 SUSPENSION OF WORK AND TERMINATION
 - A. SGC-15.04.

Under paragraph 15.04.A., CONTRACTOR May Stop Work or Terminate, change "thirty days" to "forty-five days".

1.9 ARTICLE 17 – MISCELLANEOUS

A. SGC - 17.07. through 17.09.

Add the following paragraphs:

"17.07. Safety and Health Regulations

A. Safety and Health Regulations for Construction", and subsequent amendments thereto, as established by the Department of Labor shall govern the work to be performed under this contract. The "Regulations" are comprised of Chapter XVII of Title 29, Code of Federal Regulations (CFR), Part 1926 (formerly Chapter XIII of Title 29, CFR, Part 1518)."

"17.08. Contract Conditions

A. Any underground utility or drainage facility, whether farm tile, sanitary sewer, or storm sewer cut or damaged by this construction shall be restored to functional condition and to the satisfaction of the Owner and the facility."

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contract description.
- B. Work by Owner.
- C. Owner supplied products.
- D. Salvaged equipment.
- E. Contractor's use of site.
- F. Owner occupancy.
- G. Future work.
- H. Utility Outages and Shutdown.
- I. Work sequence.

1.2 CONTRACT DESCRIPTION

- A. Work of the Project includes addition of natural gas standby generators, automatic transfer switches and modifications to the heating water system, potassium permanganate system, and natural gas system at the Water Treatment Plant and Low Lift Pump Station.
- B. Perform Work of Contract under fixed cost contract with Owner in accordance with Conditions of Contract.

1.3 WORK BY OWNER

- A. The Owner will provide programming modifications to the plant SCADA system.
- B. The Owner will pay separately for any WE Energies charges associated with removing existing metering.
- C. The Owner will pay separately for any WE Energies charges associated with modifications to the incoming natural gas service and replacement of gas meters.

1.4 OWNER SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner-reviewed Shop Drawings and Product Data to Contractor.

Clark Dietz, Inc. 00130014

- 2. Arrange and pay for delivery and unloading to site as part of separate contract. Notify Contractor at least 7 days prior to delivery.
- 3. On delivery, inspect products jointly with Contractor.
- 4. Submit claims for transportation damage and replace damaged, defective, or deficient times.
- 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 - 1. Review Owner-reviewed Shop Drawings and Product Data.
 - 2. Receive products at site; inspect for completeness or damage jointly with Owner.
 - 3. Move equipment from location where equipment is unloaded by equipment suppliers and into the buildings and onto the concrete equipment pads. Contractor shall coordinate with the Owner on the exact location where the equipment will be unloaded by the equipment supplier. The equipment will need to be relocated by Contractor as follows:
 - a. Generator GEN-101 and pad mounted oil filled transformer XFMR-3A WEST shall be stored outside at the Water Treatment Plant.
 - b. Automatic transfer switch ATS-101, GEN-101 accessories, and Panelboard PA shall be stored inside a building at the Water Treatment Plant.
 - c. Generator GEN-102 shall be stored outside at the Low Lift Pump Station.
 - d. Automatic transfer switch ATS-102, GEN-102 accessories, and motor control center MCC-2 shall be stored inside at the Low Lift Pump Station.
 - 4. Handle, store, install and finish products.
 - 5. Repair or replace items damaged after receipt.
- C. Items furnished by Owner for installation by Contractor:
 - 1. Generators GEN-101 and GEN-102. Equipment will be ready for delivery by August 31, 2011.
 - 2. Generator accessories including the following (equipment will be ready for delivery by August 31, 2011):
 - a. Engine accessories and coolant.
 - b. Heat exchangers and expansion tanks.
 - c. Exhaust silencer and fittings.
 - d. Battery and charger.
 - 3. Automatic Transfer Switch ATS-101. Equipment will be ready for delivery by August 31, 2011.
 - 4. Automatic Transfer Switch ATS-102. Equipment will be ready for delivery by July 31, 2011.
 - 5. Pad Mounted Oil Filled Transformer XFMR-3A WEST. Equipment will be ready for delivery by August 31, 2011.
 - 6. Motor Control Center MCC-2. Equipment will be ready for delivery by June 30, 2011.
 - 7. Panelboard PA. Equipment will be ready for delivery by May 31, 2011.

1.5 SALVAGED EQUIPMENT

- A. The following equipment shall be removed by the Contractor, turned over to the Owner, and stored on site where directed by the Owner.
 - 1. (1) potassium permanganate chemical metering pump and controller.
 - 2. (1) sodium hypochlorite chemical meter pump and controller.
 - 3. (1) hydropneumatic tank.
 - 4. (2) buckets and associated control devices from MCC-2.

- 5. (1) PLC from LLPS.
- 6. (1) turbine water pump.
- 7. (1) welder receptacle.
- 8. (1) portable generator receptacle.

1.6 CONTRACTOR'S USE OF SITE

- A. Limit use of site to allow:
 - 1. Owner occupancy.
- B. The existing buildings need to be secured at all times. Any openings cut into the walls in both facilities need to be secured at all times with plywood sheathing anchored to the existing structure.

1.7 OWNER OCCUPANCY

- A. The Owner will occupy the site during the entire period of construction.
- B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.8 FUTURE WORK

- A. Project is designed for a future building addition on the north end of the Administration and Filtration Facility.
- B. Provide utilities stubbed out for future building addition and equipment in addition as indicated on the drawings.

1.9 UTILITY OUTAGES AND SHUTDOWN

- A. All utility outages and shutdowns must be coordinated with Owner and have their approval prior to the outage or shutdown. Contractor shall coordinate all outages with Owner (Contractor shall also coordinate with WE Energies for natural gas service). Contractor shall provide 48 hours notice prior to the outage and get written approval from the owner of the outage.
- B. All outages shall be during the weekdays and begin early in the morning. Outages may only be performed during low pumping demands from the facilities (e.g. between the hours of 8am 3pm).
- C. Contractor shall submit a detailed plan for each outage. Contractor shall meet with Owner and Engineer on site prior to conducting each outage to discuss the following:
 - 1. Review detailed plan of the outage and get approval of plan by Owner and Engineer.
 - 2. Number of workers that will complete the work and time required for the outage.
 - 3. List of processes or equipment that will be affected by the outage.
- D. All materials must be on site and installed prior to conducting associated outage.
- E. Power Outage Requirements

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- 1. The maximum allowable power outage for the facilities is 1 hour for each outage. <u>Temporary feeder conductors must be used during outage to temporarily feed power to</u> <u>panelboards and motor control centers.</u>
- F. Natural Gas Outage Requirements
 - 1. The maximum allowable natural gas service outage for the facilities is 4 hours.
- G. Potable and Non-potable Water Outage Requirements
 - 1. The maximum allowable potable and non-potable water service outage for the facilities is 4 hours per outage.
- H. Heating Water System Outage Requirements
 - 1. The maximum allowable heating water system outage for the facilities is 4 hours for each outage.
- I. Domestic Hot Water System Outage Requirements
 - 1. The maximum allowable domestic hot water system outage for the facility is 8 hours for each outage.
- J. Compressed Air System Outage Requirements
 - 1. The maximum allowable compressed air system outage for the facilities is 4 hours for each outage.
- K. Sanitary Sewer System Outage Requirements
 - 1. The maximum allowable sanitary sewer system outage for the facilities is 4 hours for each outage.
- L. Potassium Permanganate System Outage Requirements
 - 1. The maximum allowable potassium permanganate system outage for the facility is 8 hours for each outage.
- M. Carbon Feed System Outage Requirements
 - 1. The maximum allowable carbon feed system outage for the facility is 8 hours for each outage.

1.10 WORK SEQUENCE

- A. GENERAL REQUIREMENTS
 - 1. Construct Work in stages to accommodate Owner's occupancy requirements during construction period. Coordinate construction schedule and operations with Owner and Engineer.
 - 2. The following is a Suggested Sequence of Construction for this project. The Contractor shall submit written Sequence of Construction to the Engineer and get the Engineer and Owner's approval prior to proceeding with any shutdowns.
- B. WATER TREATMENT PLANT
 - 1. Coordinate with WE Energies to install new natural gas service.
 - 2. Remove concrete slab in Electrical Room.

- 3. Remove part of the concrete slab in Mechanical Room to install sanitary lines for generator heat exchanger and cap for future connection. Pour new concrete slab after sanitary lines are installed.
- 4. <u>COMPRESSED AIR SYSTEM OUTAGE</u>: Provide outage to relocate air compressor AC-101.
 - a. Turn off existing AC-101 and relocate to new location.
 - b. Extend compressed air piping to relocated AC-101.
 - c. Turn on AC-101 and bring compressed air system back on line.
- 5. Shut off XFMR-T4A secondary circuit breaker.
- 6. Remove 208 volt feeder from XFMR-T4A to bypass isolation switch.
- 7. Provide temporary 208 volt feeder conductors from XFMR-T4A to existing panel PA and prepare for power outage.
- 8. <u>POWER OUTAGE NO. 1</u>: Provide power outage to temporarily feed existing panel PA. a. Turn off loads fed from panel PA.
 - b. Determine existing feeder conductors from bypass isolation switch to panel PA.
 - c. Terminate temporary feeder conductors from XFMR-T4A secondary circuit breaker.
 - d. Energize panel PA and bring loads fed from panel PA on line.
- 9. Install new panel PA.
- 10. Turn off circuit breaker in MCC-4 feeding XFMR-T4.
- 11. Install new concrete pads for XFMR-T4 and bypass isolation switch.
- 12. Relocate bypass isolation switch.
- 13. Relocate XFMR-T4.
- 14. Install feeders from MCC-4 to XFMR-T4, bypass isolation switch, and panel PA.
- 15. Install conduits from panel PA to feed downstream panelboards (do not terminate conduits to existing conduits and enclosures at this time).
- 16. Energize new panel PA and prepare for power outage.
- 17. <u>POWER OUTAGE NO. 2</u>: Provide power outage to cut over power to panel H.
 - a. Install temporary feeder conductors from spare circuit breaker in panel PA to panel H (do not terminate conductors at panel H at this time).
 - b. Turn off existing breaker feeding panel H in existing panel PA to de-energize panel.
 - c. Connect temporary feeder conductors from panel PA and re-energize panel.
 - d. Connect existing conduit to new conduit from panel PA.
 - e. Replace feeder conductors from new panel PA to panel H. Terminate conductors on circuit breaker in panel PA (do not terminate conductors to panel H at this time).
 - f. Provide final power outage for panel H to de-terminate temporary feeder conductors and terminate new feeder conductors from panel PA. Re-energize panel H from new feed from panel PA.
- 18. <u>POWER OUTAGE NO. 3</u>: Provide power outage to cut over power to panel D-LEFT. Work for power outage shall be similar to panel H outage.
- 19. <u>POWER OUTAGE NO. 4</u>: Provide power outage to cut over power to panel B-LEFT. Work for power outage shall be similar to panel H outage.
- 20. Install conduit and feeder conductors from panel PA to panel C (do not terminate conductors at panel C at this time).
- 21. <u>POWER OUTAGE NO. 5</u>: Provide power outage to cut over power to panel C.
 - a. Turn off existing breaker feeding panel C in existing panel PA to de-energize panel.
 - b. De-terminate existing feeder conductors at panel C and terminate new feeder conductors. Re-energize panel C from new feed from Panel PA.
 - c. Remove existing feeder conductors from panel PA to panel C.

- 22. After all power outages for panels fed from panel PA are complete, turn off XFMR-T4A secondary breaker feeding existing panel PA.
- 23. Remove existing panel PA and temporary feeder conductors.
- 24. Install feed from XFMR-T4A secondary breaker to bypass isolation switch.
- 25. Test operation of bypass isolation switch for both normal and emergency feeds.
- 26. Install new natural gas manifold, valves, and pressure regulators.
- 27. <u>NATURAL GAS SYSTEM OUTAGE</u>: Coordinate with WE Energies to provide outage to cut in the new natural gas service.
- 28. Install boiler B-101 and heating water circulation pumps.
- 29. Extend natural gas lines to B-101 and location for the relocated water heater WH-101.
- 30. Add new heating water system piping and prepare for cutover of heating water system.
- 31. <u>HEATING WATER SYSTEM OUTAGE</u>: Provide outage to bring new heating water system on line.
 - a. Turn off existing boiler B-101 and drain piping system.
 - b. Cut in piping for heating water system.
 - c. Turn on gas/electric service to B-101, heating water pumps, and bring heating water system back on line.
- 32. Modify temperature control panels.
- 33. Remove existing boiler, heating water pumps and associated piping.
- 34. <u>DOMESTIC HOT WATER SYSTEM OUTAGE</u>: Provide outage to relocate domestic water heater WH-101.
 - a. Turn off existing gas service to WH-101.
 - b. Extend water supply and return piping to relocated WH-101.
 - c. Turn on gas service to WH-101 and bring domestic hot water system back on line.
- 35. Reconnect existing natural gas piping to new valves and regulators.
- 36. Remove existing natural gas piping and metering.
- 37. Remove remainder of concrete slab in Mechanical Room.
- 38. Remove windows and part of exterior wall. Construct exterior CMU wall and frame in opening for new louvers and motorized dampers. Install temporary plywood wall to secure the space.
- 39. Extend underground sanitary sewer lines to generator heat exchanger sump pit and prepare for sanitary sewer outage.
- 40. Install pipe trench for coolant piping.
- 41. Install underground electrical conduits for GEN-101 and ATS-101. Extend conduits from ATS-101 to XFMR-3A WEST and 2.4 KV Switchgear (do not connect conduits to existing conduits and XFMR-3A WEST at this time).
- 42. Install remainder of concrete slab in Electrical and Mechanical Rooms. Install concrete equipment pads.
- 43. Construct Mechanical Room Wall.
- 44. <u>SANITARY SEWER SYSTEM OUTAGE</u>: Provide outage to cut in new sanitary line to existing sanitary sewer line.
- 45. Install exhaust fans and grills for Electrical Room.
- 46. Install ATS-101.
- 47. Install generator GEN-101.
- 48. Remove temporary plywood wall and install intake louvers and motorized dampers.
- 49. Install generator heat exchangers and potable water line back to existing potable water line and prepare for potable water system outage.
- 50. <u>POTABLE WATER SYSTEM OUTAGE</u>: Provide outage to connect generator heat exchangers to existing potable water line.

- a. Close isolation valve on potable water line and drain system.
- b. Connect new potable water line to existing line.
- c. Open isolation valve to fill potable water line.
- d. Insulate potable water lines.
- 51. Install coolant piping to GEN-101.
- 52. Extend natural gas line to GEN-101.
- 53. Install generator silencer and associated piping.
- 54. Install 5 KV cables from GEN-101 to ATS-101.
- 55. <u>POWER OUTAGE NO. 6</u>: Provide power outage to bring ATS-101 and GEN-101 on line. Please note that WTP shall be powered from XFMR-3A EAST during this outage.
 - a. Open main breaker in 2.4 KV Switchgear fed from XFMR-3A WEST and close tie breaker in 2.4 KV Switchgear.
 - b. Open switch in outdoor 24.9 KV Switchgear to de-energize XFMR-3A WEST.
 - c. Remove existing 25 KV cables from outdoor 24.9 KV Switchgear to XFMR-3A WEST.
 - d. Remove existing 5 KV cables from XFMR-3A WEST to 2.4 KV Switchgear.
 - e. Remove existing XFMR-3A WEST and concrete pad.
 - f. Extend new conduits from ATS-101 to XFMR-3A WEST.
 - g. Extend new conduits from outdoor 24.9 KV Switchgear to XFMR-3A WEST.
 - h. Install concrete pad for new XFMR-3A WEST.
 - i. Remove WE Energies CTs/PTs in 2.4 KV Switchgear.
 - j. Extend new conduits from ATS-101 to existing conduits feeding 2.4 KV Switchgear. Install 5 KV cables and terminate on both ends.
 - k. Install 5 KV cables from XFMR-3A WEST to ATS-101 and terminate on both ends.
 - 1. Install 25 KV cables from outdoor 24.9 KV Switchgear to XFMR-3A WEST and terminate on both ends.
 - m. Close switch in outdoor 24.9 KV Switchgear to energize XFMR-3A WEST.
 - n. Open tie breaker in 2.4 KV Switchgear and close main breaker in 2.4 KV Switchgear fed from XFMR-3A WEST to re-energize section of 2.4 KV Switchgear.
 - o. Test for proper operation of ATS-101 in normal and emergency modes of operation.
- 56. <u>POWER OUTAGE NO. 7</u>: Provide power outage to cut over power to MCC-4.
 - a. Place bypass isolation switch in normal position to feed panel PA from XFMR-T4A.
 - b. Install temporary feeder conductors from circuit breaker in USS NO. 1 to MCC-4 (do not terminate conductors at this time).
 - c. Turn off existing breaker in USS NO. 1 feeding MCC-4 to de-energize MCC.
 - d. Connect temporary feeder conductors and re-energize MCC-4.
 - e. Turn off breaker in SB NO. 1 feeding ATS-1. Remove emergency feeder conductors to ATS-1 and remove interior components from ATS-1 enclosure.
 - f. Replace feeder conductors from USS NO. 1 to MCC-4 (do not terminate conductors at this time).
 - g. Provide final power outage for MCC-4 to de-terminate temporary feeder conductors and terminate new feeder conductors from USS NO. 1. Re-energize MCC-4 from new feed from USS NO. 1.
- 57. <u>POWER OUTAGE NO. 8</u>: Provide power outage to cut over power to MCC-8. Work for power outage shall be similar to MCC-4 outage.
- 58. <u>POWER OUTAGE NO. 9</u>: Provide power outage to cut over power to MCC-10 from USS NO. 1 feed. Work for power outage shall be similar to MCC-4 outage except no temporary feeder is required as secondary 480 volt feed to MCC-10 will be used. Please note this outage should be minimal to switch kirk-key interlocked main breakers in MCC as MCC-10 has a second feeder from USS NO. 2 that can be utilized during the outage.

- 59. <u>POWER OUTAGE NO. 10</u>: Provide power outage to cut over power to MCC-10 from USS NO. 2 feed. Work for power outage shall be similar to MCC-10 from USS NO. 1 outage. Please note this outage should be minimal as MCC-10 has a second feeder from USS NO. 1 that can be utilized during the outage.
- 60. Remove existing 250 kw natural gas generator, SB NO. 1, and associated conduit/wire.
- 61. <u>POWER OUTAGE NO. 11 (FINAL</u>): Simulate a 25 KV power outage from the outdoor 24.9 KV Switchgear and verify that ATS-101 properly operates and loads are properly brought on line on emergency power. After test is completed, restore 25 KV power to the facility and verify that loads are properly brought back on line on normal power.
- 62. Complete remaining work (e.g. miscellaneous trade work, finish grade and seeding, clean up, etc.).

C. LOW LIFT PUMP STATION

- 1. Coordinate with WE Energies to replace natural gas service meter. Install new manifold, valves, and pressure regulators.
- 2. <u>NATURAL GAS SYSTEM OUTAGE</u>: Coordinate with WE Energies to provide outage to cut in the new natural gas service meter.
- 3. <u>POTABLE WATER SYSTEM OUTAGE</u>: Provide outage to install isolation valves on existing potable water line to feed new equipment.
 - a. Close valve on incoming potable water line and drain system.
 - b. Install new isolation valves to feed new equipment.
 - c. Open isolation valve on incoming potable water line and bring potable water system back on line.
- 4. Modify storm sewer and catch basin. Install concrete slab, curb and gutter.
- 5. Modify chain link fence and install gravel fill.
- 6. Install potable water line and compressed air to carbon feeder. Core building wall for carbon feed pipe.
- 7. Relocate existing air compressor AC-1.
- 8. Relocate carbon feeder CF-101, dumpster, and storage container.
- 9. Relocate unit heater by mezzanine.
- 10. Remove abandoned hydropneumatic tank, turbine water pump, and concrete equipment pads.
- 11. Remove existing equipment from Ammonia Room.
- 12. Patch holes in Ammonia Room (Chemical Room) walls and paint walls and floor.
- 13. Install concrete containment wall and equipment pads.
- 14. Install potassium permanganate tank T-4007 and mix tank agitator M-4007.
- 15. Relocate raw water booster supply pump P-4004 and filter FT-4004.
- 16. Install chemical metering pumps P-4010 and P-4011.
- 17. Install level indicating transmitter LIT-4007 and LE-4007 for tank.
- 18. Install potable water, non-potable water lines, and chemical feed lines to potassium permanganate mixing system.
- 19. Construct mezzanine extension and relocate existing stairs.
- 20. Install MCC-2.
- 21. Install temporary disconnect switch and temporary feeder conductors from existing generator to MCC-2 (do not terminate conductors at generator at this time).
- 22. Install ATS-102.
- 23. Install PLC-G enclosure. Install conduit and control conductors between PLC and remote control devices (do not terminate conductors at this time).

- 24. Install cat 6 cable between PLC-G enclosure and existing network switch and communication enclosure. Bring PLC-G on line.
- 25. <u>POWER OUTAGE NO. 1</u>: Provide power outage to install circuit breaker in MSWB-1B to feed MCC-2. Please note that LLPS will be powered from MSWB-1A during this outage.
 - a. Turn off loads fed from MSWB-1B and open main circuit breaker and tie breaker in MSWB-1B.
 - b. Install MCC-2 circuit breaker.
 - c. Install 480 volt feeder between MSWB-1B and MCC-2.
 - d. Install conduits for 480 volt feeder conductors from MSWB-1B to ATS-102 (do not install conductors at this time).
 - e. Re-energize MSWB-1B by closing main circuit breaker in MSWB-1B.
 - f. Bring loads fed from MSWB-1B back on line.
- 26. <u>POWER OUTAGE NO. 2</u>: Provide power outages to existing 120 volt and 480 volt equipment and controls fed from existing MCC-2, MCC-3, and panel A.
 - a. Cut over power and controls one load at a time. Confirm proper operation before proceeding to cut over of next load.
- 27. <u>POTASSIUM PERMANGANATE SYSTEM OUTAGE</u>: Provide outage to cut over potassium permanganate system.
 - a. Relocate scale WE-4006 and WIT-4006.
 - b. Cut in piping for potassium permanganate feed lines.
 - c. Bring potassium permanganate system back on line on non-potable water supply.
 - d. Relocate eductor pump P-4003.
- 28. <u>POWER OUTAGE NO. 3:</u> Provide power outage to connect temporary feed from existing generator.
 - a. Terminate temporary feeder conductors for MCC-2 at existing generator.
 - b. Turn off circuit breaker in MSWB-1B feeding MCC-2.
 - c. Test operation of generator.
 - d. After generator test is completed, de-energize generator and lock out temporary disconnect switch.
- 29. Remove existing MCC-2, MCC-3, and panel A.
- 30. Remove existing PLC-G control panel.
- 31. Remove remaining equipment from Chemical Room (Generator Room).
- 32. Remove exterior doors and cut opening in exterior wall of Generator Room. Install temporary plywood wall with door to secure the space.
- Remove wall behind MCC-2 and install new CMU wall. Cut exhaust duct opening in concrete ceiling. Install concrete pad for generator. Patch holes in ceiling, walls, and floor in Generator Room.
- 34. Install exhaust fan, ductwork, grills, and exhaust louver for Generator Room.
- 35. Install generator GEN-102.
- 36. Remove temporary plywood wall and install intake louvers, door, and motorized dampers.
- 37. Install generator heat exchangers, coolant piping, and potable water line back to isolation valve.
- 38. Install generator silencer and associated piping.
- 39. Extend natural gas line to GEN-102.
- 40. Install 480 volt feeder from GEN-102 to ATS-102.
- 41. <u>POWER OUTAGE NO. 4</u>: Provide power outage to provide temporary power to MCC-2.
 - a. Install temporary 480 volt feed from existing feeder breaker in MSWB-1A to MCC-2. Determinate conductors feeding MCC-2 from MSWB-1B and terminate conductors from MSWB-1A. Energize MCC-2.
- 42. <u>POWER OUTAGE NO. 5</u>: Provide power outage to bring ATS-102 and GEN-102 on line. Please note that LLPS will be powered from MSWB-1A during this outage.
 - a. Turn off loads fed from MSWB-1B and open main circuit breaker and tie breaker in MSWB-1B.
 - b. Open medium voltage switch SW-1B to de-energize XFMR-1B and service lateral conductors to MSWB-1B.
 - c. Remove 480 volt service lateral conductors from XFMR-1B to MSWB-1B. Remove pullbox located below MSWB-1B.
 - d. Extend service lateral conduits to ATS-102 and install 480 volt service lateral conductors from XFMR-1B.
 - e. Concrete encase service lateral conduits.
 - f. Install 480 volt feeder conductors from ATS-102 to MSWB-1B.
 - g. Close medium voltage switch SW-1B to energize XFMR-1B and service lateral conductors to ATS-102.
 - h. Test for proper operation of ATS-102 in normal and emergency modes of operation.
 - i. Re-energize MSWB-1B by closing main circuit breaker in MSWB-1B.
 - j. Bring loads fed from MSWB-1B back on line.
- 43. <u>POWER OUTAGE NO. 6</u>: Provide power outage to provide permanent power to MCC-2.
 - a. Remove temporary 480 volt feed to MCC-2 from existing feeder breaker in MSWB-1A and reterminate conductors from MSWB-1B. Disconnect temporary feeder conductors from temporary disconnect switch. Energize MCC-2. Remove temporary disconnect switch and temporary feeder conductors to existing generator.
- 44. <u>POWER OUTAGE NO. 7 (FINAL)</u>: Simulate a 25 KV power outage from the outdoor 24.9 KV Switchgear located at the WTP and verify that ATS-102 properly operates and loads are properly brought on line on emergency power. After test is completed, restore 25 KV power to the facility and verify that loads are properly brought back on line on normal power.
- 45. Remove existing 75 kw natural gas generator and associated conduit/wire.
- 46. Complete remaining work (e.g. finish grade and seeding, clean up, etc.).

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing and inspection allowances.
- B. Schedule of values.
- C. Applications for payment.
- D. Change procedures.
- E. Defect assessment.

1.2 TESTING AND INSPECTION ALLOWANCES

- A. Costs Included in Testing and Inspecting Allowances: Cost of engaging testing and inspecting agency; execution of tests and inspecting; and reporting results.
- B. Costs Not Included in Testing and Inspecting Allowance But Included in Contract Price:
 - 1. Costs of incidental labor and facilities required to assist testing or inspecting agency.
 - 2. Costs of testing services used by Contractor separate from Contract Document requirements.
 - 3. Costs of retesting upon failure of previous tests as determined by Architect/Engineer.
- C. Payment Procedures:
 - 1. Submit one copy of inspecting or testing firm's invoice with next application for payment.
 - 2. Pay invoice on approval by Architect/Engineer.
- D. Testing and Inspecting Allowances Schedule:
 - 1. Include sum of \$2,000.00 for payment of testing laboratory services specified in Section 01 40 00 Quality Requirements.

1.3 SCHEDULE OF VALUES

- A. Submit printed schedule on EJCDC 1910-8-E.
- B. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds and insurance in separate line items.

- D. Include separately from each line item, direct proportional amount of Contractor's overhead and profit.
- E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.4 APPLICATIONS FOR PAYMENT

- A. Submit three copies of each application on EJCDC 1910-8-E.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit at intervals stipulated in the Agreement.
- E. Submit with transmittal letter as specified for Submittals in Section 01 33 00 Submittal Procedures.
- F. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 - 1. Partial release of liens from major subcontractors and vendors.
 - 2. Affidavits attesting to off-site stored products.

1.5 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on AIA Form G710.
- C. The Architect/Engineer may issue a Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required. Contractor will prepare and submit estimate within 15 days.
- D. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors.
- E. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect/Engineer.
- F. Construction Change Directive: Architect/Engineer may issue directive, on EJCDC 1910-8-F Work Directive Change signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work,

and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

- G. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- H. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- I. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- J. Change Order Forms: EJCDC 1910-8-B Change Order.
- K. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- L. Correlation Of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in Project Record Documents.

1.6 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct appropriate remedy or adjust payment.
- C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer or Owner.
- D. Defective Work will be partially repaired to instructions of Architect/Engineer or Owner, and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer or Owner.
- E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- F. Authority of Architect/Engineer or Owner to assess defects and identify payment adjustments, is final.
- G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.

- 3. Products not completely unloaded from transporting vehicle.
- 4. Products placed beyond lines and levels of required Work.
- 5. Products remaining on hand after completion of the Work.
- 6. Loading, hauling, and disposing of rejected products.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Cutting and patching.
- E. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Architect/Engineer will schedule meeting after Notice of Award.
- B. Attendance Required: Owner, Architect/Engineer, and all trade Contractors.

C. Agenda:

- 1. Execution of Owner-Contractor Agreement.
- 2. Submission of executed bonds and insurance certificates.
- 3. Distribution of Contract Documents.
- 4. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
- 5. Designation of personnel representing parties in Contract, and Architect/Engineer.
- 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
- 7. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

1.4 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Architect/Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems impeding planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of off-site fabrication and delivery schedules.
 - 7. Maintenance of progress schedule.
 - 8. Corrective measures to regain projected schedules.
 - 9. Planned progress during succeeding work period.
 - 10. Coordination of projected progress.
 - 11. Maintenance of quality and work standards.
 - 12. Effect of proposed changes on progress schedule and coordination.
 - 13. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate 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 Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.2 SPECIAL PROCEDURES

- A. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.
- B. Employ skilled and experienced installer to perform alteration work.

- C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- E. Remove debris and abandoned items from area and from concealed spaces.
- F. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.
- I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.
- J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.
- L. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.
- M. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- N. Finish surfaces as specified in individual product sections.

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. References.
- B. Quality assurance.
- C. Format.
- D. Schedules.
- E. Submittals.
- F. Review and evaluation.
- G. Updating schedules.
- H. Distribution.

1.2 REFERENCES

A. The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry, Washington, D.C., The Associated General Contractors of America (AGC).

1.3 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel specializing in CPM scheduling with two years minimum experience in scheduling construction work of complexity comparable to this Project, and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.
- B. Contractor's Administrative Personnel: Two years minimum experience in using and monitoring CPM schedules on comparable projects.

1.4 FORMAT

- A. Listings: Reading from left to right, in ascending order for each activity. Identify each activity with applicable specification section number.
- B. Diagram Sheet Size: 24 inches high x 36 inches wide.
- C. Scale and Spacing: To allow for notations and revisions.

1.5 SCHEDULES

- A. Prepare network analysis diagrams and supporting mathematical analyses using Critical Path Method, under concepts and methods outlined in AGC's "The Use of CPM in Construction A Manual for General Contractors and the Construction Industry".
- B. Illustrate order and interdependence of activities and sequence of work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.
- C. Illustrate complete sequence of construction by activity, identifying work of separate tasks. Indicate dates for submittals including dates for Owner furnished items and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.
- D. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
 - 1. Preceding and following event numbers.
 - 2. Activity description.
 - 3. Estimated duration of activity, in maximum 15 day intervals.
 - 4. Earliest start date.
 - 5. Earliest finish date.
 - 6. Actual start date.
 - 7. Actual finish date.
 - 8. Latest start date.
 - 9. Latest finish date.
 - 10. Total and free float; accrue float time to Owner and to Owner's benefit.
 - 11. Monetary value of activity, keyed to Schedule of Values.
 - 12. Percentage of activity completed.
 - 13. Responsibility.
- E. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, of accepting revised completion dates, and recomputation of scheduled dates and float.
- F. Required Sorts: List activities in sorts or groups:
 - 1. By preceding work item or event number from lowest to highest.
 - 2. By longest float, then in order of early start.
 - 3. By responsibility in order of earliest possible start date.
 - 4. In order of latest allowable start dates.
 - 5. In order of latest allowable finish dates.
 - 6. Contractor's periodic payment request sorted by Schedule of Values listings.
 - 7. Listing of basic input data generating report.
 - 8. Listing of activities on critical path.
- G. Prepare sub-schedules for each stage of Work identified in Section 01 10 00 Summary.
- H. Coordinate contents with schedule of values in Section 01 33 00 Submittal Procedures.

1.6 SUBMITTALS

- A. Within 10 days after date established in Notice to Proceed, submit proposed preliminary network diagram defining planned operations for first 60 days of Work, with general outline for remainder of Work.
- B. Participate in review of preliminary and complete network diagrams jointly with Architect/Engineer.
- C. Within 20 days after joint review of proposed preliminary network diagram, submit draft of proposed complete network diagram for review. Include written certification that major[mechanical and electrical Subcontractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete network analysis consisting of network diagrams and mathematical analysis.
- E. Submit updated network schedules every 30 days.
- F. Submit number of opaque reproductions Contractor requires, plus two copies Architect/Engineer will retain.
- G. Submit under transmittal letter form specified in Section 01 33 00 Submittal Procedures.

1.7 REVIEW AND EVALUATION

- A. Participate in joint review and evaluation of network diagrams and analysis with Architect/Engineer at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise network diagrams and analysis incorporating results of review, and resubmit within 10 days.

1.8 UPDATING SCHEDULES

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update diagrams to graphically depict current status of Work.
- C. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- D. Indicate changes required to maintain Date of Substantial Completion.
- E. Submit sorts required to support recommended changes.

F. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect including effects of changes on schedules of separate contractors.

1.9 DISTRIBUTION

- A. Following joint review, distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect/Engineer, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Proposed products list.
- C. Product data.
- D. Shop drawings.
- E. Samples.
- F. Design data.
- G. Test reports.
- H. Certificates.
- I. Manufacturer's instructions.
- J. Manufacturer's field reports.
- K. Erection drawings.
- L. Construction photographs.

1.2 SUBMITTAL PROCEDURES

- A. Transmit each submittal with AIA Form G810.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver to Utility. Coordinate submission of related items.

- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Architect/Engineer review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- K. Submittals not requested will not be recognized or processed.

1.3 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.4 PRODUCT DATA

- A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit number of copies Contractor requires, plus three copies Architect/Engineer will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 Execution and Closeout Requirements.

1.5 SHOP DRAWINGS

- A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.

- 1. Include signed and sealed calculations to support design.
- 2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
- 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit in form of one reproducible transparency and one opaque reproduction.
- E. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 Execution and Closeout Requirements.

1.6 SAMPLES

- A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Samples For Selection as Specified in Product Sections:
 - 1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
 - 2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer selection.
- C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- D. Include identification on each sample, with full Project information.
- E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.
- F. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- G. Samples will not be used for testing purposes unless specifically stated in specification section.
- H. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00 Execution and Closeout Requirements.

1.7 DESIGN DATA

- A. Submit for Architect/Engineer's knowledge as Owner's representative or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 TEST REPORTS

A. Submit for Architect/Engineer's knowledge as Owner's representative or for Owner.

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B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.10 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.11 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect/Engineer's benefit as Owner's representative or for Owner.
- B. Submit report in duplicate within 5 days of observation to Architect/Engineer for information.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.12 ERECTION DRAWINGS

- A. Submit drawings for Architect/Engineer's benefit as Owner's representative or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.13 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect/Engineer.
- B. Each month submit photographs with Application for Payment.

- C. Photographs: One digital print.
- D. Take two site photographs from differing directions and five interior photographs indicating relative progress of the Work.
- E. Take photographs as evidence of existing project conditions.
- F. Identify each print with description, date and time of view,.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality control and control of installation.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Testing and inspection services.
- F. Manufacturers' field services.
- G. Examination.
- H. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 LABELING

- A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.

1.6 TESTING AND INSPECTION SERVICES

- A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.
 - 1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time specialist and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

- B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer.
 - 1. Laboratory: Authorized to operate at Project location in State of Wisconsin.
 - 2. Laboratory Staff: Maintain full time specialist on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.
- D. Reports will be submitted by independent firm to Architect/Engineer, Contractor, and authority having jurisdiction, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
 - 1. Submit final report indicating correction of Work previously reported as non-compliant.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 24 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- H. Agency Responsibilities:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Architect/Engineer and Contractor of observed irregularities or nonconformance of Work or products.
 - 6. Perform additional tests required by Architect/Engineer.
 - 7. Attend preconstruction meetings and progress meetings.
- I. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer, Contractor, and authority having jurisdiction. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.

- 6. Location in Project.
- 7. Type of inspection or test.
- 8. Date of test.
- 9. Results of tests.
- 10. Conformance with Contract Documents.
- J. Limits On Testing Authority:
 - 1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency or laboratory may not approve or accept any portion of the Work.
 - 3. Agency or laboratory may not assume duties of Contractor.
 - 4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations. Observer subject to approval of Architect/Engineer.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00 Submittal Procedures, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary ventilation.
 - 5. Telephone service.
 - 6. Facsimile service.
 - 7. Temporary water service.
 - 8. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Field offices and sheds.
 - 2. Vehicular access.
 - 3. Parking.
 - 4. Progress cleaning and waste removal.
 - 5. Project identification.
 - 6. Fire prevention facilities.
- C. Temporary Controls:
 - 1. Security.
 - 2. Water control.
 - 3. Dust control.
 - 4. Erosion and sediment control.
 - 5. Pest control.
 - 6. Pollution control.
 - 7. Rodent control.
- D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

- A. Owner will pay cost of energy used. Exercise measures to conserve energy. Utilize Owner's existing power service.
- B. Provide temporary electric feeder from existing electrical service at location as directed by Architect/Engineer. Do not disrupt Owner's use of service.
- C. Complement existing power service capacity and characteristics as required for construction operations.

- D. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.
- E. Permanent convenience receptacles may be utilized during construction.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction operations.
- B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.
- D. Maintain lighting and provide routine repairs.
- E. Permanent building lighting may be utilized during construction.

1.4 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

1.5 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

1.6 TELEPHONE SERVICE

A. Provide, maintain, and pay for telephone service to field office at time of project mobilization.

1.7 FACSIMILE SERVICE

A. Provide, maintain and pay for facsimile service and dedicated telephone line to field office at time of project mobilization.

1.8 TEMPORARY WATER SERVICE

A. Extend branch piping with outlets located so water is available by hoses with threaded connections.

1.9 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.
- B. At end of construction, return existing facilities used for construction operations to same or better condition as original condition.

1.10 FIELD OFFICES AND SHEDS

- A. Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Provide separate private office, similarly equipped and furnished, for use of Architect/Engineer.
- D. Locate offices and sheds minimum distance of 30 feet from existing structures.
- E. Do not use permanent facilities for field offices or for storage.
- F. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors.
 - 1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove at completion of Work.
 - 2. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
 - 3. Exterior Materials: Weather resistant.
 - 4. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
 - 5. Lighting for Offices: 50 ft C at desk top height, exterior lighting at entrance doors.
 - 6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.
- G. Environmental Control:
 - 1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
 - 2. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of products.
- H. Architect/Engineer Office:
 - 1. Separate space for sole use of Architect/Engineer, with separate entrance door with new lock and two keys.
 - 2. Area: Minimum 150 sq ft, minimum dimension 8 ft.

- 3. Windows: Minimum three, with operable sash and insect screens. Locate to provide views of construction area.
- 4. Electrical Distribution Panel: Two circuits minimum, 110 volt, 60 Hz service.
- 5. Minimum four 110 volt duplex convenience outlets, one on each wall.
- 6. Telephone: As specified in Section 01 50 00 Temporary Facilities and Controls.
- 7. Architect/Engineer Office Furnishings:
 - a. One desk 54 x 30 inch, with three drawers.
 - b. One drafting table 36 x 72 inch, with one equipment drawer and full width parallel straight edge.
 - c. One metal, double-door storage cabinet under table.
 - d. Plan rack to hold working Drawings, shop drawings, and record documents.
 - e. One standard four-drawer letter size metal filling cabinet with locks and two keys for each lock.
 - f. Six linear ft of metal bookshelves.
 - g. Two swivel arm chairs.
 - h. Two straight chairs.
 - i. One drafting table stool.
 - j. One tackboard 36 x 30 inch.
 - k. One waste basket for each desk and table.
- I. Storage Areas And Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00 Product Requirements.
- J. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.
- K. Installation:
 - 1. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
 - 2. Parking: Two hard surfaced parking spaces for use by Architect/Engineer, connected to office by walk.
 - 3. Employee Residential Occupancy: Not allowed on Owner's property.
- L. Maintenance And Cleaning:
 - 1. Weekly janitorial services for offices; periodic cleaning and maintenance for office and storage areas.
 - 2. Maintain approach walks free of mud, water, and snow.
- M. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

1.11 VEHICULAR ACCESS

- A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

- C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
- D. Location approved by Owner.
- E. Provide unimpeded access for emergency vehicles. Maintain 20 feet wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets.
- H. Use designated existing on-site roads for construction traffic.

1.12 PARKING

- A. Provide temporary gravel surface parking areas to accommodate construction personnel.
- B. Locate as approved by Owner.
- C. When site space is not adequate, provide additional off-site parking.
- D. Use of designated existing on-site streets and driveways used for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.
- E. Use of designated areas of existing parking facilities used by construction personnel is not permitted.
- F. Do not allow heavy vehicles or construction equipment in parking areas.
- G. Do not allow vehicle parking on existing pavement.
- H. Permanent Pavements And Parking Facilities:
 - 1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
 - 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
- I. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
 - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.
- J. Removal, Repair:
 - 1. Remove temporary materials and construction[when permanent paving is usable.
 - 2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
 - 3. Repair existing facilities damaged by use, to original condition.

K. Mud From Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.13 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

A. Project Identification Sign is not required for the project.

1.15 FIRE PREVENTION FACILITIES

- A. Prohibit smoking with buildings under construction and demolition. Designate area on site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
- B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Portable Fire Extinguishers: NFPA 10; 10 pound capacity, 4A-60B: C UL rating.
 - 1. Provide one fire extinguisher at each stair on each floor of buildings under construction and demolition.
 - 2. Provide minimum one fire extinguisher in every construction trailer and storage shed.
 - 3. Provide minimum one fire extinguisher on roof during roofing operations using heat producing equipment.

1.16 SECURITY

- A. Security Program:
 - 1. Protect Work, existing premises, and Owner's operations from theft, vandalism, and unauthorized entry.
 - 2. Initiate program in coordination with Owner's existing security system at project mobilization.
 - 3. Maintain program throughout construction period until directed by Architect/Engineer.
- B. Entry Control:

- 1. Restrict entrance of persons and vehicles into Project site and existing facilities.
- 2. Allow entrance only to authorized persons with proper identification.
- 3. Maintain log of workers and visitors, make available to Owner on request.
- 4. Control entrance of persons and vehicles related to Owner's operations.
- C. The existing buildings need to be secured at all times. Any openings cut into the walls in both facilities need to be secured at all times with plywood sheathing anchored to the existing structure.

1.17 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.18 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.19 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize surface area of bare soil exposed at one time.
- C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.20 PEST CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work and entering facility.

1.21 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.22 RODENT CONTROL

A. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment.
- B. Remove underground installations to minimum depth of 2 feet.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Product substitution procedures.
- F. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

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- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Architect/Engineer will consider requests for Substitutions only up to 15 days before Bids are submitted.
- B. Substitutions will not be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Bidder:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.

- 5. Will reimburse Architect/Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.
- E. 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 revision to Contract Documents.

PART 2 PRODUCTS

- 2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS
 - A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.
 - B. Cord and Plug: Furnish minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

PART 3 EXECUTION - Not Used

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Testing, adjusting and balancing.
- F. Protecting installed construction.
- G. Project record documents.
- H. Operation and maintenance data.
- I. Manual for materials and finishes.
- J. Manual for equipment and systems.
- K. Spare parts and maintenance products.
- L. Product warranties and product bonds.
- M. Maintenance service.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- B. Provide submittals to Architect/Engineer required by authorities having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy all portions of building as specified in Section 01 10 00 Summary.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer seven days prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 33 00 Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment and instructed by manufacturer's representative who is knowledgeable about the Project.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 TESTING, ADJUSTING AND BALANCING

- A. Owner will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services from cash allowance specified in Section 01 20 00 Price and Payment Procedures.
- B. Independent firm will perform services specified in Section 23 05 93.
- C. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.8 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

- 1. Drawings.
- 2. Specifications.
- 3. Addenda.
- 4. Change Orders and other modifications to the Contract.
- 5. Reviewed Shop Drawings, Product Data, and Samples.
- 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.
- G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

- 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
- 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
- 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Originals of warranties.

1.10 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.
- F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- H. Additional Requirements: As specified in individual product specification sections.
- I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.11 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- G. Include color coded wiring diagrams as installed.
- H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.
- I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- J. Include servicing and lubrication schedule, and list of lubricants required.
- K. Include manufacturer's printed operation and maintenance instructions.
- L. Include sequence of operation by controls manufacturer.
- M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- N. Include control diagrams by controls manufacturer as installed.
- O. Include Contractor's coordination drawings, with color coded piping diagrams as installed.
- P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- R. Include test and balancing reports as specified in Section 01 40 00 Quality Requirements.
- S. Additional Requirements: As specified in individual product specification sections.
- T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.13 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Time Of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 - 2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.14 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections for one year from date of Substantial Completion.

- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SECTION 02 41 19

SELECTIVE STRUCTURE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Demolishing designated building equipment and fixtures.
- B. Demolishing designated construction.
- C. Cutting and alterations for completion of the Work.
- D. Removing designated items for reuse and Owner's retention.
- E. Protecting items designated to remain.
- F. Removing demolished materials.

1.2 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.3 QUALITY ASSURANCE

- A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.
- B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.
- D. Perform Work in accordance with State and Municipality standard.

1.4 SCHEDULING

- A. Section 01 30 00 Administrative Requirements: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.

- C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation in adjoining spaces.
- D. Coordinate utility and building service interruptions with Owner.
 - 1. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner.
 - 2. Schedule tie-ins to existing systems to minimize disruption.
 - 3. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.5 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately if structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify affected utility companies before starting work and comply with their requirements.
- B. Mark location and termination of utilities.
- C. Erect, and maintain temporary barriers and security devices at locations indicated, including warning signs and lights, and similar measures, for protection of the Owner and existing improvements indicated to remain.
- D. Layout cuts in post tensioned concrete elements to avoid cutting concrete within 12 inches of any stressing tendon. Notify Architect/Engineer three days in advance of cutting post-tensioned concrete.
- E. Erect and maintain weatherproof closures for exterior openings.
- F. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.
- G. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.
- H. Provide appropriate temporary signage including signage for exit or building egress.
- I. Do not close or obstruct building egress path.

J. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

3.2 SALVAGE REQUIREMENTS

- A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.
- B. Tag components and equipment Owner designates for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged.
- E. Disassemble as required to permit removal from building.
- F. Package small and loose parts to avoid loss.
- G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Maintain protected egress from and access to adjacent existing buildings at all times.
- C. Do not close or obstruct roadways without permits.
- D. Cease operations immediately when structure appears to be in danger and notify Owner.
- E. Disconnect and remove designated utilities within demolition areas.
- F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.
- G. Demolish in orderly and careful manner. Protect existing improvements and supporting structural members.
- H. Carefully remove building components indicated to be reused.
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts to avoid loss.
 - 3. Mark components and packaged parts to permit reinstallation.

- 4. Store components, protected from construction operations, until reinstalled.
- I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- K. Remove temporary Work.

3.4 SCHEDULES

A. Remove, store and protect the following materials and equipment: 1. Face bricks.

SECTION 02 41 26

SELECTIVE ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
- B. Disposal of materials.
- C. Identification of utilities.
- D. Protection of items to remain as indicated on Drawings.
- E. Relocate existing equipment to accommodate construction.

1.2 CLOSEOUT SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with State and Municipality standards.

1.4 SCHEDULING

- A. Schedule work to coincide with new construction.
- B. Cease operations immediately when structure appears to be in danger and notify Engineer. Do not resume operations until directed.

1.5 COORDINATION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- C. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.

- 2. Keep shut-down period to minimum or use intermittent period as directed by Engineer.
- 3. Maintain life-safety systems in full operation in occupied facilities.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- B. Verify termination points for demolished services.

3.2 PREPARATION

A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the Owner, Contractor's employees, and existing improvements to remain.

3.3 DEMOLITION

- A. Drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.
- B. Remove exposed abandoned conduit. Cut conduit flush with walls and floors and patch surfaces.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- E. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- F. Install temporary wiring and connections to maintain existing systems in service during construction.
- G. Perform work on energized equipment or circuits with experienced and trained personnel.
- H. Remove, relocate, and extend existing installations to accommodate new construction.

- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components. Cut embedded support elements flush with walls and floors.
- K. Clean and repair existing equipment to remain or to be reinstalled.
- L. Protect and retain power to existing active equipment remaining.
- M. Cap abandoned empty conduit at both ends.

3.4 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

3.5 CLEANING

- A. Section 01 70 00 Cleaning: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

3.6 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Cleaning: Requirements for protecting finished Work.

SECTION 03 11 13

CONCRETE FORMWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General formwork.
- B. Forms and coatings.
- C. Form ties and accessories.

1.2 RESPONSIBILITY

- A. The Contractor shall be solely responsible for the ability of formwork to produce members of the size, shape, and exterior finish required, for the structural adequacy of the forms to carry construction loads without excessive deflection, and for the safe use of forms in connection with completion of the concrete work. The Contractor shall be responsible for any injury or damage arising from inadequate forms or from premature removal of formwork.
- B. Submittals
 - 1. Samples and Certifications
 - 2. Samples and certifications shall be submitted in accordance with Section 01 33 00
- C. Referenced Standards: Formwork design, construction, and removal shall conform to ACI 301, Standard Specifications for Structural Concrete.

PART 2 PRODUCTS

2.1 FORMWORK

- A. Plywood Forms and Liners: Plywood forms and liners shall be minimum grade B-B High Density Overlay Concrete Form Panels, Class I.
- B. Lumber: Formwork lumber shall be straight and clean. All nails shall be withdrawn and surfaces in contact with concrete shall be thoroughly cleaned before reuse.
- C. Metal Forms: Metal forms shall be fabricated from carbon steel sheets conforming to ASTM A569.

PART 3 EXECUTION

3.1 PREPARATIONS

A. Fastening Devices for Other Work: Coordinate with other trades and properly place and locate in position all necessary dowels, bolts, anchors, anchor slots, inserts, sleeves, openings, hangers, metal ties and other fastening devices required for attachment and support of adjacent work. Securely anchor all embedded items.

3.2 FORMWORK REQUIREMENTS

A. General:

- 1. Formwork shall comply with ACI 347 and to shape, lines and dimensions of the members as indicated on the Drawings. Joints in forms shall be horizontal or vertical. Forms shall be properly braced or tied to maintain position and shape under all dead and live loads and to prevent leakage. Forms shall be assembled so their removal will not damage the concrete. Tolerances for formed surfaces shall be in compliance with ACI 301.
- 2. Lumber formwork may be used for surfaces which will not be exposed to view. Use plywood or metal forms for exposed surfaces.
- 3. Provide temporary openings at the base of forms greater than 4 feet high, if necessary, to facilitate cleaning and inspection immediately before depositing concrete.
- 4. All external corners of concrete exposed to view shall be chamfered by using 3/4 inch by 3/4 inch by 45 degree wood stripping, except as otherwise indicated on the Drawings.
- B. Grade A Forms
 - 1. Unless otherwise indicated, Grade A forms shall be used for all exposed concrete.
 - 2. Grade A forms shall consist of steel forms lined with 3/16 inch thick tempered hardboard or 1/4 inch thick plywood, or by using plywood forms.
 - 3. Full sized sheets shall be used wherever possible. The edges of all sheets shall be straightened to insure tight, close fitting joints. Bulges or depressions more than 1/8 inch in 4 feet will not be permitted. Open joints which would permit leakage shall be sufficient cause for rejection of forms. Other tolerances shall be as allowed by ACI 347.
- C. Grade B Forms
 - 1. Use lumber, plywood or metal forms. All joints shall be solidly backed, aligned and made leakproof.

- 2. Unless otherwise indicated, Grade B Forms are intended for use where concrete will not be exposed to view, such as below grade, below normal liquid levels in water-retaining structures, or inside manholes, boxes, vaults, etc.
- D. Surface Treatment of Formwork: The inside surface of lumber forms shall be soaked with clean water prior to placing concrete. All other forms shall be treated with an approved form oil or lacquer. If oil is used, all excess oil shall be wiped off.
- E. Inspection of Formwork: Concrete shall not be placed until the forms have been inspected by the OWNER to assure surfaces in conformance with the Drawings and Specifications.
- F. Removal of Forms: Forms shall be removed in accordance with requirements of ACI 318, without damaging the concrete. Leave shoring in place until concrete will safely support its own weight plus any live loads that may be placed upon it.

SECTION 03 15 05

CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction joints.
- B. Anchors and inserts.

1.2 SUBMITTALS

A. Samples and Certifications: Samples and certifications for all materials herein shall be submitted in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.1 JOINT FILLERS

- A. Joint fillers shall be products of the following manufacturers, or equal:
 - 1. W. R. Meadows, Inc., Elgin, Illinois.
 - 2. W. R. Grace and Co., Cambridge, Massachusetts.
- B. Preformed Sponge Rubber Joint Filler: Preformed sponge rubber joint filler shall conform to ASTM D1752, Type I.
- C. Preformed Cork Joint Filler: Preformed cork joint filler shall conform to ASTM D1752, Type II.
- D. Preformed Bituminous Fiber Joint Filler: Preformed bituminous fiber joint filler shall be non-extruding type conforming to ASTM D1751.
- E. Control Joint Strips: Control joint strips shall have a minimum depth of 25 percent of slab thickness and a minimum thickness of 1/8 inch.

2.2 JOINT SEALANTS

A. Sealants for joints shall be as indicated under Execution and in accordance with Section 07 90 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove existing concrete and provide openings for installation of new work as indicated on Drawings. Repair all damage to existing work caused by concrete removal.

Clark Dietz, Inc. 00130014

Concrete Accessories 03 15 05-1

3.2 CONSTRUCTION JOINTS

A. General

- 1. Arrange construction joint bulkheads to allow concrete to be placed between construction joints in one continuous operation.
- 2. Provide construction joints with shear transfer keyways and waterstop as indicated. Unless otherwise indicated on the Drawings, spacing of construction joints for walls shall not exceed 40 feet.
- 3. Erect bulkheads where shown on the Drawings. Bulkheads shall be at right angles to the main reinforcement and shall produce a tongue and grooved joint of the configuration indicated on the Drawings. Install waterstop as indicated.
- 4. Obtain the Owner's approval if it becomes necessary to eliminate or relocate construction joints shown on the Drawings.
- 5. Tops of edge forms, bulkheads and screeds shall be set to the finished elevations and to provide uniform pitch to drains as indicated on Drawings.
- B. Horizontal Joints: Provide methods of achieving a leak proof joint. No horizontal construction joints will be permitted in slabs, beams, or girders.
- C. Vertical Joints: Joints in reinforced slabs, beams, and girders shall be perpendicular to the axis or plane of the members joined.
- D. Expansion Joints: General: Provide expansion joints and waterstop where indicated. Joint fillers shall be placed on each side of waterstop.
- E. Interior Horizontal Joints: Unless otherwise indicated, provide preformed sponge rubber or preformed cork filler. Allow for installation of two component traffic grade polyurethane sealant in compliance with Section 07 90 00.
- F. Exterior Horizontal Joints: For drives, pavements, parking areas, walks and slabs on grade, provide preformed non-extruding asphalt strip or bituminous fiber joint filler set 1/8-inch below finished surface unless otherwise indicated. Tool concrete edges on each side of joint. No sealant is required.
- G. Interior and Exterior Vertical Joints: Unless otherwise indicated, provide preformed sponge rubber or cork filler with allowance for installation of two-component polysulfide sealant in compliance with Section 07 90 00.
- H. Submerged Horizontal and Vertical Joints: Unless otherwise indicated, provide preformed sponge rubber or cork filler with allowance for installation of two component polyurethane or two-part polysulfide sealant as required in compliance with Section 07 90 00. Contractor shall submit sealant manufacturer's recommendation that his product is suitable for this application.

SECTION 03 21 05

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provision of all reinforcement.

1.2 SUBMITTALS

- A. Certifications: Certifications for reinforcement shall be submitted in accordance with Section 01 33 00.
- B. Shop Drawings: Submit checked reinforcement steel shop drawings in accordance with Section 01 33 00. Shop drawings shall be prepared in accordance with ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures. Drawings shall indicate bending diagrams, shapes, dimensions, clearances, splicing and lap lengths, accessories, and installation notes.

PART 2 PRODUCTS

0.1 REINFORCEMENT

- A. Reinforcement Bars: Reinforcement bars shall be ASTM A615, Grade 60 deformed bars, except as otherwise indicated.
- B. Smooth Dowels: Smooth dowels shall be ASTM A615, Grade 60 plain bars.
- C. Threaded Dowels: Threaded dowels shall be ASTM A36.
- D. Welded Wire Fabric: Welded wire fabric shall conform to ASTM A185. Where welded wire fabric is shown but not sized on Drawings, use 6"x6" W6xW6 WWF.
- E. Welded Deformed Wire Fabric shall conform to ASTM A496, Grade 60.
- F. Accessories: Accessories for proper installation of reinforcement shall conform to CRSI "Manual of Standard Practice for Reinforced Concrete Construction". All bar supports at exposed surfaces shall be Class 1- Plastic Protected.
- G. Reinforcement Fabrication: Reinforcement fabrication shall conform to ACI 315 and ACI 318, and approved shop drawings.
- H. Mechanical Splices: Splices shall develop 125% of the specified yield strength of the reinforcing bar.

PART 3 EXECUTION

3.1 PREPARATIONS

- A. Vapor Barrier: On porous subgrade or beddings, provide vapor barrier as specified in Section 03 30 53.
- B. Fastening Devices for Other Work: Coordinate with other trades and properly place and locate in position all necessary reinforcement, dowels, bolts, anchors, anchor slots, inserts, hangers, metal ties, and other fastening devices required for attachment and support to adjacent work. Securely anchor all fixtures and embedded items.

3.2 REINFORCEMENT

- A. General:
 - 1. The placement of reinforcing steel shall conform to "Placing Reinforcing Bars", as published by the Concrete Reinforcing Steel Institute except as noted.
 - 2. Reinforcement shall be inspected and approved by the OWNER before enclosing forms are erected and shall be rechecked immediately prior to depositing concrete.
- B. Splices, Laps, and Dowels:
 - 1. At joints in concrete:
 - a. Construction Joints: Provide continuous reinforcement or dowels through construction joints. The use of inserts in lieu of dowels shall be subject to the ENGINEER'S approval.
 - b. Control Joints: One half of reinforcement shall be discontinued across control joints unless otherwise indicated.
 - c. Expansion Joints: All reinforcement shall be discontinued across expansion joints, except for sleeved or greased dowels, if indicated.
 - 2. Splice laps shall be as indicated on the Drawings. Dowels shall be of the same size as the largest bar to which they lap, unless otherwise indicated.
- C. Welded Wire Fabric Reinforcement for Slabs
 - 1. Fabric reinforcement for slabs shall be overlapped at splices not less than the spacing of the cross wires plus 2 inches. Fabric shall extend to within 2 inches of concrete edges.
 - 2. Unless otherwise shown, place reinforcement 2 inches below the top of the finished slab. Mesh shall either be sandwiched between two layers of fresh concrete or supported on mesh supports. Supports that may puncture the vapor barrier, if any, shall not be used.

- D. Reinforcement for Formed Concrete
 - 1. Secure steel reinforcement to maintain proper position during concrete placement. Concrete protection for reinforcement shall conform to ACI 318, except as otherwise indicated on the Drawings.
 - 2. Provide Z bars and bar supports at 4-foot on centers each way in wall, columns, etc. pours to maintain proper position.

SECTION 03 30 53

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete mixtures.
- B. Mixing.
- C. Transporting.
- D. Placement schedule.
- E. Depositing and consolidating.
- F. Slab finishing.
- G. Curing.
- H. Formed surface finishing.

1.2 SUBMITTALS

- A. Samples and Certifications: Samples and certifications shall be submitted in accordance with Section 01 33 00. Unless otherwise indicated, submit certifications for all products and samples as may be specifically requested by the ENGINEER.
- B. Product Data: Submit manufacturer's literature for all admixtures proposed for the work.
- C. Delivery Tickets: Submit delivery tickets in accordance with ASTM C94 for each batch of ready-mixed concrete. Information on the ticket shall include class of concrete, water content, time of loading, truck number, admixtures, and quantity.
- D. Mix Design
 - 1. At least 35 days prior to placing of concrete, the Contractor shall submit proposed mix proportions and samples of proposed materials to the testing laboratory retained by the OWNER. The laboratory will prepare a detailed report of the 7-day and 28-day compressive strength, slump, and air-entrainment of the concrete mix submitted. The strength determination for each class of concrete will be based on not less than three concrete specimens of each age.
 - 2. The laboratory will employ techniques to adjust for mechanical vibrators and any special devices or equipment to be used for the work. The Contractor shall inform the OWNER and the Testing Laboratory of proposed techniques and devices.

- 3. As an alternate to items 1 and 2 above, the mix design may be based upon field experience. Contractor shall submit all data and calculations necessary to show compliance with Section 5.3 of ACI 318.
- E. Placement Schedule: Submit a concrete placement schedule showing the pouring sequence and location of construction and contraction joints not indicated on the Drawings to the maximum extents possible.

1.3 QUALITY CONTROL

- A. Materials and Methods: Materials and methods of mixing and placing concrete shall conform to ACI 318, Building Code Requirements for Reinforced Concrete.
- B. Laboratory Tests
 - 1. The CONTRACTOR will retain the services of testing laboratory and pay all laboratory costs to make tests and submit reports. All additional tests required because concrete fails to meet Specifications will be deducted from payments due the Contractor.
 - 2. The Contractor shall provide all necessary labor and devices to obtain samples and provide field curing.
 - 3. As directed by the ENGINEER, the testing laboratory will provide for inspection of the concrete batch plant to see that the concrete is properly mixed and that the consistency of mix is being controlled.
 - 4. The laboratory will immediately submit two copies of laboratory reports on all strength tests to the ENGINEER, the local building authority, if required, the concrete contractor, and the supplier. Reports will be made on a form acceptable to the ENGINEER and will indicate delivery ticket numbers, strength, slump, air entrainment, admixtures, concrete temperature, pour location, date, age, and remarks on properties changes.
- C. Compressive Strength Tests: Sample specimens for strength tests of Class A concrete shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete placed, nor less than once for each 5000 square feet of surface area for slabs and/or walls. Five specimens shall be secured in accordance with ASTM C172. Three specimens will be laboratory-cured in accordance with ASTM C31. The other two shall be cured entirely under field conditions. Compressive strength tests will be made at the age of 7 days on one field-cured and one laboratory-cured specimen. Compressive strength tests will be made at the age of 28 days on one field-cured and two laboratory-cured specimens. All tests will be in compliance with ASTM C39.
- D. Enforcement of Strength Requirements:
 - 1. For Class A Concrete, the average of any five consecutive compressive strength test results on laboratory-cured specimens shall be greater than the specified strength. Not more than one of the five test results shall be less than the specified strength. No individual laboratory cured strength test result shall fall below the

specified strength by more than 400 psi. Each strength test result will be the average of two laboratory cured cylinders from the same sample test at 28 days.

- 2. If more than one of the laboratory-cured specimens is below the specified strength, or if the strengths of field-cured specimens are more than 10% below the strength of the corresponding laboratory- cured specimens, the ENGINEER will determine the appropriate corrective measures to be provided at the Contractor's expense.
- E. Slump Tests: Tests for slump will be made when directed by the ENGINEER in accordance with ASTM C143. Excessive slump is cause for rejection of concrete prior to placement.
- F. Air Entrainment Tests: At least two air content tests will be made each day, and when change in consistency of the concrete mix is noted. The air content tests will be made in accordance with ASTM C138, C173, C231, or AASHTO T152.
- G. Adverse Weather Conditions:
 - 1. Comply with ACI 305 or 306 for hot or cold weather concreting.
 - 2. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing without approval of the ENGINEER. Maintain the temperature of concrete above 50 degrees F for 5 days after placement. When high early strength portland cement concrete is used, the temperature shall not be less than 70 degrees F for 2 days or 50 degrees F for 3 days. Transition the concrete to the outside temperature at a rate of 1 degree F each hour for the first 24 hours and 2 degrees F each hour thereafter.
 - 3. In no case shall the temperature of concrete exceed 90 degrees F at the time of placement. If insulated forms are used, the temperature of the concrete mixture shall not exceed 80°F at time of placement.
 - 4. If the ENGINEER determines that heat of hydration may cause excessive concrete temperatures and subsequent detrimental effects, the concrete mixture shall not exceed 60° F at time of placement for critical pours.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Water: Water shall be clean and potable.
- B. Cement: Portland cement shall be ASTM C150 Type I.
- C. Pozzolon: Pozzolons shall conform to ASTM C618 and shall have a loss of ignition less than three percent.

- D. Aggregate:
 - 1. Fine and coarse aggregate shall be clean, hard, natural, or manufactured material conforming to ASTM C33.
 - 2. The nominal maximum size of the aggregate shall not be larger than one-fifth of the narrowest dimension between forms, one-third of the depth of slabs, nor three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars. Coordinate with maximum aggregate sizes specified hereafter for classes of concrete. These limitations may be waived if, in the judgment of the ENGINEER, workability and methods of consolidation are such that the concrete can be placed without honeycomb or void.
- E. Admixtures:
 - 1. Admixtures shall conform to ASTM C260 (air entrainment) or C494 (chemical admixtures) and shall be products of one of the following manufacturers, or equivalent.
 - a. W. R. Grace and Co.
 - b. Euclid Chemical Co.
 - c. Master Builders Co.
 - d. Sika Chemical Corp.
 - e. General Resource Technology
 - f. BASF Admixtures

2.2 MISCELLANEOUS MATERIALS

- A. Vapor Barrier: Vapor barrier shall be polyethylene film 0.006 inches thick and shall conform to Product Standard PS-17.
- B. Curing and Sealing Compound: Curing compound shall be a colorless liquid acrylic formulated to comply with ASTM C309, Type 1, Class B. All interior floor slabs shall be cured and sealed with a colorless liquid acrylic formulated to comply with ASTM C309, Type 1, Class B and with ASTM C1315, Type 1, Class B.
- C. Membrane Curing Compound: Membrane curing compound shall conform to ASTM C309, Type 1 or Type 1-D. Type 1-D compound shall only be used for P.C.C. pavement.
- D. Moisture Retaining Cover: One of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.

2.3 BONDING COMPOUND, GROUT, AND MORTAR MIXTURES

A. Epoxy Bonding Compound: Epoxy bonding compound for joining new to existing concrete shall be Sikadur Hi-Mod by Sika Chemical Co., Thiopoxy by W. R. Grace and Co., Euco Epoxy 452 or 620 by Euclid Chemical Co., or equivalent.

- B. Non-Epoxy Bonding Compound: Non-epoxy bonding compound for joining new to existing concrete where bonding compound can not be placed immediately prior to pouring of new concrete shall be Weld-crete by Larsen Products Corp., Euco Weld by Euclid Chemical Co., or equal. Rewettable bonding compound shall be protected from all sources of moisture prior to pouring new concrete.
- C. Cement Grout: Mix 1 part cement and 1 part sand with water to a thick paint consistency. Add white cement to match color of adjacent concrete. Sand shall pass a No. 18 sieve.
- D. Non-Shrink Grout: Non-shrink grout shall be a premixed, nonferrous, cementitious mixture with a 28-day strength of at least 6000 psi. Grout shall not shrink. Mixtures to be placed in excess of 1-inch thickness may include 3/8-inch pea gravel.
- E. Expansive Grout: Expansive grout shall be a premixed, nonferrous, cementitious mixture with a 28-day strength of 3500 psi. Air entraining content shall be as recommended by the manufacturer. Grout shall expand no more than .10% nor less than .03%.
- F. Epoxy Grout:
 - 1. The two components of epoxy bonding compound shall be mixed in compliance with the manufacturer's instructions. If permitted by the manufacturer the epoxy bonding compound may be combined with approximately 1-1/2 parts of oven-dry sand to 1 part of the bonding compound, by volume. Mixing of trial batches may be necessary to determine the best proportions.
 - 2. The sand for epoxy grout shall meet the following gradation and shall be oven-dry:

Sieve Size	<u>No. 8</u>	<u>No. 50</u>	<u>No. 100</u>
% Passing	100	30 <u>+</u> 15	5 <u>+</u> 5

- G. Patching Mortar:
 - 1. Mix 1 part portland cement to 3 parts fine aggregate. Add white cement to match color of adjacent surface. Provide test patch for approval by owner prior to patching on exposed concrete. Mix with minimum amount of water necessary.

2.3 CONCRETE MIXTURES

- A. General:
 - 1. Concrete not indicated otherwise shall be Class A concrete.
 - 2. The proportions of cement, aggregate, and water shall be selected by the Contractor in accordance with ACI 318 to provide a plastic and workable mix. Coarse aggregate shall be limited to prevent harshness and honeycombing. Coarse aggregate size shall not be greater than the maxima listed for the various classes of concrete and as previously specified under aggregate.

- B. Class A Concrete: Class A structural concrete shall have a 28-day strength of 4000 psi, shall contain not less than 564 pounds cementitious material per cubic yard, shall have a water-cement plus pozzolon ratio of not more than 0.45, and shall contain 4 percent to 6 percent entrained air, by volume, except interior slabs subject to abrasion shall not contain more than 3 percent entrained air. If a pozzolon is used, it shall not exceed 140 pounds per cubic yard of concrete. In addition, Class A concrete shall contain a water-reducing, densifying admixture and have a maximum slump of 4 inches. The maximum aggregate size for concrete for columns, beams, and formed slabs shall be 1 inch. The maximum aggregate size for other concrete construction shall be 1-1/2 inches.
- C. Admixtures:
 - 1. Water-reducing densifying admixture added to Class A concrete shall reduce the water-cement ratio while maintaining slump and compressive strength. Use as manufacturer recommends.
 - 2. Other admixtures may be proposed by the Contractor or requested by the Engineer and shall be provided at no additional cost to the OWNER. Subject to approval, admixtures may be used for the following:
 - a. To increase slump up to 50% while maintaining compressive strength and water-cement ratio.
 - b. To retard set during hot weather.
 - c. To retard set at the surface to expose aggregate.
- D. Calcium chloride, admixtures containing calcium chloride, or admixtures not approved in writing by the Engineer are prohibited.

PART 3 EXECUTION

3.1 PREPARATIONS

- A. Subgrade Preparation: The subgrade and/or bedding shall be compacted and free of frost. If placement is allowed at temperatures below freezing, provide temporary heat and protection as required to remove all frost. Saturate the subgrade approximately 8 hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used. Remove all standing water, ice, mud, and foreign matter before concrete is deposited. Mud slabs shall be provided where necessary to obtain a dry and stable working platform for placement of slabs.
- B. Vapor Barrier: On porous subgrade or beddings, or where indicated on the Drawings, provide vapor barrier. Lay vapor barrier sheets with 6 inch edge laps and tape or seal with mastic. Stretch and weight edges and laps to maintain their positions until concrete is placed. Coordinate with placement of reinforcement specified in Section 03 21 05.
- C. Batching:
 - 1. Materials for concrete shall be proportioned according to the approved design mix and batched using either automatic or manually operated batching equipment. If manual operation is employed, fine and coarse aggregates and bulk cement shall be measured separately by weight. Proportioning aggregates for fractional bags of

cement will not be permitted unless the cement is weighed for each batch. Weighing equipment shall be arranged to permit compensation for changes in weight of moisture contained in the aggregate and shall be accurate to within 1 percent of the net load being weighed. The scale beam shall indicate at least the last 100 pounds of each aggregate required for the batch.

- 2. Water shall be measured to within 1 pint of the total amount required per batch. Admixtures shall be measured by weight or volume to an accuracy of 3 percent.
- D. Mixing and Transporting Concrete:
 - 1. Concrete shall be ready-mixed or job-mixed at the Contractor's option. Ready-mixed concrete shall be mixed and delivered to the project in accordance with ASTM C94. Job-mixed concrete shall be in accordance with the requirements of ACI 318.
 - 2. Concrete shall be in its final position within one hour after the water and aggregate have been added to the cement, except that in cool weather (50°F or less), the ENGINEER may authorize a lapsed time of up to one and one half hours.
 - 3. Concrete shall be transported from the mixer to place of final deposit in such manner to prevent separation or loss of ingredients.

4.	General Concrete and Grout Placement Schedule:	
	All structural concrete	Class A Concrete
	Grout for masonry work	See Division 4
	Bedding under structural steel bearing plates	Non-Shrink Grout
	Equipment installation and leveling	Non-Shrink Grout
		or Expansive Grout
	Heavy vibrating equipment	Epoxy Grout
	Post and anchors installation	Epoxy Grout

3.2 DEPOSITING CONCRETE

- A. General:
 - 1. Concrete shall be placed in accordance with the requirements of ACI 318 and within 10 feet of its final position. Place concrete only during normal working hours unless the ENGINEER is notified at least 24 hours in advance. Concrete shall not be placed until the ENGINEER has approved the formwork, reinforcement, and embedded items and debris has been removed.
 - 2. Whenever new concrete is to be placed against existing surfaces, remove existing coatings including paint and waterproofing, roughen and clean the surface to improve bond and apply bonding compound in accordance with the manufacturer's recommendations.

- 3. Maximum height of free-fall during placement of concrete shall not exceed 4 feet. Where free-fall would exceed allowed maximum height, use "elephant trunks", tremies, chutes, belt conveyors or similar aids to place concrete.
- B. Depositing Formed Concrete:
 - 1. Except for beams, columns, or other deep structural monolithic members, place concrete in level layers no more than 24 inches deep. To prevent cold joints between layers, each successive layer shall be placed and consolidated before the preceding layer has taken its initial set. Place concrete in a continuous operation until the section is complete.
 - 2. Concrete shall be directly placed in its final position, shall not be spaded, moved with vibrators, or permitted to fall over rods, spacers, reinforcement, or other embedded items. Any mortar coating which is more than two hours old shall be removed from items to be embedded. Hoppers with trunks, tremies, and/or other means of placement shall be used as necessary.
- C. Stopping and Resuming
 - 1. Whenever a wall pour is stopped at an intermediate height, the exposed surfaces of the joint shall be made straight and level.
 - 2. Before depositing new concrete against concrete that has hardened, retighten forms and remove foreign matter and laitance. Previously cast surfaces shall be coated with bonding compound.
- D. Depositing Slabs and Flatwork
 - 1. Provide runways and chutes to discharge concrete close to final position to minimize spreading and segregation.
 - 2. Slabs-on-grade for buildings shall be placed in a checkerboard or lane fashion. Crack control joints consisting of either construction or contraction joints shall be placed such that the area bounded by the joints does not exceed 600 square feet. The aspect ratio (length to width) of the slab units formed by the joint layout shall not exceed 1.25 to 1. Re-entrant corners are not permitted. Allow 24 hours between pours of adjacent slabs. Submit layout of joint location in accordance with Section 1.2E.
 - 3. Structural concrete slabs shall be of one course monolithic construction.
- E. Consolidating Formed Concrete
 - 1. Thoroughly compact all concrete with internal vibrators having a minimum frequency of 8000 vibrations per minute and sufficient amplitude and/or hand spading or rodding immediately after depositing, taking care to prevent any movement of the forms or reinforcement. Vibrate adjacent to waterstops and bulkheads to obtain a continuous bond and eliminate surface defects.

2. Vertically insert and withdraw vibrators to consolidate each lift, partially penetrating the previous lift. Do not drag the vibrator nor allow it to come in contact with reinforcement or formwork. Do not attempt to laterally move concrete with the vibrators.

3.3 FINISHING SLABS AND FLATWORK

- A. Finish Schedule
 - 1. Unless otherwise indicated, provide the following slab finishes:

Description	Concrete Finish
Exposed slabs	3 trowelings & sealer
Ramps, walks, and pavement	Float & broom finish

- B. Concrete Tolerances:
 - 1. Concrete shall be within 1/4-inch of a 10-foot straightedge in all directions except where slabs are dished for drains. Deviations from the elevation indicated shall not exceed 1/4-inch.
 - 2. Slabs sloped for drainage shall not have depressions which retain water.
- C. Screeding:
 - 1. Immediately after placement, screed concrete with straightedges or power strikeoffs. Do not use roller screeds or vibrating screeds.
 - 2. Stakes for wet screeds shall be driven down flush with subgrade or pulled out as work progresses to avoid disturbing screeded concrete.
 - 3. For drains in level slabs, form a 5-foot diameter depression approximately 1/2-inch below the adjacent slab surface.
 - 4. Unless otherwise indicated on the Drawings, slabs sloped for drainage shall be uniformly pitched toward the drains at 1/8-inch per foot. Form a dished depression at drains unless otherwise indicated.
- D. Darbying: Immediately after screeding, darby surface with wood or magnesium darby to eliminate ridges and to fill in voids left by screeding.
- E. Float Finish
 - 1. Float concrete using magnesium or aluminum hand floats or power floats after the concrete has stiffened to a point where only a 1/4-inch indentation can be imparted by normal foot pressure.

- 2. Float finish shall result in a uniform, smooth, granular texture. After floating, check slab tolerances with 10-foot straightedge. Fill low spots with fresh concrete; do not sprinkle with dry cement.
- F. Trowel Finish
 - 1. Where scheduled, or indicated, trowel with steel trowels after floating.
 - 2. Initial troweling shall be done either by power or by hand with the trowel blade kept as flat as possible against concrete surface to prevent washboard or chatter effect.
 - 3. Second troweling may be done by power if three trowelings are scheduled. If two trowelings are specified, second troweling shall be done by hand.
 - 4. Third troweling shall be done by hand and shall continue until the concrete is consolidated to a uniform, smooth, dense surface free of trowel marks and irregularities.
 - 5. Allow sufficient time between successive trowelings to allow the concrete to become harder. Each successive troweling shall be done with trowels that are progressively smaller and are tipped more to increase compaction of the concrete surface.
- G. Broom Finish: Broom at right angles to direction of traffic to give a non-skid finish. Use a fine, soft-bristled broom for pedestrian ramps and walks, and a coarse, hard-bristled broom for vehicular pavement.
- H. Control Joints: Control joints for non-structural slabs shall consist of partial depth plastic strips set flush with finished surface or 1/8-inch wide joints cut with a diamond saw. Control joints shall be one- quarter to one-third the depth of the slab unless otherwise indicated.

3.4 PROTECTION AND CURING

- A. General: Comply with ACI 305 and 306 for protecting and curing concrete in hot and cold weather. Fresh concrete shall be protected from rain. Cure all concrete for a minimum period of 7 days (3 days for high early strength concrete) after placing. Provide coverings or curing compound for conventional concrete that is less than 7 days old when forms are removed.
- B. Flatwork:
 - 1. Immediately after finishing, begin curing by covering with constantly saturated moisture retaining fabrics, impervious sheeting, or membrane curing compounds. Surfaces shall be thoroughly wetted with a fine spray before they are covered with sheeting.

- 2. Sheeting shall provide complete surface coverage with all joints lapped at least 4 inches, and shall be placed and secured in a manner that will not mar or damage the concrete surface.
- C. Membrane Curing Compounds:
 - 1. Apply compound in accordance with manufacturer's recommendations. Apply by spraying in a two-coat continuous operation. Apply the coats at right angles to each other with a coverage of 200 square feet per gallon per coat. Begin application not later than 4 hours after finishing of the surface. The application shall result in an uninterrupted adherent film free of defects.
 - 2. On surfaces scheduled to receive sealants, paint, seamless flooring, or other adhesive bonded finishes, either the membrane curing compound shall be compatible with the bonding agent or the curing compound shall be removed by sandblasting, acid etching or grinding, to the satisfaction of the installer of the finish surfacing. Bonded surfaces that fail to adhere to the concrete shall be removed and replaced at no additional cost to the OWNER.

3.5 DEFECTIVE CONCRETE

- A. All concrete not formed as indicated on the Drawings within tolerances specified in ACI 347 shall be removed and replaced.
- B. Concrete requiring structural repairs shall either be replaced or, with prior written approval of the ENGINEER regarding materials, methods and procedures, may be repaired with epoxy grout.
- C. Concrete that has a defective surface shall be patched or replaced. If patching does not restore the quality and appearance of the surface, the defective concrete shall be replaced.
- D. Temperature and shrinkage cracks which develop prior to final acceptance of the work shall be repaired. Contractor shall propose repair methods to be approved by ENGINEER.

3.6 FINISHING FORMED CONCRETE

- A. Patching:
 - 1. After inspection by the OWNER, patch tie holes and defective areas. Where necessary, chip out defective areas to a minimum depth of 1 inch. Wet the area to be patched and the surrounding 6 inches to prevent absorption of water from the patching mortar and/or apply a brush coat of bonding compound or cement grout immediately prior to patching with mortar.
 - 2. Thoroughly compact patching mortar into place and screed, leaving the patch slightly higher than the surrounding surface. For holes passing entirely through the wall use a plunger grout gun to force the mortar through the wall, starting at the back face. Leave undisturbed for a period of one to two hours to permit initial

shrinkage before final finishing. The patch shall be finished to match the texture and appearance of the adjoining surface.

- 3. All patching shall be cured for three days and then inspected for shrinkage cracks. Excessive cracking shall warrant complete removal and replacement of the patch.
- B. Ordinary Finish: The finish resulting directly from formwork shall be used for all surfaces which will be hidden from view by earth, submergence in water, or hidden by subsequent construction or coatings, except as otherwise indicated. Patch as specified.
- C. Smooth Finish:
 - 1. Unless otherwise indicated on the Drawings, smooth finish shall be provided for all interior and exterior cast-in-place concrete surfaces permanently exposed to view. Smooth finish shall be produced by using Grade A formwork and the following finish operations:
 - 2. After patching as specified, grind joint marks and fins smooth using a fine carborundum or abrasive stone with clean water. Remove all oil stains by scrubbing the surface with stiff bristle brushes and a 5 to 10 percent muriatic acid solution. After the stains are removed, rinse the surface thoroughly with clean water.

3.7 MISCELLANEOUS CONCRETE WORK

- A. Equipment Pads and Supports: Provide concrete equipment pads and supports as indicated and conforming to approved shop drawings. Fastening devices and accessories shall be located by templates or setting diagrams furnished by the manufacturer. Use Class A concrete with rubbed finish on exposed vertical surfaces.
- B. Correcting Slab Tolerances: Slabs exceeding specified tolerances shall have high spots ground down and low spots filled with epoxy resin floor leveler. Epoxy resin shall be applied in strict accordance with the manufacturer's printed instruction.

3.8 CLEAN-UP

- A. All concrete floor construction shall have the surfaces thoroughly scrubbed and cleaned with clear water. Cleaning shall be done immediately before application of finish flooring or coating. After cleaning, the slabs shall be protected until they are accepted for floor finishing work.
- B. Clean all surfaces affected by the Concrete Work. No extraneous concrete or discoloration shall be left on any construction.

SECTION 04 01 50

MASONRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Masonry reinforcement, anchors, and ties.
- B. Control and expansion joints.
- C. Bonding and anchorage.

1.2 SUBMITTALS

- A. Samples: Submit product data of the materials as requested by the Engineer in compliance with Section 01 33 00.
- B. Shop Drawings: Submit shop drawings showing all reinforcing bars and details in masonry walls.

PART 2 PRODUCTS

2.1 REINFORCEMENT BARS:

- A. Reinforcement bars for walls, bond beams, and other masonry reinforcement shall conform to ASTM A615, Grade 60.
- B. Shop Drawing: Submit shop drawings showing all reinforcing bars and details in masonry walls.

2.2 JOINT REINFORCEMENT:

A. Joint reinforcement shall be prefabricated from cold drawn steel wire. Joint reinforcement shall be galvanized in accordance with ACI 530.1. Side wires shall be 9 gage deformed wire; truss rods shall be 9 gage smooth or deformed wire, welded to side wires in the same plane at 16-inch centers. Provide prefabricated pieces for corners and intersections of walls. Joint reinforcement shall be two wire or three wire type as applicable. Reinforcement shall be ladder type approximately 2 inches narrower than the nominal thickness of the wall or partition.

2.3 RIGID STEEL ANCHORS

A. Rigid steel anchors shall be a minimum of 1-1/4" x 1/4" x 30" long with each end turned up 3". Anchors shall be stainless steel.

2.4 NYLON ROPE

A. Nylon rope for weep holes shall be 3/8" diameter by 12" long. Space and locate as to match existing conditions, but space no less than 24" on center at base of exterior cavity walls.

2.5 SEALS AND GASKETS FOR CONTROL JOINTS

A. Seals and gaskets for control joints shall be of closed cell natural or synthetic rubber. Provide seals and gaskets of indicated shapes and in locations as specified or indicated on Drawings. Seals and gaskets shall be resistant to oils and solvents and shall be flexible after being exposed to temperature of minus 40° F. At vertical joints provide 3/8" x 3" deep expansion joint with sealant over.

2.6 DOVETAIL ANCHOR SLOTS

A. Slots for dovetail anchors shall be 1" deep x 1" wide x 5/8" throat and shall be of 26 gage stainless steel or as shown on the Drawings. Slots shall be foam filled to prevent filling with concrete. Furnish staples and end caps.

2.7 DOVETAIL ANCHORS

A. Dovetail anchors for anchoring masonry to steel shall be compatible with anchor slots. Anchors shall be 12 gage stainless steel or as shown on the Drawings with corrugated ends 7-1/2" long, and with moisture drip.

2.8 CHANNEL SLOT ANCHORS

- A. Anchors to be 16 GA. stainless steel 1-1/4" wide x 20" long.
- B. Channel slot to be 12 gauge galvanized steel 1-3/8" wide with 1/2" flange, continuous length.

2.9 MESH TIES

A. 1/2" x 16 gauge galvanized wire.

PART 3 EXECUTION

3.1 JOINT REINFORCEMENT

- A. Install horizontal continuous joint reinforcement in all unit masonry walls, back-ups, and partitions. Reinforcement shall start not more than 8 inches above the masonry supporting surface and end within the top full mortar joint, or as indicated on the Drawings, and shall be spaced at maximum 16-inch centers vertically.
- B. Reinforcement shall be placed in the first three mortar joints above lintels and below openings. Extend the reinforcement at least 24 inches past jambs. In addition, provide

wire ties alternating with reinforcement 16 inches on centers vertically and within 12 inches of opening jambs, where face brick occurs, if any.

- C. Reinforcement shall be continuous but shall not pass through vertical masonry expansion or control joints unless otherwise shown on the Drawings. Side rods of horizontal joint reinforcement shall be lapped at least 6 inches at splices.
- D. Joint reinforcement shall be placed in a manner to assure 5/8-inch mortar cover on the exterior face of walls and 1/2 inch mortar cover on interior faces.
- E. At intersections bond each course with wire mesh ties or prefabricated joint reinforcement spaced not to exceed 16 inches vertically.

3.2 ANCHORAGE

- A. All interior masonry unit partitions that abut exterior walls, when control joints occur at such locations, shall be anchored once every 16 inches vertically with rigid steel anchors. Anchors shall extend at least 4 inches into exterior wall and not less than 18 inches into interior partition.
- B. When intersecting walls are carried up separately, the vertical joint shall be regularly toothed or bonded, or the joints provided with rigid steel anchors spaced not more than 16 inches apart vertically.
- C. At interior intersecting partitions, the vertical joint shall be tied with wire mesh ties spaced at 16 inches vertically.

3.3 VERTICAL REINFORCEMENT

A. Install vertical reinforcement bars in the hollow cores of masonry units where indicated on the Drawings. Fill all cells containing reinforcement with masonry grout for the full height of the reinforcement.

3.4 MASONRY ANCHORS (TO CONCRETE AND TO STEEL WHERE OCCURS)

- A. Provide dovetail anchor slots in concrete for securing masonry facing to concrete walls.
- B. Where concrete walls more than 16 inches high are faced with masonry veneer, place anchor slots vertically at 16-inch horizontal centers for the entire height of wall.
- C. Fill slots with foam to prevent entrance of cement or grout. Set anchor slots straight at proper locations and securely fasten to forms to prevent displacement while concrete is being poured. In all cases slots shall extend for the full height of the masonry facing.
- D. Masonry shall be anchored to concrete or steel columns with dovetail anchors spaced at 16-inch centers vertically along vertical anchor slots.
SECTION 04 03 10

UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete unit masonry exterior walls and interior partitions, complete with reinforcement and anchorages.
- B. Installation of anchor sleeves, inserts, and other accessories specified in other sections.
- C. Salving and reusing existing exterior bricks for incorporation into new work.

1.2 QUALITY ASSURANCE

- A. Qualifications of:
 - 1. Installer: Not less than 3 years documented experience in construction of masonry projects of similar scope and complexity.
- B. Regulatory requirements:
 - 1. Perform masonry work in accord with ASCE 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.
- 1.3 REFERENCES. Cited references, or specified portions thereof, current at date of bidding documents unless otherwise specified, govern the work. If conflict between cited standards and project specifications, do not proceed with any work until Architect/Engineer issues written clarification.
 - A. Standards:
 - 1. ASTM C90 Specification for Hollow Load Bearing Concrete Masonry Units.
 - 2. ASTM C129 Specification for Hollow Non-Load-Bearing Concrete Masonry Units.
 - B. Manufacturers Catalogs: The specified manufacturer's catalogs, current at the date of bidding documents, are incorporated by reference to the same force and effect as if repeated herein at length.

1.4 SUBMITTALS

- A. In accordance with 01 33 00:
 - 1. Product data:
 - a. Admixtures.
 - b. Accessories.
 - c. Flashings.
 - d. Anchors and Ties.
 - e. Horizontal Joint Reinforcing.

- 2. Samples:
 - a. New clay bricks, as required, matching existing face brick.

1.5 DELIVERY, STORAGE & HANDLING

- A. Deliver all materials in sufficient quantity and time to maintain approved construction schedule. Deliver all packaged materials in manufacturer's original containers, with all labels and markings intact and legible. Remove materials and damaged containers immediately from the site.
- B. Store all products in a secure, dry location, out of way of construction operations. Store materials on pallets, a minimum of 4 inches off of the ground. Prevent intermixing of granular materials.
- C. Handle materials in a manner to prevent damage to the materials, to other stored products, to existing construction and project work. Follow product manufacturer's instructions.
- 1.6 WARRANTY. In accordance with General Conditions:
 - A. General Contractor's Warranty: One (1) year.
- PART 2 PRODUCTS
- 2.1 MASONRY
 - A. Concrete Blocks:
 - 1. Interior non-load-bearing partitions: ASTM C129 Hollow Core Non-Load-Bearing complete with corners, bond beams and lintels to match and compliment block units; normal weight. Nominal face dimensions of 8 in. x 16 in. and thickness as shown on the drawings.
 - 2. Exterior and Below Grade Construction: ASTM C90 Hollow Core Load-Bearing, grade N, complete with corners, bases, bond beams, and lintels to match and compliment block units; normal weight. Nominal face dimensions of 8 in. x 16 in. and thickness as shown on the drawings.
 - B. Clay Bricks:
 - 1. Existing bricks salvaged and cleaned for incorporation into new work.
 - 2. New clay bricks, if required, shall be exterior grade with similar texture and color as existing.

2.2 CONCRETE

- A. Concrete for bond beams: Provide concrete with 3000 psi compressive strength at 28 days; 3 inch maximum slump; conforming to the following requirements:
 - 1. Cement: ASTM C150, Normal-Type I.
 - 2. Coarse aggregate: Maximum 3/8 in. size; graded in compliance with ASTM C33.
 - 3. Fine Aggregate: Graded in compliance with ASTM C33.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Beginning of installation means installer accepts existing conditions.

3.2 SALVAGING

- A. Carefully remove existing exterior wall for extents as indicated on the Drawings.
- B. Existing face brick shall be salvaged in sufficient quantity to be incorporated into new work. Old mortar shall be removed from brick. Abrasive methods may be used on sides of brick not exposed to view.

3.3 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other Sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Lay concrete masonry units and face brick in pattern matching existing conditions. Course one unit and one mortar joint to equal 8 inches. Form concave mortar joints.

3.5 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- C. Remove excess mortar as Work progresses.
- D. Interlock intersections and external corners.

- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform jobsite cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.6 WEEPS

A. Install weep holes in veneer at a maximum of 32 inches on center horizontally above shelf angles. Lay 3/8 inch round, 12 inch long nylon rope in each weep hole and lay horizontally in cavity.

3.7 CAVITY WALL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep holes.

3.8 REINFORCEMENT AND ANCHORAGES

- A. Install horizontal joint reinforcement spaced at maximum 16 inches on-center or as shown on the drawings.
- B. Place masonry joint reinforcement in first, second, and third horizontal joints above and below openings. Extend minimum 24 inches each side of opening.
- C. Place joint reinforcement continuous in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches. Extend minimum 6 inches each side of openings.

3.9 LINTELS

A. Install lintels where indicated on Drawings.

3.10 CONTROL (AND EXPANSION) JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Form control joint with a sheet building paper bond breaker, fitted to one side of the hollow contour end of the block unit. Fill the resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

3.11 BUILT-IN WORK

- A. As work progresses, build in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items furnished by other Sections.
- B. Build in items plumb and level.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

3.12 TOLERANCES

- A. Maximum Variation From Alignment of Columns: Pilasters: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/32 inch.
- C. Maximum Variation From Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- D. Maximum Variation From Plumb: 1/4 inch per story noncumulative; 1/2 inch in two stories or more.
- E. Maximum Variation From Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.

3.13 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit sleeves, grounds.
- B. Obtain Architect/Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 CLEANING

- A. Clean work under provisions of Section 01 70 00.
- B. Remove excess mortar and mortar smears.
- C. Replace defective mortar.
- D. Clean soiled surfaces with cleaning solution.

SECTION 04 05 03

MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar and masonry grout materials.
- B. Mixing mortars and masonry grouts.

1.2 RELATED SECTIONS

A. Concrete - Division 3.

1.3 SUBMITTALS

A. Samples: Submit samples of mortar materials as requested by the Engineer in compliance with Section 01 33 00.

PART 2 PRODUCTS

2.1 MORTAR

A. Mortar for new work to match existing construction shall be selected for appearance to match existing mortar and shall be approved by the Engineer.

2.2 MATERIALS

- A. Cement: Use one brand of cement throughout the work. Portland cement shall conform to ASTM Cl50, Type I.
- B. Hydrated Lime: Hydrated lime shall conform to ASTM C207, Type S.
- C. Admixtures: No salt, anti-freeze liquid, accelerator, or other admixture will be permitted without the written approval of the E/A.
- D. Sand: Sand shall conform to ASTM Cl44; except that sand for mortar in joints l/4-inch or less shall pass a No. 16 sieve. Sand containing any substance which will stain the masonry shall not be used.
- E. Coarse Aggregate: Coarse aggregate for masonry grout shall conform to ASTM C404. Aggregate containing any substance which will stain the masonry shall not be used.
- F. Water: Water shall be clean and potable.

2.3 MORTAR

- A. Proportions: Mortar shall be in accordance with ASTM C270, Type S
- B. Strength: The compressive strength of mortar cube specimens shall be determined in accordance with ASTM C91 using the same materials and proportions that will be used for the mortar in the construction. Mortar shall have an average compressive strength at 28 days as follows:
 - 1. Type S -1800 psi
- C. Application: Use Type S mortar for all masonry walls.

2.4 MASONRY GROUT

- A. Coarse grout for filling cells in masonry units shall be proportioned in accordance with ASTM C476 and shall have a minimum compressive strength of 2000 psi.
- B. Fine grout for bedding and grouting structural steel shall be per Section 03 30 53.

PART 3 EXECUTION

3.1 GENERAL

- A. Equipment for mixing mortar and grout shall be clean and free of hardened mortar, dirt and foreign matter.
- B. Mix all mortar and masonry grout in a mechanical batch mixer for a minimum of 5 minutes after all materials have been added. Mortar and masonry grout shall be used within 1-1/2 hours at temperatures over 80° F and within 2-1/2 hours at temperatures below 80° F.

3.2 MORTAR

A. Adjust the consistency of the mortar to the satisfaction of the mason but add only as much water as needed to make a workable mortar. If the mortar begins to stiffen from evaporation or from absorption of a part of the mixing water, retemper by adding water and remix the mortar. Do not use mortar after it has begun to set.

3.3 MASONRY GROUT

A. Mix all masonry grout in accordance with ASTM C476. Masonry grout shall have a consistency at time of placement to yield a slump as required to facilitate placement and appropriate for the absorption of the masonry units.

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members.
- B. Steel pipe bollards.
- C. Base plates.
- D. Plates.
- E. Grouting under base plates.

1.2 SUBMITTALS

- A. Samples and Certifications: Samples and certifications shall be submitted in accordance with Section 01 33 00. Unless otherwise indicated, submit certifications for all products and samples as may be specifically requested by the ENGINEER.
- B. Shop Drawings: Indicate all information necessary for fabrication including sizes, spacing, and locations of structural members, openings, connections, cambers, loads, and welded connections.

1.3 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings.
- B. High Strength Bolting: In accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- C. Welding: In accordance with AWS D1.1.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Hot Rolled Wide Flange Steel Members: ASTM A572, Grade 50; ASTM A992, Grade 50.
- B. Miscellaneous Structural Steel: ASTM A36.
- C. Structural Tubing: ASTM A500, Grade B.
- D. Pipe: ASTM A53, Grade B, Schedule 40.

- E. Bolts, Nuts, and Washers: ASTM A325.
- F. Anchor Bolts: ASTM A36 or A1554, Grade 55 with weldability supplement S1.
- G. Welding Materials: AWS D1.1; type required for materials being welded.
- H. Grout: Non-shrink type as specified in Section 03 30 53.
- I. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.

2.2 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Provide full length pieces between connections or splices shown on the drawings.

2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 2.
- B. Shop prime structural steel members exposed to view. Do not prime surfaces being field welded, in contact with concrete or high strength bolted.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify existing conditions and dimensions prior to fabrication.

3.2 ERECTION

- A. Allow for erection loads. Install temporary bracing to maintain framing in alignment until completion of erection and installation of permanent bridging and bracing.
- B. Field weld components indicated on shop drawings.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.
- D. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- E. Grout under base plates in accordance with Section 03 30 53.

3.3 FIELD QUALITY CONTROL

A. Field inspection of members, connections, and welds shall be performed at the contractor's expense, incidental to the contract.

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated ferrous metal items.
- B. Galvanized and prime painted.
- C. Aluminum handrails and guardrails.
- D. Work is to match existing conditions with similar connections, paint color, and handrails.

1.2 SYSTEM DESCRIPTION

A. Design new railing, wall rails, and attachments to resist lateral force of 200 lbs at any point or 50 pounds per linear foot without damage or permanent set.

1.3 SUBMITTALS

- A. Samples and Certifications: Samples and certifications shall be submitted in accordance with Section 01 33 00. Unless otherwise indicated, submit certifications for all products and samples as may be specifically requested by the ENGINEER.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Drawings shall show how new work is to be incorporated into existing work.
 - 1. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
 - 2. Indicate field measurements to verify existing conditions.

1.4 QUALITY ASSURANCE

A. Calculations and Shop Drawings shall be sealed by a Professional Engineer experienced in design of this Work and licensed in the State of Wisconsin. Calculations shall be submitted for review upon request by the A/E.

PART 2 PRODUCTS

- 2.1 COMPONENTS
 - A. Steel Sections: ASTM A36/A36M or ASTM A992 Grade 50.
 - B. Steel Plate: ASTM A283.
 - C. Steel Tubing: ASTM A500, Grade B.

- D. Steel Pipe: ASTM A53, Grade B.
- E. Sheet Steel: ASTM A653/A653M, Grade B Structural Quality with galvanized coating.
- F. Bolts, Nuts, and Washers: ASTM A325 galvanized to ASTM A153/A153M for galvanized members.
- G. Handrail and Guardrail Sections: Aluminum.
 1. ASTM B221, Aluminum Alloy, Extruded Bars, Rods, Wire, Shapes and Tubing.

2.2 ACCESSORIES

- A. Welding Materials: AWS D1.1.
- B. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.

2.3 FABRICATION

- A. General:
 - 1. Fit and shop assemble items in largest practical sections, for delivery to site.
 - 2. Continuously seal joined members by continuous welds.
 - 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. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, consistent with design of component.
 - 5. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication.
 - 6. Accurately form components required for anchorage of stairs and landings and railings to each other and to building structure.
- B. Handrails & Guardrails:
 - 1. All handrail and guardrail sections shall be fabricated using aluminum sections.
 - 2. Fit and shop assemble components in largest practical sizes, for delivery to site.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface.
 - 4. Accurately form components to suit stairs and landings, to each other and to building structure.
 - 5. Guardrails shall include 4" high toe plates.

2.4 FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Shop prime items with one coat. Do not prime surfaces in direct contact with concrete or where field welding is required.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive work. Existing stairs, handrails, and guardrails shall be incorporated into new work where shown on the Drawings.

3.2 PREPARATION

- A. Make provisions for erection loads with temporary bracing. Keep work in alignment.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads and provide temporary bracing to maintain indicated alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.
- D. Obtain approval prior to site cutting.
- E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.4 PROTECTION OF ALUMINUM FROM DISSIMILAR MATERIALS

- A. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint or other approved insulating material.
- B. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry, or lime mortar, exposed aluminum surfaces shall be painted with one coat of bituminous paint or other approved insulating material.

3.5 SCHEDULES

- A. Ledge and Shelf Angles, Channels and Plates Not Attached to Structural Framing: For support of steel beams; prime paint finish.
- B. Lintels: As detailed; galvanized then prime paint finish.

SECTION 05 50 32

ALUMINUM GRATING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes but is not limited to labor, materials, equipment and incidentals as shown, specified and required to furnish and install grating.

1.2 SUBMITTALS

- A. Samples and Certifications: Samples and certifications shall be submitted in accordance with Section 01 33 00. Unless otherwise indicated, submit certifications for all products and samples as may be specifically requested by the ENGINEER.
- B. Shop Drawings
 - 1. The contractor shall submit for approval shop drawings for the fabrication and erection of all work.
 - 2. Include plans, elevations, and details of sections and connections.
 - 3. Show type and location of all fasteners.
- C. The contractor shall submit the manufacturer's specifications, load tables, anchor details and standard installation details.

1.3 QUALITY ASSURANCE

- A. Comply with applicable provision and recommendations of the following:
 - 1. NAAMM Metal Bar Grating Manual, ANSI/NAAMM MBG 531 (Aluminum and Light Duty Steel and Stainless Steel Grating)
 - 2. NAAMM Metal Bar Grating Manual, ANSI/NAAMM MBG 532 (Heavy Duty Steel Grating)
- B. Aluminum
 - 1. ASTM B221, Aluminum Alloy, Extruded Bars, Rods, Wire, Shapes and Tubing.
- C. Field Measurements
 - 1. Take field measurements prior to preparation of shop drawings and fabrication where required, to ensure proper fitting of the work.

PART 2 PRODUCTS

- 2.1 Grating
 - A. Aluminum
 - 1. SGF Series by Ohio Gratings, Inc.
 - 2. SFT Series by McNichols Co.
 - 3. Or approved equal.

- B. Bearing bars
 - 1. Rectangular bar on 1 3/16" centers maximum. Select depth to match existing.
- C. Cross bars
 - 1. Locked at right angles to, and in the same plane as, the top surface of bearing bars.
 - 2. Spacing: 4" on center maximum.
- D. Surface
 - 1. Plain.
- E. Finish
 - 1. Mill finished.
- F. Fabrication and Tolerances
 - 1. In accordance with the NAAMM Metal Bar Grating Manual.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions and dimensions prior to fabrication.
- B. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the architect or owner's agent prior to grating placement.

3.2 INSTALLATION

- A. Install grating in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- B. Cutting, Fitting, and Placement
 - 1. Perform all cutting and fitting required for installation. Grating shall be such that cross bars align.
 - 2. Wherever grating is pierced by pipes, ducts or structural members, cut openings neatly and accurately to size and weld a rectangular band bar of the same height and material as bearing bars.
 - 3. Cutouts for circular obstructions are to be at least 2" larger in diameter than the obstruction. Cutouts for all piping 4" or less shall be made in the field.
 - 4. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.
 - 5. Utilize standard panel widths wherever possible.
- C. Protection of Aluminum from Dissimilar Materials
 - 1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint or other approved insulating material.
 - 2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry, or lime mortar, exposed aluminum surfaces shall be painted with one coat of bituminous paint or other approved insulating material.

3.3 GRATING ATTACHMENT

A. Use anchorage devices; saddle clips, grating clamps, or plank clips and fasteners to secure grating to supporting members or prepared openings.

3.4 FIELD QUALITY CONTROL

A. Field inspection of members, connections, and welds shall be performed at the contractor's expense, incidental to the contract.

SECTION 07 51 00

BUILT-UP BITUMINOUS ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cutting and patching of existing built-up bituminous roofing.

1.02 REFERENCE STANDARDS

- A. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2006.
- B. ASTM D 312 Standard Specification for Asphalt Used in Roofing; 2000 (Reapproved 2006).
- C. ASTM D 1863 Standard Specification for Mineral Aggregate Used on Built-Up Roofs; 2005.
- D. ASTM D 2178 Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2004.
- E. ASTM D 4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007.
- F. NRCA ML104 The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.
- G. UL (RMSD) Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

1.04 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sheet and Bitumen Materials:
 - 1. Firestone Building Products: www.firestonebpco.com.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.
- B. Insulation:
 - 1. Match existing conditions: thickness, type etc..

2.02 ROOFING - CONVENTIONAL APPLICATION

- A. Built-up Bituminous Roofing: Asphalt felt membrane, four ply plus base sheet, with vapor retarder and insulation.
- B. Roofing Assembly Requirements:1. Roof Covering External Fire-resistance Classification: UL Class A.
- C. Surfacing: Aggregate where indicated match existing.

2.03 SHEET MATERIALS

- A. Vapor Retarder Felt: Asphalt-saturated organic, ASTM D 226, Type I ("No.15") or glass fiber, ASTM D 2178, Type IV felt, unperforated.
- B. Roofing Felt: ASTM D 226; Asphalt-saturated organic felt, unperforated; Type IV fiberglass felt.
- C. Base Flashing Material: Asphalt-impregnated and -coated glass-fiber-reinforced felt, heavy weight, mineral surfaced.

2.04 BITUMINOUS MATERIALS

- A. Bitumen: ASTM D 312 Type III, asphalt.
- B. Roof Cement: ASTM D 4586, Type II.

2.05 INSULATION

A. Match existing.

2.06 SURFACING MATERIALS - CONVENTIONAL APPLICATION

A. Aggregate: ASTM D 1863; sound, hard washed river gravel; 1/4 inch minimum to 1/2 inch maximum size.

2.07 ACCESSORIES

- A. Cant and Edge Strips: Bitumen-impregnated wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle, tapered edge strips, and other configurations as detailed.
- B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 INSULATION INSTALLATION - CONVENTIONAL APPLICATION

- A. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- B. Do not apply more insulation than can be covered with membrane in same day.

3.03 MEMBRANE APPLICATION

- A. Equiviscous Temperature (EVT) at Point of Application: In accordance with NRCA recommendations.
- B. Apply membrane plies, weather lap edges and ends, and mop with 20 lb/square of bitumen per ply. Apply plies 2 on 2 in same direction.
- C. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears.
- D. At end of day's operation, install two plies membrane and bitumen glaze coat for cut-off. Glaze exposed felts. Remove cut-off before resuming roofing.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane and base sheet over cant strips and up a minimum of 4 inches onto vertical surfaces.
 - 2. Mop on base flashing of two additional plies of felt and one ply of base flashing material.
- F. Around roof penetrations, mop in and seal flanges and flashings with two additional plies of felt.

3.04 AGGREGATE SURFACING - CONVENTIONAL APPLICATION

- A. Apply uniform flood coat of bitumen at rate of 60 lb/square.
- B. While flood coat is hot, embed aggregate at rate of 400 lb/square.
- C. Evenly distribute aggregate and ensure bond with flood coat. Extend aggregate to bottom edge of cant strips.

3.05 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

SECTION 07 90 05

JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

1.02 REFERENCE STANDARDS

- A. ASTM C 920 Standard Specification for Elastomeric Joint Sealants; 2005.
- B. ASTM C 1193 Standard Guide for Use of Joint Sealants; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.04 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.

1.05 MOCK-UP

- A. Provide mock-up of sealant joints in conjunction with window under provisions of Section 01 40 00.
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

1.06 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Polyurethane Sealants:
 - 1. BASF Construction Chemicals-Building Systems; Product Sonolastic NP 1: www.chemrex.com.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.

2.02 SEALANTS

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single, or multi- component.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.

B. High Temperature Sealant: M230 High Temperature Sealant as manufactured by Forrest Paint Company (www.forrestpaint.com).

2.03 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- C. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C 1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.

3.04 PROTECTION

A. Protect sealants until cured.

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire-rated steel doors and frames.
- B. Sound-rated steel doors and frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 Door Hardware.
- B. Section 09 90 00 Painting and Coating: Field painting.

1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. ANSI A250.8 SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2004).
- D. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- E. ASTM E 413 Classification for Rating Sound Insulation; 2004.
- F. ASTM E 1408 Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).
- G. BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames; 2006.
- H. NAAMM HMMA 840 Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- I. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2010.
- J. UL (BMD) Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- K. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.05 QUALITY ASSURANCE

A. Maintain at the project site a copy of all reference standards dealing with installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.
 - 2. Windsor Republic Doors: www.republicdoor.com.
 - 3. Steelcraft: www.steelcraft.com.
 - 4. Substitutions: See Section 01 60 00 Product Requirements.

2.02 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 - 1. Accessibility: Comply with ANSI/ICC A117.1.
 - 2. Door Edge Profile: Beveled on both edges.
 - 3. Door Texture: Smooth faces.
 - 4. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 - 5. Galvanizing All Doors: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
 - 6. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 STEEL DOORS

- A. Interior Doors, Fire-Rated (Door B):
 - 1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
 - Fire Rating: 1-1/2 hours, tested in accordance with UL 10C ("positive pressure").
 a. Provide units listed and labeled by UL.
 - b. Attach fire rating label to each fire rated unit.
 - 3. Core: Polystyrene.
- B. Interior Doors Fire and Sound Rated (Door A):
 - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 1, full flush.
 - 2. STC Rating of Assembled Door, Frame, and Seals: 46, calculated in accordance with ASTM E 413, tested in accordance with ASTM E 90 or ASTM E 1408.
 - 3. Core: Mineral fiberboard.
 - 4. Sound Seals: Integral, concealed in door or frame.

2.04 STEEL FRAMES

A. AT CONTRACTOR'S OPTION, CONTRACTOR MAY ELECT TO HAVE EXISTING DOOR FRAMES RECERTIFIED BY APPROVED AGENCY, TO 1 1/2 HOUR LABEL.

B. General:

- 1. Comply with the requirements of grade specified for corresponding door.
- 2. Finish: Same as for door.
- 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- C. Interior Door Frames, Fire-Rated: Fully welded type. 1. Fire Rating: Same as door, labeled.
- D. Sound-Rated Door Frames: Fully welded type.

2.05 ACCESSORY MATERIALS

- A. Glazing: 10 inch by 10 inch .25 inch wire glass vision light at Door B, factory installed.
- B. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
 Do not provide at sound door
 - 1. Do not provide at sound door.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.
- B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.3.05 ADJUSTING
 - A. Adjust for smooth and balanced door movement.
 - B. Adjust sound control doors so that seals are fully engaged when door is closed.

3.06 SCHEDULE

- A. Door A located at Corridor to Generator Room at Water Treatment Plant.
- B. Door B located at bottom of stairs at Generator Room at Water Treatment Plant.

SECTION 08 43 13

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of metal and glass.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 Joint Sealers: Perimeter sealant and back-up materials.
- B. Section 08 71 00 Door Hardware: Hardware items other than specified in this section.
- C. Section 08 80 00 Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- B. ASTM B 209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- C. ASTM B 209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- D. ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2008.
- E. ASTM B 221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.

1.04 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- E. Samples: Submit two samples 3x3 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.06 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.07 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Position: Front.
 - 2. Vertical Mullion Dimensions: 2 inch x 4.5 inch.
 - 3. Finish: Class I color anodized.
 - 4. Color: Dark bronze.

2.02 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
- B. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
 - 1. Core: Rigid polystyrene insulation core with R value of 5.
 - 2. Finish: Same as storefront.
- C. Doors: Glazed aluminum.
 - 1. Thickness: 1-3/4 inches.
 - 2. Top Rail: 5 inches wide.
 - 3. Vertical Stiles: 5 inches wide.
 - 4. Bottom Rail: 5 inches wide.
 - 5. Face Sheets: Embossed (Vertical Ribbed) Aluminum Sheet (.062 inch thick)
 - 6. Finish: Same as storefront.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).

- B. Sheet Aluminum: ASTM B 209 (ASTM B209M).
- C. Fasteners: Stainless steel.
- D. Perimeter Sealant: Type General Purpose Exterior Sealant specified in Section 07 90 05.
- E. Glass: As specified in Section 08 80 00.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.04 HARDWARE

- A. Door Hardware: As specified in Section 08 71 00.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.
- D. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

2.05 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.

- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of mastic and secure.
- K. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- L. Install perimeter sealant in accordance with Section 07 90 05.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.02 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.03 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.04 PROTECTION

A. Protect installed products from damage during subsequent construction.

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for aluminum doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 Hollow Metal Doors and Frames.
- B. Section 08 43 13 Aluminum-Framed Storefronts: Hardware for doors in storefront, including:
 - 1. Integral weatherstripping.
 - 2. Hinges.
 - 3. Thresholds.
 - 4. Installation of lock cylinders provided under this section.

1.03 REFERENCE STANDARDS

- A. BHMA A156.1 American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.1).
- B. BHMA A156.2 American National Standard for Bored and Preassembled Locks & Latches; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.2).
- C. BHMA A156.4 American National Standard for Door Controls Closers; Builders Hardware Manufacturers Association, Inc.; 2000 (ANSI/BHMA A156.4).
- D. BHMA A156.7 American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.7).
- E. BHMA A156.18 American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.18).
- F. DHI (LOCS) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2004.
- G. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2010.
- H. UL (BMD) Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
- C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
- D. Keying Schedule: Submit for approval of Owner.
- E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- F. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.
- G. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

PART 2 PRODUCTS

2.01 DOOR HARDWARE - GENERAL

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide all items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. Fire-Rated Doors: NFPA 80.
 - 3. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.
 - 4. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.
- E. Finishes: All door hardware the same finish unless otherwise indicated.
 - 1. Primary Finish: Satin bronze, clear coated, on bronze base metal, 612 (approx US10).
 - 2. Finish Definitions: BHMA A156.18.
- F. Fasteners:

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Door Hardware 08 71 00 - 2

1. Concrete and Masonry Substrates: Stainless steel machine screws and lead expansion shields.

2.02 HINGES

- A. Hinges: $4 \frac{1}{2}$ inch ball bearing
- B. Hinges: Provide hinges on every swinging door.
 - 1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 - 2. Provide ball-bearing hinges at all doors having closers.
 - 3. Provide hinges in the quantities indicated.
 - 4. Provide non-removable pins on exterior outswinging doors.
- C. Butt Hinges: Comply with BHMA A156.1 and A156.7; standard weight, unless otherwise indicated.
- D. Quantity of Hinges Per Door:
 - 1. Doors From 60 inches High up to 90 inches High: Three hinges.

2.03 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
 - 1. Hardware Sets indicate locking functions required for each door.
 - 2. If no hardware set is indicated for a swinging door provide an office lockset.
 - 3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
 - 4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
 - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed.
- D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.04 CYLINDRICAL LOCKSETS

- A. Cylindrical Locksets:
- B. Locking Functions: As defined in BHMA A156.2, and as follows:
 - 1. Passage: No locking, always free entry and exit.
 - 2. Classroom: F84, key required to lock.
- C. Manufacturers Cylindrical Locksets:
 - Assa Abloy Corbin Russwin: www.assaabloydss.com.
 a. CL3300 Series.
 - 2. Schlage: www.schlage.com.

2.05 FLUSHBOLTS

- A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
 - 1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
 - 2. Floor Bolts: Provide dustproof strike except at metal thresholds.

- B. Automatic Flushbolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened.
- C. Coordinators: Provide on doors having closers and self-latching or automatic flushbolts to ensure that leaves close in proper order.

2.06 ELECTRIC STRIKES

- A. Reuse existing.
- 2.07 CLOSERS
 - A. Closers: LCN Cush-N-Stop Series or Sargent 351-PS Series
 - B. Closers: Complying with BHMA A156.4.
 - 1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
 - 2. Provide a door closer on every exterior door.
 - 3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
 - 4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
 - 5. At corridors, locate door-mounted closer on room side of door.
 - 6. At outswinging exterior doors, mount closer in inside of door.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- D. Mounting heights for hardware from finished floor to center line of hardware item:
 - 1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."

3.03 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust hardware for smooth operation.

3.04 PROTECTION

- A. Protect finished Work under provisions of Section 01 70 00.
- B. Do not permit adjacent work to damage hardware or finish.

3.05 SCHEDULE

A. Door A

- 1. 3 Mortise hinges
- 2. 1 Cylindrical Lockset, Classroom Function
- 3. 1 Surface Mounted Closer
- 4. 1 Door Stop (existing relocated)

B. Door B

- 1. 3 Mortise hinges
- 2. 1 Cylindrical Latchset, Passage Function
- 3. 1 Surface Mounted Closer
- C. Door C
 - 1. 6 Mortise Hinges
 - 2. 1 Cylindrical Lever Lock, Storeroom Function
 - 3. 1 Pair Flushbolts
 - 4. 2 Surface Mounted Closers
 - 5. Balance of hardware by door manufacturer
- D. Door D
 - 1. 3 Mortise Hinges
 - 2. 1 Exit Device (reuse existing)
 - 3. 1 Electric Strike (reuse existing)
 - 4. 1 Surface Mounted Closer
 - 5. Balance of hardware by door manufacturer
- E. Door E
 - 1. 6 Mortise Hinges
 - 2. 1 Cylindrical Lever Lock, Classroom Function
 - 3. 1 Automatic Flushbolt
 - 4. 1 Coordinator
 - 5. 2 Surface Mounted Closers

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 43 13 - Aluminum-Framed Storefronts.

1.03 REFERENCE STANDARDS

- A. ASTM C 864 Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005.
- B. ASTM C 1036 Standard Specification for Flat Glass; 2006.
- C. ASTM C 1048 Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2004.
- D. ASTM C 1193 Standard Guide for Use of Joint Sealants; 2009.
- E. ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation; 2008.
- F. GANA (GM) GANA Glazing Manual; Glass Association of North America; 2004.
- G. GANA (SM) FGMA Sealant Manual; Glass Association of North America; 1990.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Samples: Submit two samples 12x12 inch in size of glass units, showing coloration.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

1.06 WARRANTY

- A. See Section 01 70 00 Execution and Closeout Requirements, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLAZING TYPES

- A. Type IG-1 Sealed Insulating Glass Units: Vision glazing.
 - 1. Application(s): Door transom and sidelight.
 - 2. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Bronze.
 - b. Coating: Low-E type, on #2 surface.
 - Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 a. Tint: Clear.
 - 4. Total Thickness: 1 inch.
 - 5. Glazing Method: Gasket glazing.

2.02 GLASS MATERIALS

- A. Float Glass: All glazing is to be float glass unless otherwise indicated.
 - 1. Annealed Type: ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
 - 2. Heat-Strengthened and Fully Tempered Types: ASTM C 1048.
 - 3. Tinted Types: Color and performance characteristics as indicated.
 - 4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.

2.03 SEALED INSULATING GLASS UNITS

- A. Sealed Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E 2190.
 - 2. Edge Spacers: Aluminum, bent and soldered corners.
 - 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 - 4. Purge interpane space with dry hermetic air.

2.04 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; black color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

A. Install sealants in accordance with ASTM C 1193 and FGMA Sealant Manual.

3.03 GLAZING METHODS

- A. INSTALLATION EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)
 - 1. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 - 2. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
 - 3. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.04 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.
SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne, and lead items.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

A. Conform to ASTM D 16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D 16 Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2008.

1.05 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Samples: Submit two paper chip samples, 1x2 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on aluminum sheet, <u>x</u>

inch in size.

- E. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.
- G. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Paint and Coatings: 1 gallon of each color; store where directed.
 - 2. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.07 MOCK-UP

- A. See Section 01 40 00 Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 8 feet long by 4 feet wide, illustrating special coating color, texture, and finish.
- C. Provide door and frame assembly illustrating paint coating color, texture, and finish.
- D. Locate where directed.
- E. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Primer Sealers: The Sherwin Williams Company.
- C. Block Fillers: The Sherwin Williams Company.

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- D. Substitutions: See Section 01 60 00 Product Requirements.
- 2.02 PAINTS AND COATINGS GENERAL
 - A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 4. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
 - B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
 - C. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of State in which the project is located.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
 - D. Colors: To be selected from manufacturer's full range of available colors.
 - 1. Selection to be made by Architect after award of contract.
 - 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 - 3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the Owner's Color Coding Standards.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint MI-OP-2L Ferrous Metals, Primed, Latex, 2 Coat:
 - 1. Touch-up with latex primer. B66W310 Series.
 - 2. Semi-gloss: Two coats of latex enamel; B66W300 Series.
- B. Paint MgI-OP-3L Galvanized Metals, Latex, 3 Coat:
 - 1. One coat galvanize primer.
 - 2. Semi-gloss: Two coats of latex enamel; B31W651 Series.
- C. Paint FI-OP-2A Fabrics/Insulation Jackets, Alkyd, 2 Coat:
 - 1. One coat of alkyd primer sealer.
- D. Fabrics/Insulation Jackets, Alkyd, 2 Coat:
 - 1. One coat of latex primer sealer; B51W20 Series.
 - 2. One coat of DTM Acrylic; B66W100 Series.

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2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- G. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- H. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- I. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finished coatings until completion of project.

END OF SECTION

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating.

1.03 REFERENCE STANDARDS

- A. SSPC-SP 3 Power Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).
- B. SSPC-Paint 16 Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint; Society for Protective Coatings; 1982 (Ed. 2006).

1.04 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures, for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Maintenance Data: Include cleaning procedures and repair and patching techniques.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Coating Materials: 1 gallon of each type and color.
 - 2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience.

1.06 MOCK-UP

- A. Provide mock-up of one wall section, 4 feet long by 4 feet wide, illustrating coating, for each specified coating.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C. Restrict traffic from area where coating is being applied or is curing.

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High-Performance Coatings 09 96 00 - 1

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. High-Performance Coatings:
 - 1. Tnemec Company, Inc: www.tnemec.com.
 - 2. Substitutions: Section 01 60 00 Product Requirements.

2.02 MATERIALS

- A. Coatings General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
 - 1. Colors: Selected from manufacturer's standard colors.
- B. Acrylic Polymer: Two coats, water based acrylic polymer, gloss finish.
 - 1. Product characteristics:
 - a. Percentage of solids by volume: $37.0 \pm 2\%$, minimum.
 - b. Dry film thickness, per coat: 1.5 2.0 mils, minimum.
 - 2. Product: Tufcryl Series 28 WB manufactured by TNEMEC.
- C. Modified Polyamine Epoxy Floor Coating: Two coats, two-part, modified polyamine epoxy.
 - 1. Product characteristics:
 - a. Percentage of solids by volume: 100% mixed.
 - b. Dry film thickness, per coat: 8.0 10.0 mills per coat, minimum.
 - 2. Product: Tneme-Glaze, Series 280 manufactured by TNEMEC.
 - 3. Primer for concrete: Series 201 Epoxoprime.
- D. Coal Tar Epoxy Coating: Two coats high-build, two-part, SSPC-Paint 16.
- E. Primers: As recommended by coating manufacturer for specific substrate, unless otherwise specified.
- F. Shellac: Pure, white type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Diamond grind all floors for cansistent appearance.
- C. Confirm compatibility of coating with existing substrates with test area if necessary.
- D. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

3.02 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.

- D. Existing Painted and Sealed Surfaces:
 - 1. Remove loose, flaking, and peeling paint. Feather edge and sand smooth edges of chipped paint.
 - 2. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent.
- F. Ferrous Metal:
 - 1. Solvent clean.
 - 2. Remove loose rust, loose mill scale, and other foreign substances using power tools according to SSPC-SP 3.
- G. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 SCHEDULE

- A. Walls and ceilings in Equipment Rooms: Acrylic Polymer, gloss.
- B. Concrete Floors: Modified polyamine epoxy floor coating, non-skid finish.
- C. Steel Lintels to be Embedded in Concrete and Masonry: Coal tar epoxy coating, shop-applied, all surfaces.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe hangers and supports.
- B. Hanger rods.
- C. Inserts.
- D. Flashing.
- E. Sleeves.
- F. Mechanical sleeve seals.
- G. Formed steel channel.
- H. Firestopping relating to plumbing work.
- I. Firestopping accessories.
- J. Equipment bases and supports.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 Power Piping.
 - 2. ASME B31.5 Refrigeration Piping.
 - 3. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops.
 - 4. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 Structural Welding Code Steel.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.

- 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
- 3. UL 1479 Fire Tests of Through-Penetration Firestops.
- 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
- 5. UL Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119 ASTM E814 UL 263 UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

- 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
- 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with applicable authority AWS D1.1 for welding hanger and support attachments to building structure.
- G. Perform Work in accordance with State Municipality of Highways Public Work's standard.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.
 - 5. Michigan Hanger Co.
 - 6. Superior Valve Co.
- B. Plumbing Piping DWV:
 - 1. Conform to ASME B31.9 ASTM F708 MSS SP58 MSS SP69 MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

- 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
- 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
- 7. Vertical Support: Steel riser clamp.
- 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
- C. Plumbing Piping Water:
 - 1. Conform to ASME B31.9 ASTM F708 MSS SP58 MSS SP69 MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 7. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 - 8. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 - 9. Vertical Support: Steel riser clamp.
 - 10. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 11. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 12. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:

- 1. Thunderline Link-Seal, Inc.
- 2. NMP Corporation
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- 2.6 FORMED STEEL CHANNEL
 - A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division Unistrut Corp.
 - B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products
 - 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.8 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

- B. Dam Material: Permanent:
 - 1. Sheet metal.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.
- 3.4 INSTALLATION PIPE HANGERS AND SUPPORTS
 - A. Install in accordance with ASME B31
 - B. Support horizontal piping as scheduled.
 - C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
 - D. Place hangers within 12 inches of each horizontal elbow.
 - E. Use hangers with 1-1/2 inch minimum vertical adjustment.
 - F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
 - G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 - H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 - I. Support riser piping independently of connected horizontal piping.
 - J. Provide copper plated hangers and supports for copper piping
 - K. Design hangers for pipe movement without disengagement of supported pipe.
 - L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - M. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- 3.5 INSTALLATION EQUIPMENT BASES AND SUPPORTS
 - A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment
 - B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
 - C. Construct supports of steel members, formed steel channel, or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
 - D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower, and mop sink drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating ,to uniform density and texture.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.

- E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, cable bus, conduit, wireway, trough, and penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.9 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

PIPE HANGER SPACING			
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches	
ABS (All sizes)	4	3/8	
Aluminum (All sizes)	10	1/2	
Cast Iron (All Sizes)	5	5/8	
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8	
CPVC, 1 inch and smaller	3	1/2	
CPVC, 1-1/4 inches and larger	4	1/2	
Copper Tube, 1-1/4 inches and smaller	6	1/2	
Copper Tube, 1-1/2 inches and larger	10	1/2	
Fiberglass	4	1/2	
Glass	8	1/2	
Polybutylene	2.67	3/8	
Polypropylene	4	3/8	
PVC (All Sizes)	4	3/8	
Steel, 3 inches and smaller	12	1/2	
Steel, 4 inches and larger	12	5/8	

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Labels.
- F. Lockout devices.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:1. ASME A13.1 Scheme for the Identification of Piping Systems.
- B. National Fire Protection Association:1. NFPA 99 Standard for Health Care Facilities.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.4 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter square .
- B. Information Tags:
 - 1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame plastic laminated.

2.3 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
 - 1. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates . Identify in-line pumps and other small devices with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Identify piping, concealed or exposed, with plastic pipe markers plastic tape pipe markers . Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Plumbing piping insulation, jackets and accessories.
- B. Plumbing equipment insulation, jackets and accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 3. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
 - 4. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 5. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - 6. ASTM C921 Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - 7. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 8. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 450 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.

2.3 PIPE INSULATION JACKETS

- A. PVC Plastic Pipe Jacket:
 - 1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
 - 2. Thickness: 30 mil.
 - 3. Connections: Brush on welding adhesive Tacks Pressure sensitive color matching vinyl tape.

B. Aluminum Pipe Jacket:

- 1. ASTM B209.
- 2. Thickness: 0.016 inch thick sheet.
- 3. Finish: Smooth Embossed .
- 4. Joining: Longitudinal slip joints and 2 inch laps.
- 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
- 6. Metal Jacket Bands: 1/2 inch wide; 0.015 inch thick aluminum.

2.4 PIPE INSULATION ACCESSORIES

- A. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. Length: Based on pipe size and insulation thickness.
- B. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems less than 140 degrees F:

Clark Dietz, Inc. 00130014

- 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
- 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- F. Inserts and Shields:
 - 1. Piping 1-1/2inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- G. Insulation Terminating Points:
 - 1. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers aluminum jacket stainless steel jacket.
- I. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner allpurpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

3.3 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Domestic Hot Water Supply and Recirculation	P-1	1-1/4 inches and smaller 1-1/2 inches and larger	0.5 1.0
Domestic Hot Water Supply and Recirculation systems with domestic water temperature maintenance cable	P-1	1 inch and smaller 1-1/4 inches to 2 inches 2-1/2 inches and larger	1.0 1.5 2.0
Domestic Cold Water	P-1	1-1/4 inches and smaller 1-1/2 inches and larger	0.5 1.0
Non-Potable Water	P-1	1-1/4 inches and smaller 1-1/2 inches and larger	0.5 1.0

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Domestic water piping, above grade.
- B. Flue and Combustion Piping
- C. Unions and flanges.
- D. Valves.
- E. Pressure gages.
- F. Pressure gage taps.
- G. Thermometers.
- H. Relief valves.
- I. Strainers.
- J. Backflow preventers.
- K. Thermostatic mixing valves.
- L. Pressure balanced mixing valves.
- M. Bedding and Cover Materials

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z21.22 Relief Valves for Hot Water Supply Systems.
- B. American Society of Mechanical Engineers:
 - 1. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 4. ASME B31.9 Building Services Piping.
 - 5. ASME B40.1 Gauges Pressure Indicating Dial Type Elastic Element.
 - 6. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.
 - 7. ASME Section IX Boiler and Pressure Vessel Code Welding and Brazing Qualifications.

- C. American Society of Sanitary Engineering:
 - 1. ASSE 1011 Performance Requirements for Hose Connection Vacuum Breakers.
 - 2. ASSE 1012 Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
 - 3. ASSE 1013 Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
- D. ASTM International:
 - 1. ASTM B32 Standard Specification for Solder Metal.
 - 2. ASTM B42 Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - 3. ASTM B88 Standard Specification for Seamless Copper Water Tube.
 - 4. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 5. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 6. ASTM D2466 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 7. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 8. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - 9. ASTM D 3311 Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns.
 - 10. ASTM E1 Standard Specification for ASTM Thermometers.
 - 11. ASTM F438 Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
 - 12. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 13. ASTM F 891 Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core.
 - 14. ASTM F1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- E. American Welding Society:
 - 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
- F. American Water Works Association:
- G. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. Underwriters Laboratories Inc.:
 - 1. UL 404 Gauges, Indicating Pressure, for Compressed Gas Service.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.

- 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
- 3. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- 4. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
 - B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

- 2.1 DOMESTIC WATER PIPING, ABOVE GRADE (POTABLE AND NON-POTABLE)
 - A. Copper Tubing: ASTM B88, Type L, drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

2.2 FLUE AND COMBUSTION AIR PIPING

- A. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material.
 - 1. Fittings: ASTM D2466, Schedule 40, PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement. Prime joints with a contrasting color.
- B. PVC Pipe: ASTM D1785, Schedule 80, polyvinyl chloride (PVC) material.
 - 1. Fittings: ASTM D2467, Schedule 80, PVC ASTM D2464 PVC, threaded.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement. Prime joints with a contrasting color.
- C. CPVC Pipe: ASTM F441/F441M, Schedule 40, chlorinated polyvinyl chloride (CPVC) material. 1. Fittings: ASTM F438, CPVC, Schedule 40, socket type.

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2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement. Prime joints with a contrasting color.

D. CPVC Pipe: ASTM F441/F441M, Schedule 80, chlorinated polyvinyl chloride (CPVC) material.

- 1. Fittings: ASTM F439, CPVC, Schedule 80, socket type. ASTM F437, CPVC, Schedule 80, threaded.
- 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement. Prime joints with a contrasting color.

2.3 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Copper Piping: Class 150, bronze unions with soldered
 - 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Copper Piping: Class 150, slip-on bronze flanges.
 - 2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.4 GATE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc. Model
 - 5. Stockham Valves & Fittings Model
- B. 2 inches and Smaller: MSS SP 80, Class 125 Class 150, bronze body, bronze trim, threaded union bonnet, non-rising rising stem, lock-shield stem hand-wheel, inside screw with back-seating stem, solid split wedge disc, alloy seat rings, solder or threaded ends.
- C. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising non-rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.5 GLOBE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve Model
 - 3. Milwaukee Valve Company Model
 - 4. NIBCO, Inc. Model
 - 5. Stockham Valves & Fittings Model
- B. 2 inches and Smaller: MSS SP 80, Class 125 Class 150, bronze body, bronze trim, threaded union bonnet, hand wheel, Buna-N composition disc, solder or threaded ends.

C. 2-1/2 inches and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.6 BALL VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings
- B. 2 inches and Smaller: MSS SP 110, 400 psi WOG 600 psi WOG, one two piece bronze body, chrome plated brass ball, regular full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle wing or tee handle locking lever handle extended lever handle round handle oval handle with balancing stops.
- C. 2 inches and Smaller: MSS SP 110, Class 150, bronze, two piece body, chrome plated bronze type 316 stainless steel ball, regular full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle wing or tee handle locking lever handle extended lever handle round handle oval handle with balancing stops.

2.7 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings

B. 2-1/2 inches and Larger: MSS SP 67, Class 150 Class 200 Class 250.

- 1. Body: Cast or ductile iron, wafer lug or grooved ends, stainless steel stem, extended neck.
- 2. Disc: Nickel-plated ductile iron Aluminum bronze Elastomer coated ductile iron Chrome plated ductile iron or stainless steel.
- 3. Seat: Resilient replaceable EPDM Buna N neoprene Viton.
- 4. Handle and Operator: 10 position lever handle. Infinite position lever handle with memory stop. Hand-wheel and gear drive. Furnish gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.8 CHECK VALVES

A. Horizontal Swing Check Valves:

- 1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve
 - c. Milwaukee Valve Company

- d. NIBCO, Inc.
- e. Stockham Valves & Fittings
- 2. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.
- 3. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.
- B. Spring Loaded Check Valves:
 - 1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve Model
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
 - 2. 2 inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded ends.
 - 3. 2-1/2 inches and Larger: MSS SP 71, Class 125, wafer globe style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

2.9 PRESSURE GAGES

- A. Gage: ASME B40.1, UL 393 UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Steel Cast aluminum Fiberglass reinforced polypropylene Stainless steel ABS.
 - 2. Bourdon Tube: Brass Phosphor bronze Type 316 stainless steel.
 - 3. Dial Size: 2 inch 2-1/2 inch 3-1/2 inch 4 inch 4-1/2 inch 6 inch 8-1/2 inch diameter.
 - 4. Mid-Scale Accuracy: One two 1/2 percent.
 - 5. Scale: Psi kPa Both psi and kPa.

2.10 PRESSURE GAGE TAPS

- A. Needle Valve: Brass Steel Stainless Steel, 1/4 inch NPT for minimum 300 psi.
- B. Ball Valve: Brass Stainless Steel, 1/8 inch NPT 1/4 inch NPT for 250 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.

2.11 STEM TYPE THERMOMETERS

- A. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
 - 1. Size: 7 inch 9 inch 12 inch scale.
 - 2. Window: Clear glass Lexan.
 - 3. Stem: Brass, 3/4 inch NPT, 3-1/2 inch inch long.
 - 4. Accuracy: ASTM E77 2 percent.
 - 5. Calibration: Degrees F Degrees C Both degrees F and degrees C.

2.12 FLOW CONTROL VALVES

- A. Construction: Class 150, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, combination blow-down or back-flush drain.
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 5 psi.

2.13 RELIEF VALVES

A. Pressure Relief:

- 1. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated at maximum 60 psi, UL listed for fuel oil, capacities ASME certified and labeled.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.14 STRAINERS

- A. 2 inch and Smaller: Threaded brass body for 175 psi CWP Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- B. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.
- C. 5 inch and Larger: Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.15 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers:
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze internal parts and stainless steel springs.
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.16 THERMOSTATIC MIXING VALVES

- A. The Emergency Shower Mixing Valve shall employ two fully independent control mechanisms which split the flow in half, blend each half to the design temperature and then integrate each stream at the outlet.
- B. The valve shall control outlet temperature over a wide range of flow and shall be suitable for deluge shower or eyewash applications.

- C. The valve shall include three thermometers to measure the temperature of each stream and the merged flow. Temperature adjustment shall be vandal resistant.
- D. Each independent control mechanism shall employ a liquid-filled thermostatic motor to drive the valve without additional power requirements.
- E. Each control mechanism shall employ a stainless steel sliding piston control device with reverse seat closure and both fixed and variable coldwater bypass.
- F. In the event of interruption of the cold water supply, each control mechanism closes off the hot water port, stopping all flow.
- G. In the event of interruption of the hot water supply, each control mechanism shall allow cold flow through both the fixed and variable by-pass.
- H. In the event that one liquid motor fails, the control mechanism closes off the hot water port with the reverse seat and fully opens the internal variable bypass to allow cold water flow. The other control mechanism will be unaffected by the failure and will maintain design temperature.
- I. Maximum Inlet Pressure: 125 PSI
 - 1. Recommended Inlet Temperature: 120°F.*
 - 2. Recommended Operating Pressure: 65 PSI
 - 3. Connections: 1 1/4" NPT
 - 4. Capacity: 60 GPM at 30 PSI
 - J. Accessories:
 - 1. Check valve on inlets.
 - 2. Volume control shut-off valve on outlet.
 - 3. Stem thermometer on outlet.
 - 4. Strainer stop checks on inlets.
 - K. Cabinet: 16 gage prime coated enameled stainless steel, for recessed surface mounting with keyed lock.

2.17 PRESSURE BALANCED MIXING VALVES

- A. Valve: Chrome plated cast brass body, stainless steel cylinder and integral temperature adjustment.
- B. Accessories:
 - 1. Volume control shut-off valve on outlet.
 - 2. Stem thermometer on outlet.
 - 3. Strainer stop checks on inlets.
- C. Cabinet: 16 gage prime coated enameled stainless steel, for recessed surface mounting with keyed lock.

2.18 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type as specified in Section 31 05 16.
- B. Cover: Fill Type as specified in Section 31 05 16.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S2. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - THERMOMETERS AND GAGES

- A. Install gage taps in piping.
- B. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- D. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- E. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- F. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system size, location, and invert prior to construction.
- B. Establish elevations of buried piping with not less than 3 ft of cover.
- C. Establish minimum separation of from other services sanitary sewer piping piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.

- E. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted loose depth; compact to 95 percent maximum density.
- F. Install pipe on prepared bedding.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Install trace wire continuous over top of pipe. buried 6 inches below finish grade, above pipe line; coordinate with Section 31 23 23. Refer to Section 22 05 53 .
- J. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 31 23 23.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 6 inches compacted layers to 6 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.

3.5 INSTALLATION - ABOVE GROUND PIPING

- A. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange systems to drain at low points.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- K. Install domestic water piping in accordance with ASME B31.9.
- L. Sleeve pipes passing through partitions, walls and floors.
- M. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install gate ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- R. Install globe ball or butterfly valves for throttling, bypass, or manual flow control services.
- S. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.
- T. Provide flow controls in water circulating systems as indicated on Drawings.
- U. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs, generator coolant heat exchangers.
- V. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- W. Test backflow preventers in accordance with ASSE 5013 5015.
- X. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

3.6 FIELD QUALITY CONTROL

A. Test domestic water piping system in accordance with applicable code and local authority having jurisdiction

3.7 CLEANING

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

- C. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
- D. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.
- I. Non-potable water is exempt from this provision.

SECTION 22 13 00

FACILITY SANITARY SEWERAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary sewer piping buried within 5 feet of building.
- B. Sanitary sewer piping above grade.
- C. Floor drains.
- D. Floor sinks.
- E. Cleanouts.
- F. Bedding and cover materials.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A112.21.1 Floor Drains.
 - 2. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
 - 3. ASME B16.3 Malleable Iron Threaded Fittings.
 - 4. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - 1. ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings.
 - 2. ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM C564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - 4. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM F1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- C. Cast Iron Soil Pipe Institute:
 - 1. CISPI 301 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 2. CISPI 310 Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

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- 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include, spare parts lists, exploded assembly views for pumps and equipment.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

- 2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING
 - A. Cast Iron Soil Pipe: ASTM A74, extra heavy service weight, bell and spigot plain ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
 - B. Cast Iron Pipe: CISPI 301, hub-less.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.3 FLOOR DRAINS

A. Floor Drain (FD): ASME A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with polished bronze funnel or anti- splash rim.

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2.4 CLEANOUTS

- A. Interior Finished Floor Areas (CO): Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.
- B. Interior Finished Wall Areas (LCO): Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type as specified in Section 31 05 16.
- B. Cover: Fill Type as specified in Section 31 05 16.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system size, location, and invert prior to construction.
- B. Establish elevations of buried piping with not less than ft of cover.
- C. Establish minimum separation of from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted loose depth; compact to 95 percent maximum density.
- F. Install pipe on prepared bedding.

G. Route pipe in straight line.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- B. Install floor cleanouts at elevation to accommodate finished floor.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- E. Install piping to maintain headroom. Do not spread piping, conserve space.
- F. Group piping whenever practical at common elevations.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide clearance in hangers and from structure and other equipment for installation of insulation. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors.
- H. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- K. Install bell and spigot pipe with bell end upstream.
- L. Sleeve pipes passing through partitions, walls and floors.
- M. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- N. Support cast iron drainage piping at every joint.

3.5 FIELD QUALITY CONTROL

A. Test sanitary waste and vent piping system in accordance with applicable code local authority having jurisdiction.

SECTION 22 15 00

GENERAL SERVICE COMPRESSED-AIR SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Compressed air piping.
- B. Unions and flanges.
- C. Valves.
- D. Strainers.
- E. Flexible connectors.
- F. Relief valves.
- G. Compressed air outlets.
- H. Air pressure reducing valve.
- I. Pressure regulators.
- J. Compressed air filters.
- K. Hose connectors.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 Malleable Iron Threaded Fittings.
 - 2. ASME B31.1 Power Piping.
 - 3. ASME B31.9 Building Services Piping.
 - 4. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.
 - 5. ASME Section IX Boiler and Pressure Vessel Code Welding and Brazing Qualifications.
- B. ASTM International:
 - 1. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 3. ASTM F1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

C. American Welding Society:

- 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
- 2. AWS D1.1 Structural Welding Code Steel.

1.3 SUBMITTALS

A. Product Data:

- 1. Piping: Submit data on pipe materials, fittings, and accessories.
- 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
- 3. System Components: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes. When applicable, include electrical characteristics and connection requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit assembly views, lubrication instructions, replacement part numbers and availability.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.1 B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with applicable authority AWS D1.1 for welding hanger and support attachments to building structure.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping and equipment from weather and construction traffic. Maintain factory packaging and caps in place until installation.
- B. Deliver each length of piping with manufacturer's plugged or capped ends and keep sealed until installation.
- C. Deliver fittings, valves, and other components in sealed containers and keep sealed until installation.

PART 2 PRODUCTS

2.1 COMPRESSED AIR PIPING

- A. Copper Tubing: ASTM B88, Type K, drawn.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Tee Construction: Mechanically extracted collars with notched and dimpled branch tube.
 - 3. Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

- B. Copper Tubing: ASTM B88, Type K, drawn, rolled grooved ends.
 - 1. Fittings: ASME B16.18 cast copper alloy, or ASME B16.22 wrought copper and bronze, groove ends.
 - 2. Joints: Grove mechical couplings meetings ASTM F1476.
 - a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.
 - b. Gasket: Elastomer composition for operating temperature range from 86 degrees F to 180 degrees F.
 - c. Accessories: Stainless steel bolts, nuts, and washers.

2.2 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.3 GATE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. Stockham Valves & Fittings
- B. 2 inches and Smaller: MSS SP 80, Class 125 Class 150, bronze body, bronze trim, threaded union bonnet, non-rising rising stem, lock-shield stem hand-wheel, inside screw with back-seating stem, solid split wedge disc, alloy seat rings, solder or threaded ends.
- C. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising non-rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.4 BALL VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. Stockham Valves & Fittings
- B. 2 inches and Smaller: MSS SP 110, Class 150, bronze, two piece body, chrome plated bronze type 316 stainless steel ball, full port, teflon seats, blow-out proof stem, solder or threaded

ends with union, lever handle wing or tee handle locking lever handle extended lever handle round handle oval handle with balancing stops.

2.5 STRAINERS

A. Manufacturers:

- 1. Mueller Steam Specialty
- 2. O.C. Keckley Company
- 3. Spirax Sarco, Inc.
- B. 2 inch and Smaller: Y pattern, ASTM B62 bronze body, threaded soldered ends, Class 150 250, 1/16 inch 1/32 inch 20 60 100 mesh stainless steel perforated screen.
- C. 2 inch and Smaller: Y pattern, ASTM A126 cast iron body, threaded ends, Class 250, 1/16 inch 1/32 inch 20 60 100 mesh stainless steel perforated screen.
- D. 2-1/2 inch and Larger: Y pattern, ASTM A126 cast iron body, flanged ends, Class 125, with 1/8 inch 3/64 inch 1/16 inch 20 60 100 mesh stainless steel perforated screen.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers:

- 1. Flex-Hose Co., Inc.
- 2. Flex-Weld, Inc./Keflex
- 3. The Metraflex Company
- 4. Twin City Hose, Inc.
- 5. USHose Corp.
- B. 2 inches and Smaller: Corrugated bronze stainless steel hose with single layer of bronze stainless steel exterior braiding, Schedule 40 black steel copper tubing ends; maximum working pressure 190 psig, threaded or soldered connections.
- C. 2-1/2 inches and Larger: Corrugated stainless steel hose with single layer of stainless steel exterior braiding, Class 150 flanged ends; maximum working pressure 190 psig.

2.7 COMPRESSED AIR OUTLETS

A. Compressed Air Outlets: Quick Connector: 3/8 1/4 inch brass, snap on connector with self closing valve, Style A L T M. Contractors shall verify type of quick connect prior to installation.

2.8 HOSE CONNECTORS

- A. Hose Connectors: Corrugated stainless steel tubing with stainless steel wire braid covering and ends welded to inner tubing.
- B. Working Pressure: 250 psig minimum.
- C. End Connections:

- 1. 2 inches and Smaller: Threaded steel pipe nipple.
- 2. 2-1/2 inches and Larger: Class 150 Flanges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify connection to existing piping system size, and location indicated on Drawings.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - ABOVE GROUND PIPING - COMPRESSED AIR SYSTEMS

- A. Install drip connections with valves at low points of piping system.
- B. Install take-off to outlets from top of main, with shut off valve after take-off. Slope take-off piping to outlets.
- C. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated as indicated on Drawings.
- D. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
- E. Cut pipe and tubing accurately and install without springing or forcing.
- F. Slope piping in direction of flow.
- G. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions.
- H. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- I. Except where indicated, install manual shut off valves with stem vertical and accessible for operation and maintenance.
- J. Install strainers on inlet side of pressure reducing valves. Install pressure reducing valves with bypasses and isolation valves to allow maintenance without interruption of service.
- K. Install strainers on inlet side of pressure regulators and .

3.4 INSTALLATION - EQUIPMENT

- A. Install air compressor on concrete housekeeping pad, minimum 4 inches high and 6 inches larger than compressor base on each side. Install air valve and drain connection on horizontal casing.
- B. Install line size shut-off valve and check valve on compressor discharge.
- C. Install replaceable cartridge type filter silencer for each compressor.
- D. Install shut-off valve on water inlet to after cooler. Pipe drain to floor drain.
- E. Install condensate drain piping to nearest floor drain.
- F. Install bypass with valves around air dryer. Use factory insulated inlet and outlet connections.
- G. Provide bypass with valves, around receivers.

3.5 FIELD QUALITY CONTROL

- A. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.9.
- B. Verify for atmospheric pressure in piping systems, other than system under test.
- C. Test system with dry compressed air or dry nitrogen with test pressure in piping system at 50 psi.

3.6 CLEANING

A. Blow systems clear of free moisture and foreign matter.

SECTION 22 34 00

FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Instantaneous gas-fired water heaters.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME PTC 25 Pressure Relief Devices.
- B. National Fire Protection Association:
 - 1. NFPA 54 National Fuel Gas Code.
 - 2. NFPA 58 Liquefied Petroleum Gas Code.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.
- B. Product Data:
 - 1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit electrical characteristics and connection locations.
- C. Manufacturer's Installation Instructions: Submit mounting and support requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.5 QUALITY ASSURANCE

- A. Conform to ASME Section VIII for construction of water heaters.
- B. Water Heater Performance Requirements: As scheduled on drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept water heaters on site in original labeled cartons. Inspect for damage.
- B. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 GAS FIRED WATER HEATERS

- A. Manufacturers:
 - 1. Takagi.
 - 2. Noritz.
 - 3. Rinnai.
- B. Type: Automatic, natural gas-fired, high-efficiency, condensing, tankless on-demand, direct-vented.
- C. Capacity: As scheduled on drawings.
- D. Certification: ANSI Z21.10.3.
- E. Heating: Copper/Stainless steel heat exchanger.
- F. Controls: Automatic water thermostat, temperature range adjustable from 100 to 180 degrees F. Communication cable to link multiple units and operate them simultaneously.
- G. Intake and Flue vent with PVC venting, built-in safety controls to monitor exhaust temperature.
- H. Electric ignition. Built-in freeze protection sensors, auto-firing system and heating blocks.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heater on wall per manufacturer's installation instructions.
- C. Connect natural gas piping in accordance with NFPA 54 and manufacturer's installation instructions.
- D. Connect domestic hot water and domestic cold water piping to supply and return water heater connections.
- E. Install piping accessories per plumbing details.
- F. Install discharge piping from relief valves and drain valves to nearest floor drain.
- G. Install expansion tank on water heater.
- H. Install water heater trim and accessories furnished loose for field mounting.
- I. Install electrical devices furnished loose for field mounting.

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Emergency Eye and Face Wash.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A117.1 Accessible and Usable Buildings and Facilities.
 - 2. ANSI Z358.1 Emergency Eyewash and Shower Equipment.

1.3 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.5 QUALITY ASSURANCE

- A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Accept fixtures on site in factory packaging. Inspect for damage.
 - B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

- 2.1 EMERGENCY EYE AND FACE WASH
 - A. Manufacturers:

Clark Dietz, Inc. 00130014

- 1. Bradley Corp.
- 2. Chicago Faucet Co.
- 3. Encon Safety Products.
- 4. Speakman.
- 5. Guardian.
- B. Shower: ANSI Z358.1; free standing, self- cleaning, non-clogging 8 inch diameter plastic drench shower head, instant action stay open valve actuated by rigid stainless steel pull rod.
- C. Eyewash: ANSI Z358.1; Stainless Steel bowl with aerated eye/face wash. 1-1/4 inch galvanized pipe pedestal with floor flange, instant action stay open valve actuated by push flag, twin spray heads, dust cover assembly, and tailpiece and with galvanized pipe P-trap.
- D. Supply and Waste Piping: 1-1/4 inch galvanized pipe pedestal with floor flange.
- E. Factory applied CRP (corrosive atmospheres coating).
- F. Alarms: 120 VAC emergency alarm and light system, with flow switch and dry remote contacts for remote alarm activated when eyewash or safety shower in use.
- G. Furnish universal emergency sign.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify electric power is available and of correct characteristics.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports or wall carriers and bolts.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit use of fixtures before final acceptance.

3.8 SCHEDULES

A. Emergency Eye and Face Wash: Standard: 38 inches to receptor rim.

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single-phase and three-phase motors for application on equipment provided under other sections.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:1. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 1. NEMA MG 1 Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
 - B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
 - C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT

- A. Manufacturers:
 - 1. Cooper Industries Inc.
 - 2. Eaton Corp.
 - 3. General Electric Co.

- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Voltage: 460 volts, three phase, 60 Hz.
 - 2. Service Factor: 1.15.
 - 3. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings.
 - 4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 5. Insulation System: NEMA Class F.
 - 6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
 - Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
 - 9. Sound Power Levels: Conform to NEMA MG 1.
- E. Single Phase Motors:
 - 1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
 - 2. Voltage: 115 volts, single phase, 60 Hz.
- F. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 EXECUTION

- 3.1 EXISTING WORK
 - A. Disconnect and remove abandoned motors
 - B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe hangers and supports.
- B. Hanger rods.
- C. Inserts.
- D. Flashing.
- E. Equipment curbs.
- F. Sleeves.
- G. Mechanical sleeve seals.
- H. Formed steel channel.
- I. Firestopping relating to HVAC work.
- J. Firestopping accessories.
- K. Equipment bases and supports.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 Power Piping.
 - 2. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - 1. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 2. ASTM E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops.
 - 3. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 Structural Welding Code Steel.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.

- 3. UL 1479 Fire Tests of Through-Penetration Firestops.
- 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
- 5. UL Fire Resistance Directory.

1.3 **DEFINITIONS**

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestop interruptions to fire rated assemblies, materials, and components.
- 1.5 PERFORMANCE REQUIREMENTS
 - A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
 - B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.
 - 5. Michigan Hanger Co.
 - 6. Superior Valve Co.

B. Hydronic Piping:

- 1. Conform to ASME B31.9.
- 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
- 5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
- 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
- 8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
- 9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
- 10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- 11. Vertical Support: Steel riser clamp.
- 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- 15. Copper Pipe Support: Copper-plated, carbon steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 EQUIPMENT CURBS

A. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match root insulation, 1-1/2 inch thick insulation, factory installed wood nailer.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- E. Sealant: Acrylic.

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp. B-Line Systems.
 - 2. Midland Ross Corporation, Electrical Products Division
 - 3. Unistrut Corp.
- B. Product Description: Galvanized (12 gage) thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products
 - 6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

2.9 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Sheet metal.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1 ASME 31.9.
- B. Support horizontal piping as scheduled.

- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Provide curbs for roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.7 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

3.8 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.9 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.11 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2 (Note 2)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	3/4

B. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Labels.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.4 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

- 2.2 TAGS
 - A. Plastic Tags:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems
 - b. Safety Sign Co.
 - c. Seton Identification Products
 - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter .
 - B. Information Tags:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems
 - b. Safety Sign Co.
 - c. Seton Identification Products
 - 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
 - C. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.3 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems
 - b. Safety Sign Co.
 - c. Seton Identification Products
 - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
 - 3. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Underground Pipe Markers:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems
 - b. Safety Sign Co.
 - c. Seton Identification Products
 - 2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 LABELS

- A. Manufacturers:
 - 1. Craftmark Identification Systems

Clark Dietz, Inc. 00130014

- 2. Safety Sign Co.
- 3. Seton Identification Products
- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates . Identify in-line pumps and other small devices with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers . Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. For exposed natural gas lines other than steel pipe, attach yellow pipe labels with "GAS" in black lettering, at maximum 5 foot spacing.
- L. Identify ductwork with plastic nameplates. Locate identification, at each side of penetration of structure or enclosure, and at each obstruction.

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of air systems.
- B. Testing, adjusting, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Sound measurement of equipment operating conditions.
- E. Vibration measurement of equipment operating conditions.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- B. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- C. Submit draft copies of report for review prior to final acceptance of Project.
- D. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance ASHRAE 111, NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.6 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience certified by AABC Certified by NEBB.

1.7 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place or in normal position.
 - 15. Service and balancing valves are open.

3.2 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.3 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

3.4 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. At modulating damper locations, take measurements and balance at extreme conditions.

3.5 WATER SYSTEM PROCEDURE

- A. Adjust water systems, after air balancing, to obtain design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.6 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. HVAC Pumps.
 - 2. Boilers.
 - 3. Fans.
 - 4. Air Inlets and Outlets.
 - 5. Heat Exchangers.

B. Report Forms

- 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect

- g. Project Engineer
- h. Project Contractor
- i. Project altitude
- j. Report date
- 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
- 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP and kW
 - g. Actual flow rate, pressure drop, BHP and kW
 - h. Discharge pressure
- i. Suction pressure
- j. Total operating head pressure
- k. Shut off, discharge and suction pressures
- 1. Shut off, total head pressure
- 7. Heat Exchanger:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Steam pressure, design and actual
 - h. Primary water entering temperature, design and actual
 - i. Primary water leaving temperature, design and actual
 - j. Primary water flow, design and actual
 - k. Primary water pressure drop, design and actual
 - 1. Secondary water leaving temperature, design and actual
 - m. Secondary water leaving temperature, design and actual
 - n. Secondary water flow, design and actual
 - o. Secondary water pressure drop, design and actual
- 8. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - 1. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
- 9. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure
 - h. Discharge pressure
 - i. Sheave Make/Size/Bore

- j. Number of Belts/Make/Size
- k. Fan RPM
- 10. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. HVAC piping insulation, jackets and accessories.
- B. HVAC equipment insulation, jackets and accessories.
- C. HVAC ductwork insulation, jackets, and accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 2. ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 3. ASTM C921 Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - 4. ASTM C1071 Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
 - 5. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - 6. ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 - 7. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 8. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 9. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
 - 10. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - 11. ASTM E84 Standard Test Method For Surface Burning Characteristics Of Building Materials
 - 12. ASTM E2231 Standard Practice For Specimen Preparation And Mounting Of Pipe And Duct Insulation Materials To Assess Surface Burning Characteristics
- B. Sheet Metal and Air Conditioning Contractors':
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- C. Underwriters Laboratories Inc.:
 - 1. UL 1978 Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.

- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
 - 1. Aeroflex. Aerocell.
 - 2. Armacell, LLC. Armaflex.
 - 3. Nomaco. K-flex.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
- C. TYPE P-3: ASTM C547, Type I or II, mineral fiber preformed pipe insulation, noncombustible.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Canvas Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric treated with fire retardant lagging adhesive.

2.3 PIPE INSULATION JACKETS

- A. Vapor Retarder Jacket:
 - 1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
 - 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
- B. PVC Plastic Pipe Jacket:
 - 1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
 - 2. Thickness: 30 mil.
 - 3. Connections: Brush on welding adhesive .
- C. Aluminum Pipe Jacket:
 - 1. ASTM B209.
 - 2. Thickness: 0.020 inch thick sheet.
 - 3. Finish: Smooth .
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum. 0.020 inch thick stainless steel.

2.4 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- G. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- H. Adhesives: Compatible with insulation.
- I. Fasten Aluminum jacket with screws and rivets.

2.5 EQUIPMENT INSULATION

- A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.
 - 1. Thermal Conductivity: 0.24 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 450 degrees F.
 - 3. Density: 2.3 pound per cubic foot.
- B. TYPE E-2: ASTM C612, man made mineral fiber, noncombustible, Classes 1-4.
 - 1. Thermal Conductivity: 0.25 at 100 degrees F.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Density: 8 pound per cubic foot.

2.6 EQUIPMENT INSULATION JACKETS

- A. PVC Plastic Equipment Jacket:
 - 1. Product Description: ASTM D1785, sheet material, off-white color.
 - 2. Minimum Service Temperature: -40 degrees F.
 - 3. Maximum Service Temperature: 150 degrees F.
 - 4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
 - 5. Thickness: 30 mil.
 - 6. Connections: Brush on welding adhesive Tacks Pressure sensitive color matching vinyl tape.
- B. Aluminum Equipment Jacket:
 - 1. ASTM B209 Thickness: 0.016 inch thick sheet.
 - 2. Finish: Smooth Embossed .

- 3. Joining: Longitudinal slip joints and 2 inch laps.
- 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
- 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum. 0.010 inch thick stainless steel.

2.7 EQUIPMENT INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- E. Adhesives: Compatible with insulation.
- F. Fasten Aluminum jacket with screws and rivets.

2.8 DUCTWORK INSULATION

- A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Maximum Operating Temperature: 250 degrees F.
 - 3. Density: 0.75 pound per cubic foot.
- B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing reinforced aluminum foil facing metalized polypropylene scrim kraft facing meeting ASTM C1136, Type II.
 - 1. Thermal Conductivity: 0.24 at 75 degrees F.
 - 2. Density: 3.0 pound per cubic foot.

2.9 DUCTWORK INSULATION JACKETS

- A. Aluminum Duct Jacket:
 - 1. ASTM B209.
 - 2. Thickness: 0.016 inch thick sheet.
 - 3. Finish: Smooth .
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum. 0.010 inch thick stainless steel.
- B. Vapor Retarder Jacket:

- 1. Kraft paper with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
- 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
- 3. Secure with pressure sensitive tape.

2.10 DUCTWORK INSULATION ACCESSORIES

- A. Vapor Retarder Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- B. Vapor Retarder Lap Adhesive: Compatible with insulation.
- C. Adhesive: Waterproof, ASTM E162 fire-retardant type.
- D. Liner Fasteners: Galvanized steel, self-adhesive pad impact applied welded with integral press-on head.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Lagging Adhesive: Fire retardant type with maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- H. Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

- 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factoryapplied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
- 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems greater than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Insulate flanges and unions at equipment.
- F. Diesel Fuel piping:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Insulate flanges and unions at equipment.
 - 4. Provide stainless steel jacket on all external and internal piping.
- G. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- H. Insulation Terminating Points:
 - 1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.

- 2. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- 3. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with aluminum jacket .

3.3 INSTALLATION - EQUIPMENT

- A. Factory Insulated Equipment: Do not insulate.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- D. Equipment Containing Fluids Below Ambient Temperature:
 - 1. Insulate entire equipment surfaces.
 - 2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factoryapplied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 4. Finish insulation at supports, protrusions, and interruptions.
- E. Equipment Containing Fluids 140 degrees F Or Less:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- F. Equipment Containing Fluids Over 140 degrees F:
 - 1. Insulate flanges and unions with removable sections and jackets.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with aluminum jacket .
- H. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.
- I. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 INSTALLATION - DUCTWORK SYSTEMS

- A. Duct dimensions indicated on Drawings are finished inside dimensions.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with tape and vapor retarder jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with or without standard vapor retarder jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting aluminum jacket.
- E. External Glass Fiber Duct Insulation:
 - 1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
 - 2. Secure insulation without vapor retarder with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.5 SCHEDULES

A. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Heating Water Supply and	P-1	3 inches and smaller	1.0
Return 141 to 200 degrees F		4 inches and larger	1.5
Heating Water Supply and	P-1	1-1/4 inches and smaller	1.5
Return 201 to 250 degrees F		1-1/2 inches and larger	2.0
Coolant Water Supply &	P-1	3 inches and smaller	1.0
Return 101-140 degrees F		4 inches and larger	1.0

Coolant Water Supply & Return 141-200 degrees F	P-1	3 inches and smaller4 inches and larger	1.0 1.5
Coolant Water Supply & Return 201-250 degrees F	P-1	1-1/4 inches and smaller 1-1/2 inches and larger	1.5 2.0
Generator Exhaust	P-3	All Sizes	3.0

B. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Combustion Air	D-2	1.5
Outside Air Intake	D-2	1.5
Supply Ducts (externally insulated) Thickness indicated is installed thickness.	D-1 or D-2	1.5
Exhaust Ducts Within 10 feet of Exterior Openings Thickness indicated is installed thickness.	D-1 or D-2	1.5
Exhaust Ducts Exposed to Outdoor Air	D-2	2.0

C. Equipment Insulation Schedule:

EQUIPMENT INSULATION	INSULATION TYPE	INSULATION THICKNESS inches
Expansion Tank	E-1	2.0
Generator Exhaust Muffler	E-2	4.0

END OF SECTION

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Natural gas piping above grade.
- B. Unions and flanges.
- C. Valves.
- D. Pipe hangers and supports.
- E. Strainers.
- F. Natural gas pressure regulators.
- G. Natural gas pressure relief valves.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z21.15 Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
 - 2. ANSI Z21.80 Line Pressure Regulators
- B. American Society of Mechanical Engineers:
 - 1. ASME B16.3 Malleable Iron Threaded Fittings.
 - 2. ASME B16.33 Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 2).
 - 3. ASME B31.9 Building Services Piping.
 - 4. ASME Section IX Boiler and Pressure Vessel Code Welding and Brazing Qualifications.
- C. ASTM International:
 - 1. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- D. American Welding Society:
 - 1. AWS D1.1 Structural Welding Code Steel.
- E. National Fire Protection Association:
 - 1. NFPA 54 National Fuel Gas Code.

- F. Underwriters Laboratories Inc.:
 - 1. UL 842 Valves for Flammable Fluids.
 - 2. UL 651 Schedule 40 and 80 Rigid PVC Conduit and Fittings

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708.
- D. Use plug, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
- B. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54.
- B. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- C. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.8 COORDINATION

A. Coordinate trenching excavating bedding backfilling of buried piping systems with requirements of Section.

PART 2 PRODUCTS

- 2.1 NATURAL GAS PIPING, ABOVE GRADE
 - A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.2 REGULATOR VENT PIPING, ABOVE GRADE

- A. Indoors: Same as natural gas piping, above grade.
- B. Outdoors: PVC pipe, tubing, and fittings, UL 651.

2.3 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with soldered brazed joints.
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.4 BALL VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings

- B. 1/4 inch to 1 inch: Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.
- C. 1-1/4 inch to 3 inch: Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.

2.5 PLUG VALVES

- A. Manufacturers:
 - 1. DeZURIK, Unit of SPX Corp.
 - 2. Flow Control Equipment, Inc.
 - 3. Homestead Valve
- B. 2 inches and Smaller: Class 150 semi-steel construction, round square rectangular port, full pipe area regular opening, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
- C. 2-1/2 inches and Larger: Class 150 semi-steel construction, round square rectangular port, full pipe area regular opening, pressure lubricated, teflon packing, flanged ends. Furnish wrench-operated worm gear-operated.

2.6 STRAINERS

- A. Manufacturers:
 - 1. Mueller Steam Specialty
 - 2. O.C. Keckley Company
 - 3. Spirax Sarco, Inc.
- B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.7 NATURAL GAS PRESSURE REGULATORS

- A. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 - 1. Comply with ANSI Z21.80.
 - 2. Temperatures: minus 20 degrees F to 150 degrees F.
 - 3. Body: Cast iron Steel.
 - 4. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 - 5. Disk, diaphragm, and O-ring: Nitrile .
 - 6. Maximum inlet pressure: 150 psig.

7. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.8 NATURAL GAS PRESSURE RELIEF VALVES

- A. Product Description: Spring loaded type relief valve.
 - 1. Body: Aluminum.
 - 2. Diaphragm: Nitrile .
 - 3. Orifice: Aluminum Brass Stainless steel.
 - 4. Maximum operating temperature: 150 degrees F.
 - 5. Inlet Connections: Threaded.
 - 6. Outlet or Vent Connection: Same size as inlet connection.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.
- E. Install piping to conserve building space and not interfere with use of space.
- F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Sleeve pipe passing through partitions, walls and floors.
- J. Provide clearance for installation of insulation and access to valves and fittings.

- K. Provide access where valves and fittings are not exposed.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- M. Provide support for utility meters in accordance with requirements of utility company.
- N. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood. Protect vent against entry of insects and foreign material.
 - 1. Minimum Vent Size: Connection size at regulator vent connection.
 - 2. Run individual vent line from each relief device, independent of breather vents.
- O. Breather vents may be manifolded together with piping sized for combined appliance vent requirements.
- P. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.Install medium pressure gas pressure regulator with tee fitting between regulator and upstream shutoff valve. Cap or plug one opening of tee fitting.
- S. Install medium pressure gas pressure regulator with tee fitting not less than 10 pipe diameters down stream of regulator. Cap or plug one opening of tee fitting.
- T. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors as indicated on Drawings.
- U. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.3 FIELD QUALITY CONTROL

- A. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.
- B. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.
- C. Pressure test natural gas piping in accordance with NFPA 54.
- D. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.

- E. When pressure tests do not meet specified requirements, remove defective work, replace and retest.
- F. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.
 - 1. Where leakage is detected, shut off gas supply until necessary repairs are complete.
- G. Do not place appliances in service until leak testing and repairs are complete.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coolant and Heating Water piping, above ground.
- B. Equipment drains and over flows.
- C. Unions and flanges.
- D. Valves.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 Malleable Iron Threaded Fittings.
 - 2. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
 - 3. ASME B16.22 Wrought Copper And Copper Alloy Solder Joint Pressure Fittings
 - 4. ASME B31.1 Power Piping.
 - 5. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - 1. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/ A234M Standard Specification For Piping Fittings Of Wrought Carbon Steel And Alloy Steel For Moderate And High Temperature Service
 - 3. ASTM B88 Standard Specification For Seamless Copper Water Tube
 - 4. ASTM B32 Standard Specification For Solder Metal
 - 5. ASTM D1785 Standard Specification For Poly(Vinyl Chloride) (Pvc) Plastic Pipe, Schedules 40, 80, And 120
 - 6. ASTM D2241 Standard Specification For Poly(Vinyl Chloride) (Pvc) Pressure-Rated Pipe (Sdr Series)
 - 7. ASTM D2466 Standard Specification For Poly(Vinyl Chloride) (Pvc) Plastic Pipe Fittings, Schedule 40
 - 8. ASTM D2855 Standard Practice For Making Solvent-Cemented Joints With Poly(Vinyl Chloride) (Pvc) Pipe And Fittings.
 - 9. ASTM D2564 Standard Specification For Solvent Cements For Poly(Vinyl Chloride) (Pvc) Plastic Piping Systems
 - 10. ASTM D2464 Standard Specification For Threaded Poly(Vinyl Chloride) (Pvc) Plastic Pipe Fittings, Schedule 80
 - 11. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- C. Provide pipe hangers and supports in accordance with ASME B31.1, ASME B31.9, ASTM F708.
- D. Use gate ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Use globe ball or butterfly valves for throttling, bypass, or manual flow control services.
- F. Use spring loaded check valves on discharge of hot water chilled water and condenser water pumps.
- G. Use butterfly valves in heating water systems interchangeably with gate and globe valves.
- H. Use lug end butterfly valves to isolate equipment.
- I. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
- B. Test Reports: Indicate results of piping system pressure test.
- C. Welders' Certificate: Include welders' certification of compliance with ASME Section IX. AWS D1.1.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.1 ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 HEATING WATER AND Coolant PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and larger, black.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18 cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type DWV, L, drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
- B. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inch and larger, or ASTM D2241, polyvinyl chloride (PVC) material.
 - 1. Fittings: ASTM D2466, Schedule 40, PVC
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.3 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150 malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with soldered brazed joints.
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 - 4. PVC Piping: PVC.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150 forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. PVC Piping: PVC flanges.

- 4. Gaskets: 1/16 inch thick preformed neoprene gaskets.
- C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.4 GATE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings
- B. 2 inches and Smaller: Class 125 Class 150, bronze body, bronze trim, union bonnet, non-rising stem, , inside screw with back-seating stem, solid split wedge disc, alloy seat rings, solder or threaded ends.
- C. 2-1/2 inches and Larger: Class 125, cast iron body, bronze trim, bolted bonnet, rising non-rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.5 GLOBE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings
- B. 2 inches and Smaller: Class 125 Class 150, bronze body, bronze trim, threaded union bonnet, hand wheel, Buna-N teflon composition disc, solder or threaded ends.
- C. 2-1/2 inches and Larger: Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.6 BALL VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings

- B. 2 inches and Smaller: 400 psi WOG 600 psi WOG, one two piece bronze body, chrome plated brass ball, regular full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle wing or tee handle locking lever handle extended lever handle round handle oval handle with balancing stops.
- C. 2 inches and Smaller: Class 150, bronze, two piece body, chrome plated bronze type 316 stainless steel ball, regular full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle wing or tee handle locking lever handle extended lever handle round handle oval handle with balancing stops.

2.7 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings
- B. 2-1/2 inches and Larger: Class 250.
 - 1. Body: Cast or ductile iron, wafer lug or grooved ends, stainless steel stem, extended neck.
 - 2. Disc: Nickel-plated ductile iron Aluminum bronze Elastomer coated ductile iron Chrome plated ductile iron or stainless steel.
 - 3. Seat: Resilient replaceable EPDM Buna N.
 - 4. Handle and Operator: 10 position lever handle. Hand-wheel and gear drive. Furnish gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.8 CHECK VALVES

- A. Horizontal Swing Check Valves:
 - 1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
 - 2. 2 inches and Smaller: Class 150, bronze body and cap, bronze seat, Buna-N teflon disc, solder or threaded ends.
 - 3. 2-1/2 inches and Larger: Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.
- B. Spring Loaded Check Valves:
 - 1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.

- e. Stockham Valves & Fittings
- 2. 2 inches and Smaller: Class 250, bronze body, in-line spring lift check, silent closing, Buna-N teflon disc, integral seat, solder or threaded ends.
- 3. 2-1/2 inches and Larger: Class 125, wafer globe style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems..

3.2 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install coolant, and engine exhaust piping in accordance with ASME B31.9.
- B. Route piping parallel to building structure and maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls and floors.
- F. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide access where valves and fittings are not exposed.
- I. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- L. Install valves with stems upright or horizontal, not inverted.

3.3 FIELD QUALITY CONTROL

A. Test coolant and heating water piping system in accordance with ASME B31.9 and ASME B31.1.

END OF SECTION

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pressure gages.
- B. Pressure gage taps.
- C. Thermometers.
- D. Thermometer Supports
- E. Test plugs.
- F. Flexible connectors.
- G. Expansion tanks.
- H. Air vents.
- I. Air separators.
- J. Strainers.
- K. Combination pump discharge valves.
- L. Flow controls.
- M. Relief valves.
- N. Glycol solution.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B40.1 Gauges Pressure Indicating Dial Type Elastic Element.
 - 2. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.
- B. ASTM International:
 - 1. ASTM E1 Standard Specification for ASTM Thermometers.
 - 2. ASTM E77 Standard Test Method for Inspection and Verification of Thermometers.
- C. Underwriters Laboratories Inc.:
 - 1. UL 404 Gauges, Indicating Pressure, for Compressed Gas Service.

1.3 SUBMITTALS

- A. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

PART 2 PRODUCTS

- 2.1 PRESSURE GAGES
 - A. Manufacturers:
 - 1. Trevice
 - 2. Weiss
 - 3. Taylor
 - 4. Ametek
 - B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Steel Cast aluminum
 - 2. Bourdon Tube: Phosphor bronze
 - 3. Dial Size: 4-1/2 inch diameter.
 - 4. Mid-Scale Accuracy: One percent.
 - 5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

A. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

- B. Ball Valve: Brass, 1/8 inch NPT for 250 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- D. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Trevice
 - 2. Weiss
 - 3. Taylor
 - 4. Ametek
- B. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
 - 1. Size: 9 inch.
 - 2. Window: Clear glass Lexan.
 - 3. Stem: Brass, 3/4 inch NPT, 3-1/2 inch inch long.
 - 4. Accuracy: ASTM E77 2 percent.
 - 5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

- A. 1/4 inch NPT or 1/2 inch NPT brass stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 - 1. Nordel core for temperatures up to 350 degrees F.
 - 2. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

- 1. Carrying case, internally padded and fitted containing:
 - a. Two 3-1/2 inch diameter pressure gages.
 1) Scale range: to psi Scale range:
 - b. Two gage adapters with 1/8 inch probes.
 - c. Two 1-1/2 inch dial thermometers.
 - 1) Scale range: to degrees F.

2.6 EXPANSION TANKS

- A. Construction: Closed, welded steel, tested and stamped in accordance with ASME Section VIII; cleaned, prime coated, and supplied with steel support saddles; with taps for installation of accessories.
 - 1. Pressure rating: 125 psi.
 - 2. Size: As scheduled on drawings.
- B. Gage Glass Set: Brass compression stops, guard, and 3/4 inch red line glass, maximum 24 inches length, long enough to cover tank for 2 inches above bottom to 2 inches below top.
- C. Quick Connect Air Inlet:
 - 1. Compressed Air: 75 inches of 1/4 inch diameter braided reinforced air hose, air chuck, check valve, and shut-off valve on supply from control air compressor .
 - 2. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.
- D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.
- E. Hot Water Heating System:
 - 1. Select expansion tank pressure relief valve at psi maximum.
 - 2. Set pressure reduction valve at select 12 psi.

2.7 TEST PLUGS

- A. 1/4 inch NPT or 1/2 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 - 1. Neoprene core for temperatures up to 200 degrees F.
 - 2. Nordel core for temperatures up to 350 degrees F.
 - 3. Viton core for temperatures up to 400 degrees F.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Flexonics.
 - 2. Vibration Isolator.
 - 3. Mason.
- B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 300 psig.

2.9 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- B. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.10 AIR SEPARATORS

- A. Manufacturers:
 - 1. ITT Bell & Gossett
 - 2. Armstrong
 - 3. Spirovent
- B. Combination Air Separators/Strainers: Steel, tested and stamped in accordance with ASME Section VIII; for 125 psig operating pressure, with integral bronze galvanized steel strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.11 STRAINERS

- A. Manufacturers:
 - 1. Spirax Sarco.
 - 2. Amtrol.
 - 3. Watts.
 - 4. Armstrong.
- B. Size 2 inch and Smaller:
 - 1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 2-1/2 inch to 4 inch:
 - 1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Size 5 inch and Larger:
 - 1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.12 COMBINATION PUMP DISCHARGE VALVES

A. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.13 FLOW CONTROLS

- A. Manufacturers:
 - 1. ITT Bell & Gossett
 - 2. Tour Anderson
 - 3. Aurora
 - 4. Nexxus

- B. Construction: Brass or bronze body with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain. Calibrated, multi turn, memory stop.
- C. Calibration: Control within 5 percent of design flow over entire operating pressure.
- D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.14 RELIEF VALVES

A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.15 GLYCOL SOLUTION

A. Inhibited propylene glycol and water solution mixed 50 percent glycol - 50 percent water, suitable for operating temperatures from -40degrees F to 325 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

- A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Where thermometers are provided on local panels, pipe mounted thermometers are not required.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs adjacent to thermometers and thermometer sockets adjacent to pressure gages and pressure gage taps adjacent to pressure gages and pressure gage taps adjacent to control device sockets as indicated on Drawings.
- B. Where large air quantities accumulate, provide enlarged air collection standpipes.
- C. Install manual air vents at system high points.
- D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide drain and hose connection with valve on strainer blow down connection.
- G. Support pump fittings with floor mounted pipe and flange supports.
- H. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- I. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- J. Pipe relief valve outlet to nearest floor drain.
- K. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- L. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill at 12 psig. Pressure system cold at 5 psig.

3.3 FIELD QUALITY CONTROL

A. Test for strength of glycol and water solution and submit written test results.

3.4 CLEANING

A. Clean and flush glycol system before adding glycol solution.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. In-line circulators.

1.2 REFERENCES

A. Underwriters Laboratories Inc.:1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

- A. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 IN-LINE CIRCULATORS

- A. Manufacturers:
 - 1. Bell & Gosset.

- 2. Taco.
- 3. Aurora.
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Stamped brass or cast bronze, keyed to shaft.
- E. Bearings: Two, oil lubricated bronze sleeves.
- F. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.
- G. Seal: Carbon rotating against stationary ceramic seat, 240 degrees F maximum continuous operating temperature.
- H. Drive: direct.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. Install pumps on vibration isolators.
- C. Install flexible connectors at or near pumps where piping configuration does not absorb vibration.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized combination pump discharge valve on pump discharge.
- E. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Lubricate pumps before start-up.

END OF SECTION

SECTION 23 24 16

INTERNAL-COMBUSTION ENGINE EXHAUST PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Engine exhaust.
- B. Equipment drains and over flows.
- C. Unions and flanges.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 2. ASTM F1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

1.3 SYSTEM DESCRIPTION

- A. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- B. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- C. Flexible Connectors: Use at or near engine driven equipment where piping configuration does not absorb vibration.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate schematic layout of piping system, including equipment, critical dimensions, and sizes.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Hangers and Supports: Submit manufacturers catalog information including load capacity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 ENGINE EXHAUST

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
 - 1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
 - 2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove scale and dirt on inside and outside before assembly.
- B. Prepare piping connections to equipment with flanges or unions.
- C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Sleeve pipe passing through partitions, walls and floors.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- F. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- G. Insulate piping and equipment.

SECTION 23 25 00

HVAC WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System Cleaner
- B. Closed system treatment (water).
- C. Test Equipment

1.2 SUBMITTALS

- A. Shop Drawing: Indicate system schematic, equipment location, and controls schematics.
- B. Product Data: Submit chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit placement of equipment in systems, piping configuration, and connection requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- B. Operation and Maintenance Data: Submit data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. HOH Chemicals.
- B. Butler Chemical Co.
- C. Nalco Chemical Co.

2.2 SYSTEM CLEANER

A. Product Description: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tri-Poly phosphate and sodium molybdate.

Clark Dietz, Inc. 00130014

B. Biocide; chlorine release agents including sodium hypochlorite or calcium hypochlorite, or microbiocides including quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

2.3 CLOSED SYSTEM TREATMENT (WATER)

- A. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
- B. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulfites.
- C. Conductivity enhancers; phosphates or phosphonates.

2.4 CHEMICAL FILTERING TYPE POT FEEDER

- A. 1.8 gal quick opening cap for working pressure of 175 psig.
- B. Filtering pot shall include replaceable bag type filters and sized to filter the system volume once every 4 hours.

2.5 TEST EQUIPMENT

- A. Furnish white enamel test cabinet with local and fluorescent light, capable of accommodating 4 10 ml zeroing titration burettes and associated reagents.
- B. Furnish following test kits:
 - 1. Alkalinity titration test kit.
 - 2. Chloride titration test kit.
 - 3. Sulphite titration test kit.
 - 4. Total hardness titration test kit.
 - 5. Low phosphate test kit.
 - 6. Conductivity bridge, range 0 10,000 micro-ohms.
 - 7. Creosol red pH slide, complete with reagent.
 - 8. Portable electronic conductivity meter.
 - 9. High nitrite test kit.

PART 3 EXECUTION

3.1 PREPARATION

A. Operate, fill, start and vent systems prior to cleaning. Use temporary water meter to record capacity in each system. Place terminal control valves in open position during cleaning.

3.2 CLEANING

- A. Concentration:
 - 1. As recommended by manufacturer.
 - 2. One pound per 100 gallons of water contained in the system.

- 3. One pound per 100 gallons of water for hot systems and one pound per 50 gallons of water for cold systems.
- 4. Fill steam boilers only with cleaner and water.
- B. Hot Water Heating Systems:
 - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
 - 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
 - 3. Circulate for 6 hours at design temperatures, then drain.
 - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Use neutralizer agents on recommendation of system cleaner supplier and acceptance of Architect/Engineer.
- D. Remove, clean, and replace strainer screens.
- E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and interconnecting piping. Install around balancing valve downstream of circulating pumps as indicated on Drawings.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.
- C. Install ³/₄ inch water coupon rack around circulating pumps with space for (4) 12 test specimens.

3.4 DEMONSTRATION

A. Furnish two hour training course for operating personnel, instruction to include installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct Materials.
- B. Ductwork fabrication.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A90/A90M Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 2. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A36/A36M Standard Specification For Carbon Structural Steel
- B. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Air Duct Leakage Test Manual.
 - 2. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- D. Underwriters Laboratories Inc.:
 - 1. UL 181 Factory-Made Air Ducts and Connectors.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA HVAC Duct Construction Standards Metal and flexible.
- B. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealant.

PART 2 PRODUCTS

2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 (zinc coating of in conformance with ASTM A90/A90M.
- B. Fasteners: Rivets, bolts, or sheet metal screws.
- C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.
 - 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Back-draft dampers.
- B. Duct access doors.
- C. Volume control dampers.
- D. Control air dampers.
- E. Actuators.
- F. Flexible duct connections.
- G. Duct test holes.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers duct access doors and duct test holes.
- B. Product Data: Submit data for shop fabricated assemblies and hardware used.
- C. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 - 1. Backdraft dampers.
 - 2. Flexible duct connections.
 - 3. Volume control dampers.
 - 4. Control air dampers.
 - 5. Actuators.

- 6. Duct access doors.
- 7. Duct test holes.

1.4 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Protect dampers from damage to operating linkages and blades.
 - B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
 - C. Storage: Store materials in a dry area indoor, protected from damage.
 - D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 BACK-DRAFT DAMPERS

A. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6 inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, and as indicated on Drawings.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.3 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
 - 2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
 - 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw;
 - 4. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch. 12 x 48 inch. .
- C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.
- D. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg;
- E. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.

2.4 CONTROL AIR DAMPERS

A. Dampers:

- 1. Performance: Test leakage and pressure drop per AMCA 500.
- 2. Opposed style modulation blades are to be used for volume and pressure control for fresh air, return air and relief air control. Parallel blade style of construction can be used for exhaust air applications. Actuators and pilot-positioners shall be mounted out of the air stream.
- 3. Bearings, bearing pins (axles), jamb seals or side seals, and damper linkages shall use stainless steel. The damper blade drive shaft shall be zinc plated.
- 4. Leakage rates shall not exceed 7 cfm per sq. ft. at 1-inch w.c. and shall not exceed 15 cfm at 4 in w.c. for applications using entering air temperature that can fall below 55 degrees F db but not below 40 degrees F db.
- 5. Ultra Low Leakage Dampers shall be required for applications using an entering air temperature that can fall below 40 F. Leakage rates for these dampers shall not exceed 3 cfm per sq. ft. at 1-inch w.c. and shall not exceed 7 cfm at 4 in w.c.
- 6. Maximum individual blade height shall be 8 inches.
- 7. All damper blades and drive components shall use 16 gage or heavier galvanized steel unless specified otherwise. Each damper frame shall use 12 gage or heavier galvanized steel. Use multiple damper motors for multiple damper installations, jackshafts are not allowed. Note: Damper linkage is to be exposed in the air stream for maintenance purpose.

- 8. A maximum damper area of 16-sq. ft. should be design criteria for each damper actuator. Individual blade length is to be limited to 48 inches.
- 9. Seals: Mechanically attached blade edge seals. Blade edge seals shall be extruded vinyl for standard temperature applications, silicon for high temperature applications (e.g. steam coil face and bypass dampers). Stainless steel jamb seals.
- 10. Linkage: Located exposed in the airstream. All linkage to be stainless steel.
- 11. Axles: Stainless steel. Extended through damper frame as required for operator (unless noted otherwise).
- 12. Modulating control dampers shall be sized to provide appropriate damper authority. Opposed blade dampers shall be selected to achieve a damper authority of 10-15%. Parallel blade dampers shall be selected to achieve a damper authority of 30-50%. They should not necessarily be duct size.
- 13. Maximum air velocity: Dampers shall be selected such that air velocity through the damper shall not exceed 2/3 of the manufacturers published maximum for the make and module used.

2.5 ACTUATORS

- A. General:
 - 1. All equipment shall use actuation as indicated on dampers.
 - 2. Actuators shall be large enough to provide smooth modulating operation and shall have sufficient torque to operate dampers under all normal conditions of operation.
 - 3. Provide "spring return" type motors on outside air dampers.
 - 4. Actuators shall be rigidly mounted out of the airstream and located such that ambient temperatures exceed the control air dewpoint temperature.
 - 5. Where controlled damper area exceeds 20 square feet, provide one actuator for each 20 square feet of damper area or portion thereof.
- B. Control Dampers:
 - 1. Operation: Reversing type proportional motor, spring-return.
 - 2. Enclosure Rating: NEMA 250 Type 1.
 - 3. Mounting: Direct mount.
 - 4. Stroke: 90 seconds end to end full stroke, 15 seconds return to normal for spring return.
 - 5. Protection: Electronic stall protection.
 - 6. Power: Nominal 120 volt AC.
 - 7. Torque: Size for minimum 150 percent of required duty.
 - 8. Duty cycle: rated for 65,000 cycles.

2.6 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, and as indicated on Drawings.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately 2 3 6 inches wide.
 - 3. Metal: 3 inch wide, 24 gage galvanized steel .

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs. per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.7 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment installations are ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards Metal and Flexible.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on Drawings.
- C. Access Doors: Install access doors at the following locations and as indicated on Drawings:
 - 1. Spaced every 50 feet of straight duct.
 - 2. Upstream of each elbow.
 - 3. Before and after each duct mounted fan.
 - 4. Before and after each automatic control damper.
- D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- E. Install temporary duct test holes where indicated on Drawings and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

3.2 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use double nuts and lock washers on threaded rod supports.

3.3 INTERFACE WITH OTHER PRODUCTS

Install openings in ductwork where required to accommodate thermometers and controllers. Install pilot tube openings for testing of systems. Install pilot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

SECTION 23 34 00

HVAC FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Axial fans.
- B. Centrifugal roof fans.
- C. Roof Ventilators.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 204 Balance Quality and Vibration Levels for Fans.
 - 2. AMCA 210 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 3. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. Underwriters Laboratories Inc.:
 - 1. UL 705 Power Ventilators.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- B. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

PART 2 PRODUCTS

2.1 AXIAL FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. Penn Ventilation

B. Product Requirements:

- 1. Performance Base: Sea level conditions.
- 2. Temperature Limit: Maximum 300 degrees F 600 degrees F degrees F.
- C. Hub and Impeller:
 - 1. Airfoil Impeller Blades: Adjustable die cast aluminum alloy or glass reinforced polyester resin or welded steel die formed blades with belt drive.
 - 2. Hub: Die cast aluminum alloy or cast iron hub or with belt drive of spun, welded steel, bored and keyed to shaft; to facilitate indexing of blade angle with manual automatic adjustment stops.
 - 3. Controllable Pitch Assemblies: Incorporate ball bearing counterbalanced blade and variable pitch assembly into hub with mechanical link to casing exterior mounted actuator, or pneumatic or electric actuator incorporated within hub.
 - 4. Cast Components: X-ray components after fabrication and statically and dynamically balance assembly before attachment to motor or shaft.
- D. Casing:
 - 1. Fabricate casing of 1/4 inch inch steel for fans 40 inch 50 inch inch in diameter and smaller and 3/8 inch inch steel for larger fans.
 - 2. Continuously weld, with inlet and outlet flange connections, and motor or shaft supports. Incorporate flow straightening guide vanes for fans specified for static pressures greater than one inch wg 1.5 inch wg 2 inches wg inches wg.
 - 3. Finish with one coat enamel applied to interior and exterior by hot dip galvanizing finished assembly.

- E. Bearings and Drives:
 - 1. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 11, L-10 life at 120,000 hours.
 - 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.
 - 3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
 - 4. Belt Guard: Fabricate to SMACNA Standards; 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 5. Lubrication: Extend lubrication fittings to outside of casing.
- F. Accessories:
 - 1. Guide Vanes: Welded steel construction with airfoil vanes and casing flanges, finished to match casing.
 - 2. Inlet Bell: Bell mouth inlet fabricated of steel with flange.
 - 3. Outlet Cones: Fabricated of steel with flanges, outlet area/inlet area ratio of 1.5/1.0, with center pod as recommended by manufacturer.
 - 4. Access Doors: Shaped to conform to casing with quick opening latches and gaskets.

2.2 CENTRIFUGAL ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. Penn Ventilation
- B. Fan Unit: Downblast or Upblast type. V-belt direct drive, with spun aluminum galvanized steel with baked-on enamel fiberglass reinforced plastic housing; resilient mounted motor; aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.
- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at midposition; fan shaft with self-aligning pre-lubricated ball bearings.
- D. Motor: Open drip proof Roof Curb: 12 inch high self-flashing of galvanized steel aluminum construction with continuously welded seams, built-in cant strips, 1 inch insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, ventilated double wall, hinged curb adapter, and factory installed nailer strip.
- E. Accessories:
 - 1. Gravity Damper: Aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, spring return .

2.3 GRAVITY ROOF VENTILATORS – ROUND OR SQUARE

A. Manufacturers:

- 1. Greenheck Corp.
- 2. Loren Cook Company.
- 3. Carnes.
- B. Product Description: Round type, with aluminum housing; aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 12 inch high of galvanized steel construction with continuously welded seams, built-in cant strips, 1 inch insulation and curb bottom, and factory installed nailer strip.
- D. Performance: As scheduled on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed and dimensions are as shown on shop drawings instructed by manufacturer.

3.2 INSTALLATION

- A. Secure roof wall fans and gravity ventilators with cadmium plated steel aluminum stainless steel lag screws to roof curb structure.
- B. Install safety screen where inlet or outlet is exposed.
- C. Pipe scroll drains to nearest floor drain.
- D. Install backdraft dampers on discharge of exhaust fans and as indicated on Drawings. Provide sheaves required for final air balance.

3.3 PROTECTION OF FINISHED WORK

A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Louvers.
 - B. Grilles

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 70 Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:1. SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.3 SUBMITTALS

- A. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- B. Test Reports: Rating of air outlet and inlet performance.

1.4 QUALITY ASSURANCE

A. Test and rate louver performance in accordance with AMCA 500.

PART 2 PRODUCTS

2.1 CEILING SUPPLY REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Anemostat Air Products.
 - 2. Krueger.
 - 3. Price.
 - 4. Titus.
- B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection. Module size shall be 24 inch by 24 inch.

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- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket. In plaster ceilings, furnish plaster frame and ceiling frame.
- D. Fabrication: Aluminum extrusions with factory finish.
- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.2 LOUVERS

- A. Manufacturers:
 - 1. Greenheck Corp.
 - 2. Ruskin Manufacturing
 - 3. Vent Products
 - 4. American Warming and Ventilators
- B. Product Description: Stationary Drainable.
- C. Type: 6 inch deep with blades on 35 degree slope, heavy channel frame.
- D. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory anodized finish color to be selected by Architect.
- E. Mounting: Furnish with interior exterior flat flange angle flange screw holes in jambs masonry strap anchors for installation.
- F. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, removable from outside of louver in frame to match louver color.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Verify ceiling wall systems are ready for installation.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

SECTION 23 52 36

FLEXIBLE WATER-TUBE BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible water-tube boilers.
- B. Boiler controls.
- C. Hot water boiler trim.
- D. Natural gas fired burner.

1.2 REFERENCES

- A. American National Standards Institute:
 1. ANSI Z21.13 Gas-fired Low Pressure Steam and Hot Water Boilers.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. American Society of Mechanical Engineers:
 - 1. ASME Section I Boiler and Pressure Vessel Code Power Boilers.
 - 2. ASME Section IV Boiler and Pressure Vessel Code Heating Boilers.
- D. Hydronics Institute:
 - 1. H.I. Heating Boiler Standard Testing and Rating Standard for Heating Boilers.
- E. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. National Fire Protection Association:
 - 1. NFPA 31 Standard for the Installation of Oil-Burning Equipment.
 - 2. NFPA 54 National Fuel Gas Code.
 - 3. NFPA 58 Liquefied Petroleum Gas Code.
- G. Underwriters Laboratories Inc.:
 - 1. UL 726 Oil-Fired Boiler Assemblies.

1.3 SUBMITTALS

A. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, steam, fuel, electric and vent connections, electrical

characteristics, weight and mounting loads. Provide project specific wiring diagrams showing interface of all remote devices and interface to temperature control panel.

- B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- C. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.5 QUALITY ASSURANCE

- A. Conform to ASME Section I Section IV and ANSI Z21.13 Code UL 726 for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.
- B. Boiler Performance Requirements: Conform to minimum efficiency prescribed by ASHRAE 90.1 when tested in accordance with H.I. Heating Boiler Standard.
- C. Gas Train and Safety Controls: Conform to requirements of Factory Mutual (FM) Industrial Risk Insurers (IRI).
- D. Unit Certification: AGA ETL UL certified.
- E. Conform to applicable code for internal wiring of factory wired equipment.
- F. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept boilers and accessories on site in factory shipping packaging. Inspect for damage.
- B. Protect boilers from damage by leaving packing in place until installation.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 SYSTEM DESCRIPTION

A. Boiler Design: The basis of design is the Bryan Boilers gas fired boiler as specified in the Boiler Schedule – Gas Fired. Other listed manufacturer's boiler must be equivalent and meet the same equipment standards pertaining to specifications, performance, and fit in the designated space shown on the drawings with proper working space clearances as required.

PART 2 PRODUCTS

2.1 FLEXIBLE WATER-TUBE BOILERS

- A. Manufacturers:
 - 1. Bryan Steam Corporation
 - 2. Cleaver-Brooks
 - 3. International Boiler Works
 - 4. Universal Boiler Works, Inc.
- B. Product Description: Factory assembled and tested, packaged type boiler. Factory mounted on steel base frame, complete with integral forced atmospheric draft burner, burner controls, boiler trim, and refractory. Factory assemble and wire boilers so only piping, fuel, electrical, and vent connections are required. Provide 5 square feet of heating surface per rated boiler horsepower.
- C. Working Pressure: Water boiler designed, constructed, and hydrostatically tested according to ASME Section IV Section I, and contain ASME stamp for maximum working pressures up to 150 psig at 250 degree F
- D. Construction: Shell constructed with welded steel boiler plate with steel drums, water legs, and tube headers. Water tubes constructed of 1 inch, steel of serpentine bend design not subject to thermal shock. Individual water tubes removable and replaceable without welding or rolling. Tube access from exterior of boiler. Furnish with tappings and inspection openings to allow for internal boiler inspection and cleaning. Furnish steam drum minimum of 24 inches in diameter with internals designed to produce steam quality in excess of 99 percent.
- E. Jacket: Factory painted steel jacket mounted over structural steel frame. Each jacket panel and access door individually removable.
- F. Insulation: Sides and top covered with minimum 1-1/2 inch glass fiber insulation. Interior walls lined with high temperature insulation. Floor beneath tubes lined with insulating refractory and mineral fiber backup insulation.
- G. Gas Burner: Integral part of boiler. Constructed of tubular alloy steel. Atmospheric type for operation with atmospheric draft requiring no motor or blower. Electric ignition gas pilots.
- H. Burner Controls: Furnish boiler complete with the following:
 - 1. Capacity control: on-off operation two stage, low fire start high fire run modulating.
 - 2. Automatic gas valve operator.
 - 3. Auxiliary safety shutoff valve.
 - 4. Pilot solenoid valve.
 - 5. Pilot ignition assembly.
 - 6. Pilot ignition transformer.
 - 7. Pilot gas shutoff valves.
 - 8. Main gas shutoff valves.
 - 9. Pilot gas pressure regulators.
 - 10. Main gas pressure regulators.
 - 11. Main manual gas shutoff valve.
 - 12. Air flow (air safety) switch.

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- 13. Electronic combustion safety control with UV sensor.
- 14. Auxiliary safety gas shutoff valves.
- 15. Electronic pilot safety control.
- 16. 100 percent gas pilot safety shutoff.
- 17. Draft diverter or barometric draft control.
- I. Hot Water Boiler Trim: Factory piped and wired according to ASME Code and UL requirements. Furnish boiler complete with the following:
 - 1. Control Panel: NEMA 250 Type 1 enclosure, mounted on boiler with hinged metal door.
 - 2. ASME safety relief valve.
 - 3. Combination thermometer and pressure gauge.
 - 4. Water temperature control operator.
 - 5. High limit safety control.
 - 6. Low water cut-off.
 - 7. Manual reset type high limit.
 - 8. Manual reset low water cutoff.
 - 9. Auxiliary low water cutoff.
 - 10. Alarm bell or horn.
 - 11. Lead-lag system of control for two or more boilers.
 - 12. Indicator lights as follows.
 - 13. 120 volt control transformer mounted in control panel.
 - 14. Motor starter.
 - 15. Indirect water heating coil (tankless water heater).
 - 16. Electric heating in addition to fossil fuel burners.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install boilers plumb and level, to plus or minus 1/16 inch over boiler base.
- B. Maintain manufacturer's recommended clearances around and over boilers.
- C. Install boiler on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than boiler base on each side.
- D. Connect natural gas piping in accordance with NFPA 54.
- E. Connect natural gas piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances for burner removal and service.
- F. Connect hot water piping to supply and return boiler connections.
- G. Install the following piping accessories.
 - 1. On supply:
 - a. Thermometer well for temperature controller.
 - b. Thermometer well and thermometer.
 - c. Well for control system temperature sensor.

- d. Strainer.
- e. Nipple and flow switch.
- f. Pressure gage.
- g. Shutoff valve.
- 2. On return:
 - a. Thermometer well and thermometer.
 - b. Well for control system temperature sensor.
 - c. Pressure gage.
 - d. Shutoff valve.
 - e. Balancing valve.
- H. Install the following piping accessories on natural gas piping connections. Strainer.
 - 1. Pressure gage.
 - 2. Shutoff valve.
 - 3. Check valve.
 - 4. Pressure reducing valve.
- I. Install discharge piping from relief valves and drain valves to nearest floor drain.
- J. Install boiler trim and accessories furnished loose for field mounting.
- K. Install electrical devices furnished loose for field mounting.
- L. Install control wiring between boiler control panel and field mounted control devices.
- M. Connect flue to boiler outlet, full size of outlet.

3.2 FIELD QUALITY CONTROL

- A. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.
- B. Arrange with local authorities having jurisdiction for inspection of boiler, piping, and for certificate of operation.

3.3 MANUFACTURER'S FIELD SERVICES

A. Start-up boilers according to manufacturer's start-up instructions and in presence of boiler manufacturer's representative. Test controls and demonstrate compliance with requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

3.4 CLEANING

A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's startup instructions.

3.5 DEMONSTRATION

- A. Demonstrate operation and maintenance procedures.
- B. Furnish services for manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

SECTION 23 55 00

FUEL-FIRED HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gas fired unit heaters.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z83.8 Gas Unit Heaters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. National Fire Protection Association:
 - 1. NFPA 54 National Fuel Gas Code.
 - 2. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 3. NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
 - 4. NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.
- B. Product Data: Submit manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Manufacturer's Installation Instructions: Submit Indicate rigging and assembly.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.5 QUALITY ASSURANCE

A. Gas-Fired Unit Heater Performance Requirements: Conform to minimum efficiency prescribed by ASHRAE 90.1 when tested in accordance with ANSI Z83.8.

1.6 WARRANTY

A. Furnish five year manufacturer warranty for heat exchanger.

PART 2 PRODUCTS

2.1 GAS FIRED UNIT HEATERS

A. Manufacturers:

- 1. Reznor
- 2. Sterling
- 3. Modine
- B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:
 - 1. Heating fuel: Natural gas fired .
 - 2. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
 - 3. Air Filters: Filter cabinet with 1 inch 2 inch thick polyurethane, washable glass fiber, disposable type filters.
 - 4. Gas Control: Single stage
 - 5. Ignition System: Electric direct ignition.
 - 6. Control Voltage: 115 volt, 60 hertz.
 - 7. Location: Suspended overhead.
 - 8. Separated Combustion
- C. Cabinet: Galvanized steel, easily removed and secured access panels, insulated or double panel construction.
- D. Supply Fan: Propeller with direct belt drive.
- E. Heat Exchanger: 409 Stainless steel heat exchanger. 4 pass serpentine style steel, no welding or brazing.
- F. Gas Burner: One piece burner assembly with singe orifice. Power-vented with non-corrosive air blower with permanently lubricated motor.
- G. Gas Burner Safety Controls:
 - 1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - 2. Flame rollout switch: Installed on burner box and prevents operation.
 - 3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 - 4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic reset.

H. Controls:

- 1. Room Thermostat: Adjustable, low voltage, to control burner operation, heater stages in sequence with delay between stages, and supply fan to maintain temperature setting. Include system selector switch (heat-off-cool) and fan control switch (auto-on).
- I. Performance: As shown on the drawings

SECTION 26 05 03

EQUIPMENT WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 General Requirements for Wiring Devices.
 - 2. NEMA WD 6 Wiring Devices-Dimensional Requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures.
- B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.4 COORDINATION

- A. Section 01 30 00 Project Coordination.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.1 CORD AND PLUGS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.
- C. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations. Maximum length shall be 3'-0" for motors, control devices, and appliances. Maximum length shall be 6'-0" for lighting fixtures (use only between a junction box and fixture).
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install cord and cap for field-supplied attachment plug.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

- A. Section 01 40 00 Testing, adjusting, and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

3.5 EQUIPMENT CONNECTION SCHEDULE

A. Provide electrical connection to equipment as indicated in the Equipment Connection Schedule on the drawings.

SECTION 26 05 13

MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Medium voltage cable.
- B. Cable terminations.
- C. Fireproofing tape.
- D. Underground cable markers.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for cable, terminations, and accessories.
- C. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual sizes and locations of cables.
- C. Operation and Maintenance Data: Submit instructions for testing and cleaning cable and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect cable ends from entrance of moisture.

PART 2 PRODUCTS

2.1 MEDIUM VOLTAGE CABLE

- A. Manufacturers:
 - 1. The Okonite Company.
 - 2. The Kerite Company.
 - 3. Pirelli Cable Corporation.
 - 4. Rome Cable Corporation
- B. Voltage: 5 and 25 KV.
- C. Insulation Level: 133 percent of operating voltage.
- D. Cable Continuous Operating Temperature Rating: MV-90.
- E. Configuration: Single conductor for 5 KV cables; single conductor with concentric neutral for 25 KV cables.
- F. Size: As indicated on the drawings.
- G. Conductor Material: Copper.
- H. Conductor Construction: Compact stranded.
- I. Conductor Shield: Semiconducting tape.
- J. Non-Armor Jacket: EPR insulation with red extruded identification stripe.

2.2 CABLE TERMINATIONS

- A. Manufacturers:
 - 1. 3M Electrical Products Division.
 - 2. Elastimold.
 - 3. Blackburn.
- B. Product Description: Cable terminations shall be stress cone type and have voltage ratings not less than 5 KV or 25 KV for associated cables. Properly size all terminations for the type of cable used.

2.3 FIREPROOFING TAPE

- A. Manufacturers:
 - 1. 3M Electrical Products Division.
 - 2. Plymouth Rubber Co., Bishop Division
- B. Product Description: Flexible, conformable fabric, coated on one side with flame retardant, flexible polymeric or chlorinated elastomer. Non-corrosive to and compatible with cable sheaths jackets. Does not support combustion.

Clark Dietz, Inc. 00130014

- C. Width: Approximately 3 inches.
- D. Thickness: Not less than 0.03 inch.
- E. Weight: Not less than 2.5 pounds per square yard.

2.4 UNDERGROUND CABLE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- B. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Medium Voltage Cable" in large letters.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.
- C. Verify conduit, duct, trench, and manholes are ready to receive cable.
- D. Verify routing and termination locations of cable prior to rough-in.

3.2 PREPARATION

A. Use swab to clean conduits and ducts before pulling cables.

3.3 EXISTING WORK

- A. Remove abandoned medium-voltage cable.
- B. Maintain access to existing medium-voltage cable and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Extend existing medium-voltage cable installations using materials and methods compatible with existing electrical installations, or as specified.
- D. Clean and repair existing medium-voltage cable to remain or to be reinstalled.

3.4 INSTALLATION

- A. Avoid abrasion and other damage to cables during installation.
- B. Use suitable manufacturer approved lubricants and pulling equipment.

- C. Sustain cable pulling tensions and bending radii below manufacturer's recommended limits.
- D. Ground cable shield at each termination and splice.
- E. Install cables in manholes along wall providing longest route and secure with plastic tie wraps.
- F. Arrange cable in manholes to avoid interference with duct entrances.
- G. Provide a number 12 TW copper pull wire in each spare or empty duct.

3.5 FIREPROOFING

- A. Apply fireproofing tape to cables when installed in manholes, pull boxes, or other enclosures.
- B. Smooth out irregularities, at splices or other locations, with insulation putty before applying fireproofing tape.
- C. Apply fireproofing tape tightly around cables spirally in half-lapped wrapping or in butt jointed wrapping with second wrapping covering joints first.
- D. Extend fireproofing 1 inch into conduit or duct.
- E. Install tape with coated side toward cable.
- F. Install random wrappings of plastic tape around fireproofing tape to prevent unraveling.
- G. Install fireproofing to withstand a 200 Ampere arc for 30 seconds.

3.6 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect exposed cable sections for physical damage.
- C. Inspect cable for proper connections.
- D. Inspect shield grounding, cable supports, and terminations for proper installation.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.3.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 Execution and Closeout Requirements: Protecting installed construction.
- B. Protect installed cables from entrance of moisture.

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. All conductors shall be stranded, except for drops to outlets and switches which may be solid.
 - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductor not smaller than 14 AWG for control circuits.
 - 4. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Branch Circuits: Use only building wire, Type THHN/THWN insulation, in raceway.
 - 2. Feeders: Use only building wire, Type THHN/THWN insulation, in raceway.
 - 3. Cable Tray Locations: Use only Tray cable Type TC.
 - 4. Service Entrance: Use only building wire, Type THWN or XHHN insulation, in raceway.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures.
- B. Product Data: Submit for building wire.
- C. Test Reports: Indicate procedures and values obtained.
1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 Closeout Procedures.
- B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

A. Provide wires, cables, connectors and splices that are UL listed and labeled.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.

2.2 UNSHIELDED CABLE

- A. Manufacturers:
 - 1. Belden.
 - 2. Approved equal.
- B. Product Description: TIA/EIA 568, 100-ohm, unshielded twisted pair with pairs and size of copper conductor as indicated and as recommended by equipment manufacturer.

2.3 SHIELDED CABLE

- A. Manufacturers:
 - 1. Belden.
 - 2. Approved equal.
- B. Product Description: TIA/EIA 568, 150-ohm shielded, twisted-pair cable with pairs and size of copper conductor as indicated and as recommended by equipment manufacturer.

2.4 WIRING CONNECTORS

A. Factory fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated.

B. High pressure crimp connectors shall be used for #6 AWG and larger conductors. Connectors shall be color keyed with insulating sealing collars. Split bolt type connectors will not be acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Run all wire in conduit, unless otherwise indicated in the Contract Documents.
 - 1. All analog wiring must be installed in a separate conduit system.
 - 2. All control wiring must be installed in a separate conduit system.
 - 3. All power and lighting wiring must be installed in a separate conduit system.
- D. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

- E. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- F. Special Techniques Cable:
 - 1. Protect exposed cable from damage.
 - 2. Use suitable cable fittings and connectors.
- G. Special Techniques Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install high pressure crimp connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

3.5 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rod electrodes.
- B. Wire.
- C. Mechanical connectors.
- D. Exothermic connections.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Existing building ground system.
 - 2. Existing water piping.

1.4 PERFORMANCE REQUIREMENTS

- A. Maximum grounding to resistance values are as follows:
 - 1. Equipment rated 500 kVA and less: 10 ohms.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures.
- B. Test Reports: Indicate overall resistance to ground and resistance at existing equipment where power is derived from for new equipment.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- 1.7 QUALITY ASSURANCE
 - A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- 1.8 DELIVERY, STORAGE, AND HANDLING
 - A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
 - B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
 - C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Product Description:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet.
- B. Connector: Connector for exothermic welded connection.
- 2.2 WIRE
 - A. Material: Stranded copper.
 - B. Grounding Electrode Conductor: Copper conductor bare.
 - C. Bonding Conductor: Copper conductor bare.
- 2.3 MECHANICAL CONNECTORS
 - A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

A. Extend existing grounding system using materials and methods as specified.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142 and 1100.
- B. Install grounding and bonding conductors concealed from view.
- C. Use exothermic-welded connections for connections to structural steel and for underground connections.
- D. Ground metal poles supporting outdoor lighting fixtures to a grounding electrode in addition to separate equipment grounding conductor run with supply branch circuit.
- E. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- F. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- G. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- H. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by

means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

I. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground resistance testing in accordance with IEEE 142.
- E. Perform leakage current tests in accordance with NFPA 99.
- F. Perform continuity testing in accordance with IEEE 142.
- G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit supports.
- B. Formed steel channel.
- C. Spring steel clips.
- D. Sleeves.
- E. Mechanical sleeve seals.
- F. Firestopping relating to electrical work.
- G. Firestopping accessories.
- H. Equipment bases and supports.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Surface Burning: ASTM E84, UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.6 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

- 2.1 CONDUIT SUPPORTS
 - A. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
 - B. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
 - C. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
 - D. Conduit clamps general purpose: One hole malleable iron for surface mounted conduits.
 - E. Cable Ties: High strength nylon temperature rated to 185 degrees F. self locking.

2.2 FORMED STEEL CHANNEL

A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

- A. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- B. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- C. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

- 1. Furnish UL listed products or products tested by independent testing laboratory.
- 2. Select products with rating not less than rating of wall or floor being penetrated.
- D. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify openings are ready to receive sleeves.
 - B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

- 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
 - 4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:

1.

- Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- 2. Where cable tray, bus, cable bus, conduit, wireway, or trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Division 3.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing or fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 01 70 00 Closeout Procedures: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Closeout Procedures: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and tubing.
- B. Surface raceways.
- C. Wireways.
- D. Outlet boxes.
- E. Pull and junction boxes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc Coated.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 5. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 6. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground: Provide type as indicated on Drawings. Provide cast metal boxes or nonmetallic handhole.
- C. In or Under Slab on Grade: Provide thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.

- D. Outdoor Locations, Above Grade: Provide rigid steel. Provide cast metal outlet, pull, and junction boxes.
- E. In Slab Above Grade: Provide thickwall nonmetallic conduit. Provide cast sheet metal boxes.
- F. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- G. Concealed Dry Locations: Provide electrical metallic tubing, unless otherwise indicated on Drawings. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- H. Exposed Dry Locations: Provide rigid steel conduit, unless otherwise indicated on Drawings. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch, except for switch legs which may be ½ inch or unless otherwise specified.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures.
- B. Product Data: Submit for the following:
 - 1. Conduit and Tubing.
 - 2. Surface raceway.
 - 3. Wireway.
 - 4. Pull and junction boxes.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch.
 - 2. Record actual locations and mounting heights of pull and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

- 2.1 METAL CONDUIT
 - A. Rigid Steel Conduit: ANSI C80.1.
 - B. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit..
- 2.2 PVC COATED METAL CONDUIT
 - A. Product Description: NEMA RN 1; rigid steel conduit with external and internal PVC coating, 40 mil thick.
 - B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external and internal PVC coating to match conduit.
- 2.3 FLEXIBLE METAL CONDUIT
 - A. Product Description: Interlocked steel construction.
 - B. Fittings: NEMA FB 1.
- 2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
 - A. Product Description: Interlocked steel construction with PVC jacket.
 - B. Fittings: NEMA FB 1.
- 2.5 ELECTRICAL METALLIC TUBING (EMT)
 - A. Product Description: ANSI C80.3; galvanized tubing.
 - B. Fittings and Conduit Bodies: NEMA FB 1; steel, compression type.

2.6 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 or 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.
- 2.7 SURFACE METAL RACEWAY
 - A. Manufacturers:

- 1. Monosystems.
- 2. Thomas & Betts Corp.
- 3. Walker Systems Inc.
- 4. The Wiremold Co.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Two Cell Raceway: Two cell raceways shall be galvanized steel, two compartment with removable snap-on cover. Raceway shall be 1 ³/₄" x 4 ³/₄" in size with length as required unless otherwise indicated.
- D. Finish: white enamel, unless otherwise indicated.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.8 WIREWAY

- A. Manufacturers:
 - 1. Monosystems.
 - 2. Thomas & Betts Corp.
 - 3. Hoffman.
- B. Product Description: General purpose type wireway, unless otherwise indicated on Drawings.
- C. Size: size and length as indicated on Drawings.
- D. Cover: Screw cover with full gaskets.
- E. Finish: Rust inhibiting primer coating with gray enamel finish.

2.9 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- C. Wall Plates for Finished Areas: Gasketed cover with stainless steel screws.
- D. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.10 PULL AND JUNCTION BOXES

A. Manufacturers:

- 1. Hoffman.
- 2. Thomas & Betts Corp.
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: As specified in Section 26 27 16.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type as indicated on drawings; flatflanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to roughin.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 1 inch. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings or specified in section for outlet device.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.

- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with contract documents.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

- A. Section 01 40 00 Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Section 01 70 00 Closeout Procedures: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Labels.
- C. Wire markers.
- D. Conduit markers.
- E. Underground Warning Tape.

1.2 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01 60 00 Common Product Requirements: Requirements for transporting, handling, storing, and protecting products.
 - B. Accept identification products on site in original containers. Inspect for damage.
 - C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
 - D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Common Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.5 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white background color.
- B. Letter Size: ¹/₄ inch high letters for identifying equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch.

1.6 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch black letters on white background.

1.7 WIRE MARKERS

- A. Description: Cloth tape type wire markers.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on shop drawings.

1.8 CONDUIT AND RACEWAY MARKERS

- A. Description: Nameplate and labels fastened with adhesive.
- B. Color: Black lettering on white background

1.9 UNDERGROUND WARNING TAPE

A. Description: 4 inch wide plastic tape, detectable type, colored red or yellow with suitable warning legend describing buried electrical lines.

PART 2 EXECUTION

- 2.1 PREPARATION
 - A. Degrease and clean surfaces to receive adhesive for identification materials.

2.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.

- 4. Secure nameplate to equipment front using screws and adhesive.
- 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
- 6. Install nameplates for the following:
 - a. Panelboards.
 - b. Transformers.
 - c. Disconnect switches.
 - d. Motor control centers all spaces and main.
 - e. Variable frequency drives and soft start controllers.
 - f. Control panels as noted for exterior and interior.
- C. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations.
 - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
 - 1. Install wire marker for each conductor at panelboard gutters, pull boxes, junction boxes and each load connection.
 - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 - 3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.
- E. Conduit Marker Installation:
 - 1. Install conduit marker for each conduit by junction box, pull box, equipment, and where conduit penetrates building walls. Coordinate label descriptions with Engineer.
- F. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

SECTION 26 12 00

MEDIUM-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDED

A. Liquid-filled pad-mounted distribution transformers.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling, storing, and protecting products.

PART 2 PRODUCTS

- 2.1 LIQUID-FILLED TRANSFORMERS
 - A. Transformer will be furnished by the Owner, installed by the Contractor.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
 - B. Verify pads and supports are suitable for installation.

3.2 EXISTING WORK

A. Disconnect and remove abandoned pad-mounted transformers. Remove all abandoned conduit to below grade.

3.3 INSTALLATION

- A. Install plumb and level on concrete pad.
- B. Install safety labels in accordance with NEMA 260.
- C. Install engraved plastic nameplates in accordance with Section 26 05 53.

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D. Ground and bond in accordance with Section 26 05 26.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

3.5 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Adjust primary taps so secondary voltage is within 2 percent of rated voltage.

SECTION 26 13 14

MEDIUM-VOLTAGE TRANSFER SWITCHGEAR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Medium-voltage transfer switchgear.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to internal components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

PART 2 PRODUCTS

2.1 MEDIUM-VOLTAGE TRANSFER SWITCHGEAR

A. Medium-voltage transfer switchgear will be furnished by the Owner, installed by the Contractor.

2.2 SEQUENCE OF OPERATION

- A. The transfer switchgear shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the normal utility source.
- B. When the voltage of any phase of the normal utility source is reduced to 80% or exceeds 110% nominal voltage, or frequency is displaced 2 Hz from nominal, for a period of 0 10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
- C. When the emergency source has reached a voltage value within +/- 10% of nominal and achieved frequency within +/- 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

The programmable time delay shall be set at 15 seconds after transfer of 24.9 KV feed to second WE Energies transmission feed at outdoor 24.9 KV Switchgear. Contractor shall coordinate the time delay setting in the field with existing equipment.

- D. When the normal utility source has been restored to not less than 90% of rated voltage on all phases, the load shall be retransferred to the normal utility source after a time delay of 0 to 30 minutes (programmable). The generator shall run unloaded for 0 15 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- E. If the engine generator should fail while carrying the load, retransfer to the normal utility source shall be made instantaneously upon restoration of proper voltage (90%) on the normal utility source.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with IEEE C37.20.2.
- B. Install switchgear on level structural steel channels accurately embedded in the floor, and in accordance with manufacturer's published instructions.
- C. Install switchgear plumb and level and with each section aligned properly.
- D. Make electrical connections between equipment sections using connectors furnished by manufacturer.
- E. Ground and bond switchgear in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.2.
- D. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of transfer switchgear. Remove fronts to make joints and connections accessible to a portable scanner.
 - 1. Follow-up Infrared Scanning: Perform 1 additional follow-up infrared scan of equipment 11 months after date of Substantial Completion.
 - 2. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
 - 3. Record of Infrared Scanning: Prepare a certified report identifying equipment

checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.3 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust operating mechanisms for free mechanical movement.
- C. Torque bolted bus connections in accordance with manufacturer's instructions after placing switchgear.
- D. Adjust protective relays in accordance with recommendations in Engineer's coordination study.
- E. Adjust time delays as indicated by Engineer in the field.

3.4 DEMONSTRATION

- A. Section 01 70 00 Execution and Closeout Requirements: Demonstrating installed work.
- B. Demonstrate operation of circuit breakers and transfer switch. Coordinate with generator and transfer switchgear supplier and provide demonstration of transfer switch with the generator.
- C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide standby power.

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Two-winding transformers.
- 1.2 RELATED SECTIONS
 - A. Section 26 24 19 Motor Control Centers.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ST 1 Specialty Transformers (Except General Purpose Type).
 - 2. NEMA ST 20 Dry Type Transformers for General Applications.
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
 - B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
 - C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Transformer will be furnished by the Owner, installed by the Contractor.

PART 3 EXECUTION

- 3.1 INSTALLATION
 - A. Install grounding and bonding in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.3 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Distribution and branch circuit panelboards.

1.2 RELATED SECTIONS

A. Section 26 24 19 – Motor Control Centers.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

- 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
- 2. NEMA FU 1 Low Voltage Cartridge Fuses.
- 3. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
- 4. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
- 5. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- 6. NEMA PB 1 Panelboards.
- 7. NEMA PB 1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 Safety for Panelboards.
 - 2. UL 1283 Electromagnetic Interference Filters.
 - 3. UL 1449 Transient Voltage Surge Suppressors.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

A. Panelboard will be furnished by the Owner, installed by the Contractor.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Panelboard will be furnished by the Owner, installed by the Contractor.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling and below floor. Minimum spare conduits: 3 empty 1 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.
3.3 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Motor control centers.

1.2 RELATED SECTIONS

- A. Section 26 22 00 Low-Voltage Transformers.
- B. Section 26 24 16 Panelboards.
- C. Section 26 29 23 Variable Frequency Motor Controllers.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 2.3 Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
 - 5. NEMA ICS 3 Industrial Control and Systems: Factory Built Assemblies.
 - 6. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 7. NEMA ICS 7 Industrial Control and Systems: Adjustable Speed Drives.
 - 8. NEMA ICS 7.1 Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
 - 9. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

- B. Deliver in 60 inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.
- C. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MOTOR CONTROL CENTER

A. Motor control center will be furnished by Owner, installed by the Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions before.
- B. Verify surfaces are suitable for motor control center installation.

3.2 EXISTING WORK

- A. Disconnect and remove abandoned motor control centers.
- B. Maintain access to existing motor control centers and other installations remaining active and requiring access.
- C. Clean and repair existing motor control centers to remain or are to be reinstalled.

3.3 INSTALLATION

- A. Install in accordance with NEMA ICS 2.3 and NEMA 7.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.
- C. Install fuses in fusible switches.
- D. Select and install heater elements in motor controllers to match installed motor characteristics.
- E. Ground and bond motor control centers in accordance with Section 26 05 26.

3.4 ADJUSTING

A. Adjust settings on adjustable circuit breakers as indicated in Coordination Study.

3.5 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16.
- D. Inspect and test variable frequency controllers according to NEMA ICS 7.1.
- E. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of motor control center. Remove fronts to make joints and connections accessible to a portable scanner.
 - 1. Follow-up Infrared Scanning: Perform 1 additional follow-up infrared scan of equipment 11 months after date of Substantial Completion.
 - 2. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
 - 3. Record of Infrared Scanning: Prepare a certified report identifying equipment checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 4 Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Manufacturers:
 - 1. Hoffman.
 - 2. Rittal.
 - 3. Wiegmann.
- B. Construction: NEMA 250, Type as indicated on Drawings.
- C. Covers: Continuous hinge, held closed by screwdriver, key, hasp and staple for padlock as indicated on Drawings.

- D. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard enamel.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove abandoned cabinets and enclosures, including abandoned cabinets and enclosures above accessible ceiling finishes. Patch surfaces.
- B. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Extend existing cabinets and enclosures using materials and methods compatible with existing electrical installations, or as specified.
- D. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- B. Install cabinet fronts plumb.

3.3 CLEANING

- A. Section 01 70 00 Closeout Procedures: Final cleaning.
- B. Clean electrical parts to remove conductive and harmful materials.
- C. Remove dirt and debris from enclosure.
- D. Clean finishes and touch up damage.

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Device plates.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 General Requirements for Wiring Devices.
 - 2. NEMA WD 6 Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Pass & Seymour.
- B. Product Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- C. Body and Handle: Plastic with toggle handle, color as indicated on Drawings.
- D. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.

2.2 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell.

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- 2. Leviton.
- 3. Pass & Seymour
- B. Product Description: NEMA WD 1, Heavy-duty general use receptacle.
- C. Device Body: Plastic, color as indicated on Drawings.
- D. Configuration: NEMA WD 6.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Pass & Seymour
- B. Cover Plate: Type and color as indicated on Drawings.
- C. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 EXISTING WORK

- A. Disconnect and remove abandoned wiring devices.
- B. Modify installation to maintain access to existing wiring devices to remain active.
- C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.4 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole on bottom.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- E. Install gasketed steel plates on switch, receptacle, and blank outlets in finished areas.
- F. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- G. Use jumbo size plates for outlets installed in masonry walls.
- H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above back splash of counter.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 Equipment Testing and Facility Startup: Field inspecting, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

- A. Section 01 40 00 Equipment Testing and Facility Startup: Testing, adjusting, and balancing.
- B. Adjust devices and wall plates to be flush and level.

3.8 CLEANING

- A. Section 01 70 00 Closeout Procedures: Final cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

SECTION 26 28 13

FUSES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 FUSE PERFORMANCE REQUIREMENTS

A. Motor Branch Circuits: Class RK1 (time delay).

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures: Closeout procedures.
- B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

- A. Section 01 70 00 Closeout Procedures: Spare parts and maintenance products.
- B. Furnish two fuse pullers.

1.7 EXTRA MATERIALS

- A. Section 01 70 00 Closeout Procedures: Requirements for extra materials.
- B. Furnish three spare fuses of each Class, size, and rating installed.

PART 2 PRODUCTS

- 2.1 FUSES
 - A. Manufacturers:
 - 1. Bussman.
 - 2. Approved equal.

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- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove fuses from abandoned circuits.
- B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

A. Install fuse with label oriented so manufacturer, type, and size are easily read.

SECTION 26 28 19

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fusible and nonfusible switches.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Eaton.
 - 2. General Electric.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

D. Enclosure: NEMA KS 1, type as indicated on Drawings. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Eaton.
 - 2. General Electric.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, type as indicated on Drawings. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

2.3 SWITCH RATINGS

- A. Switch Rating: Horsepower rated sized as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere), 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes), 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches.
- B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed switches to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet to operating handle.
- C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Equipment Testing and Facility Startup: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

SECTION 26 28 26

LOW-VOLTAGE AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low-voltage automatic transfer switches.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 00 00 Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to internal components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH

- A. Automatic transfer switch will be furnished by the Owner, installed by the Contractor.
- 2.2 SEQUENCE OF OPERATION
 - A. The automatic transfer switch shall incorporate adjustable three phase under and overvoltage and three phase under and over-frequency sensing on the normal utility source.
 - B. When the voltage of any phase of the normal utility source is reduced to 80% or exceeds 110% nominal voltage, or frequency is displaced 2 Hz from nominal, for a period of 0 10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
 - C. When the emergency source has reached a voltage value within +/- 10% of nominal and achieved frequency within +/- 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

The programmable time delay shall be set at 15 seconds after transfer of utility sources from main-tie-main breakers in existing switchboard.

- D. When the normal utility source has been restored to not less than 90% of rated voltage on all phases, the load shall be retransferred to the normal utility source after a time delay of 0 to 30 minutes (programmable). The generator shall run unloaded for 0 15 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- E. If the engine generator should fail while carrying the load, retransfer to the normal utility source shall be made instantaneously upon restoration of proper voltage (90%) on the normal utility source.
- F. See "Transfer Switch Operation Matrix" at end of this section for additional information.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned transfer switches.
- B. Clean and repair existing transfer switches to remain or to be reinstalled.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.2 and 7.22.3.
- D. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of transfer switch. Remove fronts to make joints and connections accessible to a portable scanner.
 - 1. Follow-up Infrared Scanning: Perform 1 additional follow-up infrared scan of equipment 11 months after date of Substantial Completion.
 - 2. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
 - 3. Record of Infrared Scanning: Prepare a certified report identifying equipment checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.3 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust operating mechanisms for free mechanical movement.
- C. Adjust protective relays in accordance with recommendations in Engineer's coordination study. Adjust time delays in accordance with recommendations from the Engineer.

3.4 DEMONSTRATION AND TRAINING

- A. Section 01 00 00 General Requirements: Demonstration and Instructions.
- B. Demonstrate operation of circuit breakers and transfer switch. Coordinate with generator and transfer switch supplier and provide demonstration of the transfer switch with the generator.
- C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide standby power.

LOW LIFT PUMP STATION – TRANSFER SWITCH OPERATION MATRIX 3.5

		ORDER OF ACTION	NORMAL STATUS	MBA, TB	FBB, TB	MBA, TB, GEN, ATS	GEN, ATS	TB, MBA	FBB, MBA	MBA, FBB, GEN, ATS	TB, FBB	MBA, FBB	ATS, GEN	FBB, MBA, ATS (Drive to Normal), GEN	TB, MBA, ATS, GEN
STANDBY POWER		ATS	Ν	z	N	N→E	N→E	N	N	N→E	N	N	E→N	E→N	E→N
		GEN	0	0	0	0→1	0→1	0	0	0→1	0	0	1→0	$1 \rightarrow 0$	$1 \rightarrow 0$
VOLTAGE	RELAY -	MSWB-1A	1	$1 \rightarrow 0 \rightarrow 1$	1	$1 \rightarrow 0 \rightarrow 1$	1→0→1	$1 \rightarrow 0 \rightarrow 1$	1→0→1	1→0→1	1	$1 \rightarrow 0 \rightarrow 1$	1	1	1
CIRCUIT BREAKER POSITION		MBA	1	1→0	1	$1 \rightarrow 0$	0	0→1	0→1	1→0	1	$1 \rightarrow 0$	0	0→1	0→1
		TB	0	0→1	0→1	0→1	1	$1 \rightarrow 0$	1	1	$1 \rightarrow 0$	1	1	1	$1 \rightarrow 0$
		FBB	1	1	$1 \rightarrow 0$	1	1	1	$1 \rightarrow 0$	0→1	0→1	0→1	1	$1 \rightarrow 0$	1
CIRCUIT STATUS		A	1	$\overline{I} \rightarrow 0$	Ī	$\overline{I} \rightarrow 0$	<u>0</u>	$\underline{\theta}{\rightarrow}1$	$\underline{\varrho}{\rightarrow}1$	$I \rightarrow 0$	Ī	$\overline{I} \rightarrow 0$	<u>0</u>	$\underline{\theta}{\rightarrow}1$	$\underline{\varrho}{\rightarrow}1$
		В	1	Ī	$I \rightarrow 0$	$I \rightarrow 0$	$I \rightarrow 0$	Ī	$I \rightarrow 0$	0	$\underline{\theta}{\rightarrow}1$	$\underline{\theta}{\rightarrow}1$	$\underline{\theta}{\rightarrow}1$	0	$\underline{\theta}{\rightarrow}1$

END OF SECTION

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SECTION 26 29 23

VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable frequency controllers.

1.2 RELATED SECTIONS

A. Section 26 24 19 – Motor Control Centers.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

- 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- 2. NEMA FU 1 Low Voltage Cartridge Fuses.
- 3. NEMA ICS 7 Industrial Control and Systems: Adjustable Speed Drives.
- 4. NEMA ICS 7.1 Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

PART 2 PRODUCTS

- 2.1 VARIABLE FREQUENCY CONTROLLER
 - A. Variable frequency controller will be furnished by the Owner, installed by the Contractor.
- 2.2 FUNCTIONAL DESCRIPTION
 - A. The VFD shall be capable of operating in Hand and Automatic mode as follows:
 - 1. Hand Mode: The VFD shall operate as follows when "Hand/Off/Auto" selector switch is in the "Hand" position.
 - a. Fan shall run when the "start" pushbutton is depressed.
 - b. Fan shall stop when the "stop" pushbutton is depressed.
 - c. Variable speed operation of the fan shall be controlled from cover mounted potentiometer switch.

- 2. Automatic Mode: The VFD shall operate as follows when "Hand/Off/Auto" selector switch is in the "Auto" position.
 - a. Fan shall be started and stopped from "run command" remote signal from generator control panel or from "remote run" signal from PLC.
 - b. Variable speed operation of the fan shall be controlled from speed command signal from PLC (coordinate speed setting with Engineer in the field).
 - c. The VFD shall send a "auto" signal to the PLC when in automatic position.
- B. In all modes of operation the following shall occur.
 - 1. The "on" green indicating light shall illuminate when power to the VFD is on.
 - 2. The "fan run" red indicating light shall illuminate when the fan motor is running. The VFD shall send a "run" signal to the PLC.
 - 3. The "drive fail" yellow indicating light shall illuminate then the VFD or fan motor fails to operate. The VFD shall send a "fail' signal to the PLC.
 - 4. The VFD and motorized dampers shall be controlled from the PLC and open on the following signals:
 - a. Upon "run command" signal from generator control panel, VFD shall ramp up to 20 Hz and MD-105A shall open.
 - b. At high temperature setpoint from space sensor, VFD shall ramp up to 40 Hz and MD-105B shall open.
 - c. At high-high temperature setpoint from space sensor, VFD shall ramp up to 60 Hz and MD-105C shall open.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1.
- B. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- C. Ground and bond controller in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Section 01 60 00 Product Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

SECTION 26 32 13

ENGINE GENERATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Engine generator set.
- B. Heat exchanger.
- C. Exhaust silencer and fittings.
- D. Fuel fittings.
- E. Battery and charger.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 3. NEMA ICS 10 Industrial Control and Systems: AC Transfer Switch Equipment.
 - 4. NEMA MG 1 Motors and Generators.
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 30 Flammable and Combustible Liquids Code.
 - 2. NFPA 99 Standard for Health Care Facilities.
 - 3. NFPA 110 Standard for Emergency and Standby Power Systems.

PART 2 PRODUCTS

2.1 GENERATOR SET

- A. Generators and generator accessories will be furnished by the Owner, installed by the Contractor.
- B. Generator accessories include the following:
 - 1. Heat exchangers.
 - 2. Heat exchanger expansion tanks.
 - 3. Exhaust silencer with connecting flanges and flexible stainless steel exhaust fitting.
 - 4. Batteries, cables, clamps, battery tray, and battery charger.
 - 5. Line circuit breaker (for Low Lift Pump Station generator).
 - 6. Engine-Generator control panel.

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- 7. Remote annunciator panel.
- 8. Communications Module and associated software.
- 9. Air/fuel ratio controller.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned engine-generator assemblies and accessories.
- B. Clean and repair existing engine-generator assemblies to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install equipment per manufacturer's instructions.
- B. Install engraved plastic nameplates in accordance with Section 26 05 53.
- C. Ground and bond generator and other electrical system components in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.
- D. Provide performance testing of ground-fault protection system per NEC 230.95(C).

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust generator output voltage and engine speed to meet specified ratings.

3.5 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean engine and generator surfaces. Replace oil and fuel filters with new.

3.6 DEMONSTRATION AND TRAINING

- A. Simulate power outage by interrupting normal source, and demonstrate system operates to provide standby power.
- B. Step Loading Requirements: Generator sets shall be tested with loads being brought on-line as follows.

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- 1. Water Treatment Plant 12 MGD pumping capacity and backwash capabilities.
 - a. Step 1: 600 amp load for 500 KVA, 480Y/277 volt transformer (lighting, controls, miscellaneous pumps, process equipment, etc.).
 - b. Step 2: High Lift Pump #7 250 HP motor on single speed, full voltage, 2300 volt controller.
 - c. Step 3: High Lift Pump #8 250 HP motor on single speed, full voltage, 2300 volt controller.
 - d. Step 4: Backwash Pump 200 HP motor on single speed, full voltage, 2300 volt controller.
- 2. Low Lift Pump Station 24 MGD pumping capacity.
 - a. Step 1: 150 amp load fed from MCC-2 (lighting, controls, process equipment, etc.).
 - b. Step 2: Low Lift Pump #4 300 HP on 480 volt soft start controller.
 - c. Step 3: Low Lift Pump #2 200 HP on 480 volt VFD.
 - d. Step 4: Low Lift Pump #1 200 HP on 480 volt soft start controller.
 - e. Step 5: Low Lift Pump #3 100 HP on 480 volt soft start controller.

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Lamps.
- C. Ballasts.
- D. Accessories.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 MAINTENANCE MATERIALS

- A. Section 01 70 00 Closeout Procedures: Spare parts and maintenance products.
- B. Furnish two of each plastic lens type.

- C. Furnish 10% replacement lamps for each lamp installed.
- D. Furnish two of each ballast type.

PART 2 PRODUCTS

- 2.1 INTERIOR LUMINAIRES
 - A. Product Description: Provide light fixture types as indicated on the Drawings. No substitutions will be permitted.

2.2 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. Advance.
 - 2. Osram/Sylvania.
 - 3. Magnetek/Universal.
 - 4. Howard Industries.
- B. Product Description: Electronic ballast, rapid start, with less than 10 percent THD, suitable for lamps specified, with voltage to match luminaire voltage.

2.3 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers:
 - 1. Advance.
 - 2. Osram/Sylvania.
 - 3. Magnetek/Universal.
 - 4. Howard Industries.
- B. Product Description: ANSI C82.4, HID lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.4 INCANDESCENT LAMPS

A. Incandescent lamps shall be 130 volt inside frosted extended service lamps.

2.5 FLUORESCENT LAMPS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Sylvania.
 - 3. Philips.
- B. Product Description: Fluorescent lamps shall be as follows:
 - 1. 4' fluorescent lamps shall be 32 watt, T8, SP color, instant start, 3500 K.
 - 2. 2' fluorescent lamps shall be 31 watt, T8, SP color, instant start, 3500 K.
 - 3. Compact fluorescent lamps shall be PL or BX, double 26 watt or single 13 watt (as specified), SP color, 3500K.

2.6 HID LAMPS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Sylvania.
 - 3. Philips.
- B. Product Description: Lamps shall be clear coated.

PART 3 EXECUTION

- 3.1 EXISTING WORK
 - A. Disconnect and remove abandoned luminaires, lamps, and accessories.
 - B. Extend existing interior luminaire installations using materials and methods compatible with existing installations, or as specified.
 - C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. Install wall-mounted luminaires at height as indicated on Drawings.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.

- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Install specified lamps in each luminaire.
- N. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Equipment Testing and Facility Startup: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Section 01 40 00 Equipment Testing and Facility Startup: Testing, adjusting, and balancing.
- B. Aim and adjust luminaires as indicated on Drawings.

3.5 CLEANING

- A. Section 01 70 00 Closeout Procedures: Final cleaning.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Closeout Procedures: Protecting finished work.
- B. Relamp luminaires having failed lamps at Substantial Completion.

SECTION 26 52 00

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Emergency lighting units.
- B. Exit signs.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SYSTEM DESCRIPTION

A. Emergency lighting to comply with requirements.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit dimensions, ratings, and performance data.

1.5 MAINTENANCE MATERIALS

- A. Section 01 70 00 Closeout Procedures: Spare parts and maintenance products.
- B. Furnish 10% replacement lamps for each lamp installed.
- C. Furnish one replacement battery for each battery type and size.

PART 2 PRODUCTS

2.1 EMERGENCY LIGHTING UNITS

A. Product Description: Provide light fixture types as indicated on the Drawings. No substitutions will be permitted.

2.2 EXIT SIGNS

- A. Product Description: Provide light fixture types as indicated on the Drawings. No substitutions will be permitted.
- B. Directional Arrows: Universal type for field adjustment.

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- C. Mounting: Universal, for field selection.
- D. Battery: 6 or 12 volt, nickel-cadmium type, with 1.5 hour capacity.
- E. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- F. Lamps: LED.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned emergency lighting units, exit signs, lamps, and accessories.
- B. Extend existing emergency lighting and exit sign installations using materials and methods compatible with existing installations, or as specified.
- C. Clean and repair existing emergency lighting units and exit signs remaining or are to be reinstalled.

3.2 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit outlets provided in Section 26 05 33 as indicated on Drawings.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.
- H. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Equipment Testing and Facility Startup: Field inspecting, testing, adjusting, and balancing.
- B. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Section 01 40 00 Equipment Testing and Facility Startup: Testing, adjusting, and balancing.
- B. Aim and adjust lamp fixtures as indicated on Drawings.
- C. Position exit sign directional arrows as indicated on Drawings.

3.5 PROTECTION OF FINISHED WORK

- A. Section 01 40 00 Closeout Procedures: Protecting finished work.
- B. Relamp emergency lighting units and exit signs having failed lamps at Substantial Completion.

SECTION 26 90 00

PROCESS INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section covers general provisions and requirements for all work necessary for Engineering, furnishing, installing, adjusting, testing, and documenting the Process Control System.
- B. System Integrator shall assume responsibility for specification sections 26 90 00 through 26 90 10.
- C. System Integrator shall be responsible for the following equipment:
 - 1. PLC-G Enclosure including all equipment inside the enclosure.
 - 2. Ultrasonic Level Transducer and Transmitter for chemical mixing tank.
- D. The Owner shall be responsible for the following work:
 - 1. All programming changes required in the PLCs as required.
 - 2. Modifying the graphic screens on the plant SCADA system.
 - 3. Mapping of points and associated programming for control and monitoring functions from the generator control panels, automatic transfer switch controller, and digital power metering. Suppliers of that equipment shall provide 8 hours of assistance to the Owner for each piece of equipment being interfaced with the plant SCADA system.
- E. The Contract Documents including drawings and specifications are complementary parts and what is called for by one part shall be as binding as if called for by all parts.
 - 1. All hardware shall be delivered to Project site or other site agreeable to OWNER no later than 60 days after the date of ENGINEER'S approval of the respective process instrumentation and control system shop drawing and product data submittal.
 - 2. CONTRACTOR shall accommodate this delivery schedule in scheduling Work.

1.2 REFERENCES

- A. National Fire Protection Agency (NFPA).
- B. National Electric Code (NEC).
- C. Underwriters Laboratory (UL).
- D. National Electrical Manufacturers Association (NEMA).
- E. Instrumentation, Systems and Automation Society (ISA).
- F. Institute of Electrical and Electronics Engineers (IEEE).
- G. American National Standards Institute (ANSI).

1.3 SELECTED ABBREVIATIONS

HMI	Human-Machine-Interface
I/O	Input / Output
OIU	Operator Interface Unit
ISA	Instrument Society of America
LOS	Line of sight
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
PC	Personal Computer
PCS	Process Control System
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
UL	Underwriters' Laboratories, Inc.
UPS	Uninterruptible Power Supply

1.4 **DEFINITIONS**

A. Not used

1.5 SUBMITTALS

- A. In addition to the requirements of the Contract Documents, the following information shall be provided in tabbed, booklet format covering all Work.
- B. Shop Drawings:
 - 1. Panel Layout Drawings: Drawings shall show all panel mounted devices to scale and dimensioned and shall include legend. Drawings shall include ancillary devices such as additional terminal strips, relays, fuses, utility lights and receptacles, fans, heaters, etc. Typical drawings for multiple circuits or systems are not acceptable.
 - 2. Loop Diagrams: Drawings shall consist of wiring diagrams for each analog and discrete loop showing all PLC input/output module terminations, terminal numbers, location of dc power supplies, location of current boosting and interposing relays, and common dropping resistors. The loop diagrams shall meet the minimum requirements of ISA S5.4.
 - 3. PLC Equipment Layout Drawing including processing equipment, I/O components, power supplies, and peripheral devices.
 - 4. PLC I/O module cross reference identification for each control cabinet.
 - 5. Remote I/O documentation describing size and structure; listing of I/O; data table memory and size of memory available for all programs.
 - 6. Communication Connection Drawings: Drawings shall show connections between PLC and existing Network Switch and Communication Enclosure.
 - 7. Electrical power, UPS, Grounding, and DC Power Schematics for all equipment.
 - 8. Heat calculations for all enclosures.
 - 9. Electrical distribution diagrams identifying Motor Control Center equipment and Power Panels associated with each new electrical connection.
 - 10. Test reports.
- C. List of special tools (including software) required for instrument calibration, startup, checking, testing, parts replacement, troubleshooting, and maintenance of all components of the Process

Control System. Identify any special tools specially designed or adapted for use on parts of this system.

- D. Product Data:
 - 1. Catalog Information: Provide catalog information and descriptive literature on all equipment associated with the Process Control System. Uniquely identify submittal items on catalog pages containing more than the submitted item.
 - 2. Product Data (Specification) Sheets: Provide product data sheets for each component provided under this Section. The purpose of the data sheets is to supplement the generalized catalog information provided by citing all specific features for each specific component (e.g.: scale range, materials of construction, special options included). Product Data Sheets shall follow General ISA S20 format.
- E. Test Outline and Procedure Submittal
 - 1. A detailed description of each specified test procedure and demonstration shall be submitted for approval. The decision of ENGINEER upon the acceptability of the procedure shall be final.
 - 2. It is required that this be a two-step submittal: outlines first followed, upon receipt of ENGINEER'S approval, by specific test descriptions.
 - 3. Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with these Specifications.
 - 4. Provide detailed step-by-step in-factory and field test procedure at least 8 wks in advance of scheduled test date. Include proposed test documentation and sign-off sheets and punch list forms.
 - 5. Identify complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.
- F. Spare and Expendable Items Submittal
 - 1. CONTRACTOR shall provide a list of recommended spares and expendable items as recommended by System Integrator in sufficient quantities to sustain the Process Control System for a period of 3 years after acceptance.
 - 2. A total purchase cost for the recommended list shall be provided in addition to the unit cost for each item. The cost of spare and expendable items selected by OWNER will be addressed as a Change Order.
 - 3. In addition to the Spares and Expendables List, CONTRACTOR shall provide a Component Part List as recommended by Systems Integrator. The Component Part List shall be a complete parts list for the entire Process Control System, and shall have the following features:
 - a. All components shall be grouped by component type, with the component types identified in a similar manner to the component identification code used in these Specifications.
 - b. All components shall be listed with their exact and complete manufacturer's part number, including all options or accessories.
 - c. All components shall be identified with their complete tag number as shown in these Specifications, or as modified or assigned by CONTRACTOR and approved by ENGINEER.
 - d. All components without tag numbers shall be grouped within component types by manufacturer's part number. Exact quantities shall be listed for each part number.

- G. Prepare In-Factory Inspection and Testing, and Field Wiring and Testing Sign-Off documents. Documents shall be submitted during course of project to ENGINEER for approval.
- H. Operation and Maintenance (O&M) Data:1. Process Control System: Submit in accordance with Contract Documents.
- I. Record Drawings: Submit in accordance with Contract Documents.
- J. Provide revised loop descriptions and annotated ladder diagrams on CD-ROM in PDF format.

1.6 QUALITY ASSURANCE

- A. CONTRACTOR shall engage the services of a qualified System Integrator for the purposes of furnishing the Process Control System, providing technical assistance on the installation of System and certifying the correctness of said installation.
- B. Equipment shall be latest and most modern design at time of Notice to Proceed.
- C. All software and firmware used in this Project shall be latest version as of the Notice to Proceed.
- D. Like items of Equipment shall be end products of single manufacturer to achieve standardization for maintenance, spare parts, operation, and service.
- E. Process Control System components shall be grounded in accordance with National Electric Code (NEC) requirements.
- F. Coordination: In order to insure timely performance of the Contract and the System's conformance with Specifications, coordination meeting(s) shall be held during the course of the project.

1.7 SYSTEM INTEGRATOR RESPONSIBILITY

- A. System Integrator shall inspect Equipment provided under this Section prior to shipment to Project sites.
- B. System Integrator shall coordinate work with CONTRACTOR to insure that:
 - 1. All components provided under this Section are properly installed.
 - 2. All components provided under this Section are properly configured.
 - 3. The proper type, size, and number of control wires with conduits are furnished and installed.
 - 4. Proper electric power circuits are provided for all components and systems.
- C. System Integrator shall be responsible for coordination of voltage levels and signal types for signals connected to Process Control System. Provide relays, signal isolators, termination or pull-up resistors, signal conditioners or other devices only as required for proper interfacing and operation of non-compatible devices.
- D. System Integrator shall supply all equipment fully configured, specific to the process functions described herein.

- E. All field located conduits, wiring and cables shall be provided under Division 26 ELECTRICAL.
- F. System Integrator shall provide end to end input/output connections and verify functions. Logic programming will be by the Owner.

1.8 WORK FOR HIRE

- A. Any and all configuration, programming, setup or other software functions (SOFTWARE) performed on all intelligent devices provided as part of this Project is to be considered "Work for Hire" under the 1976 Copyright Act as amended (title 17 of the United States Code). The SOFTWARE shall be owned by OWNER and shall be turned over to OWNER fully documented as the work is completed.
- B. OWNER intends only to obtain the SOFTWARE for its own use.
- C. OWNER will not prevent the SOFTWARE supplier from reuse of the SOFTWARE concepts and ideas for other projects. Any reuse of the SOFTWARE concepts and ideas generated under this Project is solely the responsibility of the SOFTWARE supplier. The SOFTWARE supplier shall defend, indemnify and hold harmless OWNER from all claims, damages and expenses (including reasonable litigation costs), arising out of any use, misuse or misapplication of SOFTWARE concepts and ideas.

1.9 WARRANTY

- A. Furnish a copy of the warranty together with the operating instructions and maintenance data for the complete system.
- B. System defects and deficiencies shall be corrected by CONTRACTOR within 24 hours of notification if OWNER does not have necessary replacement parts in stock and within 4 hours of notification if OWNER has necessary replacement parts in stock. Failure to correct these items per these requirements may result in CONTRACTOR losing Maintenance Bond.
- C. Products found to be defective or nonconforming during the warranty period shall be replaced with new products.

PART 2 PRODUCTS

2.1 SYSTEM INTEGRATORS

- A. Starnet Technologies.
- B. Eclipse Controls.
- C. Energenecs.
- D. Precision Controls Systems.
- E. Other integrators as approved by Owner prior to submitting Bid.
- F. Pieper Electric.

2.2 SYSTEM INTEGRATOR EXPERIENCE REQUIREMENT

- A. The CONTRACTOR shall utilize a System Integrator having the experience and knowledge, as defined herein, to undertake the work specified in this Section. The System Integrator shall be an organization having the following organizational and individual experience, knowledge, and capability:
 - 1. System Integrator shall be regularly engaged in the design, installation, and servicing of wastewater treatment Process Control Systems.
 - 2. System Integrator shall demonstrate the ability to produce electrical and control logic diagrams in the level of detail required by this specification.
 - 3. System Integrator shall have previously executed a minimum of five (5) water treatment Process Control System projects of similar size and complexity to this Project and incorporating PLCs and HMI platforms included in this Project.
 - 4. Systems Integrator shall have previously successfully executed Ethernet wireless and wired networked projects of comparable size and complexity to this Project.
 - 5. The person(s) performing the field I&C work as required by the Contact Documents shall have a minimum of five (5) years experience on PLC-based systems.
 - 6. System Integrator shall provide, on-site, a Control Systems Engineer to commission the functional testing, start-up and training as required by the Contract Documents. The individual shall have authored and commissioned control logic for no fewer than three (3) projects of similar or greater complexity, and shall have a demonstrated proficiency in authoring logic in PLC Function Block Language.
 - 7. Upon request of OWNER and in addition to other specified requirements, CONTRACTOR shall provide a minimum of five (5) System Integrator references to confirm compliance with these requirements.

2.3 EQUIPMENT, SYSTEMS AND SERVICES

- A. Equipment, Systems and Services provided under this Section shall conform to the following requirements.
 - 1. UL 508 Standards for Safety, Industrial Control Equipment.
 - 2. NEMA ICS 1 General Standards for Industrial Control and Systems.
 - 3. NEMA ICS 2 Standards for Industrial Control Devices, Controllers and Assemblies.
 - 4. NEMA ICS 3 Industrial Systems.
 - 5. NEMA ICS 6 Enclosures for Industrial Controls and Systems.
 - 6. NEMA ICS 250 Enclosures for Electrical Equipment.
- B. Equipment, Systems and Services provided under this section include the following:
 - 1. Section 26 90 08 Miscellaneous Control Devices.
 - 2. Section 26 90 10 Modular Programmable Logic Controllers (PLC).

2.4 ULTRASONIC LEVEL TRANSDUCER

A. Manufacturers:

- 1. Siemens Hydroranger Plus with Echomax XPS/XCT series transducers.
- 2. Milltronics equivalent.
- 3. Provide manufacturer recommended model.
- B. Flange mounted ultrasonic level transducer with remote transmitter. System designed for continuous operation in potassium permanganate mixing system.
- C. Provide the following minimum features as standard:
 - 1. Flange mounting kit (refer to drawings)
 - 2. Transmitter level indication
 - 3. Narrow beam angle
 - 4. 4-20 mA scaled output for transducer
- D. Coordinate transducer cable length with final instrumentation equipment locations.

2.5 SYSTEM FUNCTIONALITY

- A. Common SCADA functions shall be provided for all similar process equipment and process measurements. These functions include calculated points which are not included in the PLC Input/Output Schedule included at the end of this section.
- B. All motor driven equipment shall have FAIL detection based upon a mismatch between the SCADA entered RUN command and ON status feedback with the FAIL condition alarm at the OIU's and logged on the alarm printer.
- C. All ON status signals shall be integrated over time and equipment run time values made available for reporting purposes.
- D. Provide system monitoring and control per the function description listed in the PLC Input/Output Schedule included at the end of this section.
- E. Generators GEN-101 and GEN-102: Provide system monitoring and remote control for all points available from the generator control panel. Generator control panel is provided with 2-way communication via Ethernet connection and will be connected with Cat 6 cable to existing patch panel in Network Switch and Communication Enclosure.
- F. Automatic Transfer Switches ATS-101 and ATS-102: Provide system monitoring and remote control for all points available from the ATS microprocessor controller and customer digital meter. Controller and digital meter are provided with 2-way communication via Ethernet connection and will be connected with Cat 6 cable to existing patch panel in Network Switch and Communication Enclosure.

SCADA system shall be programmed to monitor the kW demand on the ATS when on generator power. SCADA programming shall automatically bring on high lift or low lift pumps one step at a time as flow demand increases. Programming shall not allow additional pumps to be brought on line once the generator is 85% loaded. See Specification Section 26 32 13 for Step loading requirements for the generators.

G. Main Switchboard MSWB-1A and MSWB-1B: Provide system monitoring for all points available from the customer digital metering. Contractor shall provide interface module and gateway to interface with existing digital metering to provide communication via Ethernet connection with Cat 6 cable to existing patch panel in Network Switch and Communication Enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. CONTRACTOR shall install and wire Process Control System equipment in accordance with System Integrator's and Instrument Manufacturer's written instructions and approved submittals.
- B. CONTRACTOR shall coordinate with OWNER on tagging of devices and modify as required per the OWNER'S direction.
- C. Each tag number shall be unique to that device.
- 3.2 REMOTE I/O INPUT/OUTPUT SIGNAL CHARACTERISTICS
 - A. Analog signals shall be 4 20 mA dc and shall conform to the compatibility requirements of ISA Standard S50.1. Transmitters and receivers shall be fully isolated.
 - B. Discrete signals shall be two-state logic signals of two types. Except as identified herein, discrete input and output signals shall utilize 120V AC sources. DC source may be used for discrete input and output signals only for intrinsically safe devices, field devices available only as DC, and existing DC powered devices.

3.3 PLC INPUT/OUTPUT SIGNAL POWER SOURCE

- A. Except for 4-wire instruments, all analog loops shall be powered from respective process control panel.
- B. 120V AC and DC shall be sourced from respective process control panel.

3.4 FIELD QUALITY CONTROL

- A. Protection During Construction.
 - 1. Throughout Contract, CONTRACTOR shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the ENGINEER-reviewed System Integrator's recommendations.
- B. Cleaning and Touch-up Painting.
 - 1. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior

surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

- C. Panels and Panel-Mounted Equipment.
 - 1. Panels and panel-mounted devices shall be assembled as completely as possible at the System Integrator's factory. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the job site.
- D. Inspections.
 - 1. System Integrator shall provide services of qualified service Engineer to supervise and inspect equipment installation to ensure system is installed in accordance with System Integrator's recommendations.
 - 2. All materials, equipment, and workmanship shall be subject to observation at any time by ENGINEER'S representatives. Correct any work, materials or equipment not in accordance with these Contract Documents or found to be deficient or defective. Make corrections in a manner satisfactory to ENGINEER at no additional cost to OWNER.
 - 3. The System Integrator shall supervise final power and signal connections by CONTRACTOR to all equipment provided under this Section. For all equipment provided under this Section and all other equipment interfaced by the system, the System Integrator shall verify and certify by written notice to ENGINEER, correctness of final signal connections and correctness of adjustment.
 - 4. System Integrator shall field calibrate equipment at time of complete startup on loop-by-loop basis. Submit calibration certification to ENGINEER for each piece of equipment. Make adjustments necessary to place equipment in satisfactory operation.
 - 5. During this startup period, CONTRACTOR'S personnel are to thoroughly check all of the equipment and perform the on-site tests specified above.

3.5 SUBSTANTIAL COMPLETION

- A. In addition to requirements identified in other parts of the Contract Documents, Substantial Completion shall require the following process instrumentation and control work is successfully completed:
 - 1. OWNER'S receipt of required site documentation including required O&M material.
 - 2. Completion of specified training associated with equipment provided.
 - 3. Successful completion of the specified demonstration period.
 - 4. OWNER'S receipt of required tools.
 - 5. OWNER'S receipt of spare parts.

		PLC-G INPUT/OUTPUT	S	CI	HE	ED	ULE			
NEW OR	DEVICE		TYI	PE	lat	140	MIDE		FROM	TO
EXISTING	DESCRIPTION	FUNCTION DESCRIPTION		100	X	AU	18 TSP	PLC ADDRESS	TEMP SENSOR	PLC-G
NEW		LLPS PUMP ROOM TEMP STATUS	-	-	Ŷ	-	18 TSP		TEMP SENSOR	PLC-G
EVISTING		LEPS GENERATOR ROOM TEMP STATUS	x	-	1	-	(2)#14		MCC-2	PLC-G
NEW		LOW LIFT SCREEN SC-101 RUNNING LOW SPEED	x	-	1	-	(2)#14		MCC-2	PLC-G
EXISTING		LOW LIFT SCREEN SC-101 HIGH DIFFERENTIAL PRESSURE	X	-	1	-	(2)#14		EXISTING PANEL	PLC-G
EXISTING		LOW LIFT SCREEN SC-107 HIGH DITTERENTIAL TREGOGRE	x	-	-	-	(2)#14		SC-102 PANEL	PLC-G
EXISTING		LOW LIFT SCREEN SC 102 KONINING	1x	-	-	-	(2)#14		SC-102 PANEL	PLC-G
NEW		LOW LIFT SCREEN SC 102 LOSS OF SDDAY WATER DRESSURE	X	-	-	-	(2)#14		SC-102 PANEL	PLC-G
EVISTING		SHOPEWELL LEVEL BEFORE SCREEN	r~	-	x	-	18 TSP		EXISTING SENSOR	PLC-G
NEW			-	-	X	-	18 TSP		EXISTING SENSOR	PLC-G
			x	+	<u> </u>	-	(2)#14		MSWB-1A	PLC-G
NEW			Ŷ	-	-	-	(2)#14		ATS-102	PLC-G
NEW		LOW LIFT NORWAL POWER AFMR-18 PAILORE	1x	-	-	-	(2)#14		MSWB-1A	PLC-G
NEW		LOW LIFT ON XEMP.18 UTILITY POWER SOURCE	1x	-	-	-	(2)#14		ATS-102	PLC-G
NEW		LOW LIFT ON GENERATOR GEN-102 STANDRY POWER SOURCE	X	+	-	-	(2)#14		ATS-102	PLC-G
NEW		LOW LIFT ON GENERATOR GEN-102 STANDST FOWER SOURCE	1x	-	1	-	(2)#14		GEN-102	PLC-G
NEW		LOW LIFT GENERATOR GEN 102 REMOTE E STOP	r^	x	-	-	(2)#14		GEN-102	PLC-G
EXISTING		LOW LIFT GENERATOR GEN-102 REMOTE E-STOP	X	r-	-	-	(2)#14		EXISTING PANEL	PLC-G
EVICTING			X	-	-	-	(2)#14		EXISTING PANEL	PLC-G
EXISTING			12	-	-	-	(2)#14		MCC-2	PLC-G
NEW		EDUCTOR PUMP P-4003 RUNNING	<u>^</u>	Y	-	-	(2)#14		MCC-2	PLC-G
NEW		EDUCTOR POMP P-4003 REMOTE E-STOP	V	^	-	-	(2)#14		MCC-2	PLCC
NEW		NAW WATER SUPPLY BOUSTER PUMP P-4004 RUNNING	^	V	-	-	(2)#14		MCC-2	PLCC
NEW		KAW WATER SUPPLY BOUSTER PUMP P-4004 REMOTE E-STOP	v	^	-	-	(2)#14		MCC-2	PLCC
NEW		MIX TANK AGITATOR M-4007 RUNNING	~	V	-	-	(2)#14		MCC 2	PLC-G
NEW		MIX TANK AGITATOR M-4007 REMOTE E-STOP	-	A	V	-	(2)#14		NICC-2	PLC-G
NEW		POTASSIUM PERMANGANATE TANK T-4007 LEVEL	V	-	X	-	2#18		LI1-4007	PLC-G
EXISTING		POTASSIUM PERMANGANATE PUMP P-4010 RUNNING	X	1	-	-	(2)#14		510-4010	PLC-G
EXISTING		POTASSIUM PERMANGANATE PUMP P-4010 RUN COMMAND	-	X	-	-	(2)#14		SIC-4010	PLC-G
NEW		POTASSIUM PERMANGANATE PUMP P-4010 FLOW RATE	-	-	X	1	2#18		SIC-4010	PLC-G
EXISTING		POTASSIUM PERMANGANATE PUMP P-4010 FLOW COMMAND	-	-	-	X	2#18		SIC-4010	PLC-G
NEW	Concernance and the second	POTASSIUM PERMANGANATE PUMP P-4011 RUNNING	X				(2)#14		SIC-4011	PLC-G
NEW		POTASSIUM PERMANGANATE PUMP P-4011 RUN COMMAND		X			(2)#14		SIC-4011	PLC-G
NEW		POTASSIUM PERMANGANATE PUMP P-4011 FLOW RATE			X		2#18		SIC-4011	PLC-G
NEW		POTASSIUM PERMANGANATE PUMP P-4011 FLOW COMMAND				X	2#18		SIC-4011	PLC-G
EXISTING		LOW LIFT PUMP #1 RUNNING	X	1			(2)#14		MCC-1A	PLC-G
EXISTING		LOW LIFT PUMP #2 RUNNING	Х				(2)#14		VFD	PLC-G
EXISTING		LOW LIFT PUMP #3 RUNNING	Х			1.1	(2)#14		MCC-1A	PLC-G
EXISTING		LOW LIFT PUMP #4 RUNNING	Х				(2)#14		MCC-1A	PLC-G
EXISTING		LOW LIFT PUMP #5 RUNNING	X				(2)#14		MCC-1B	PLC-G
EXISTING		LOW LIFT PUMP #6 RUNNING	X				(2)#14		MCC-1B	PLC-G
EXISTING		LOW LIFT PUMP #7 RUNNING	X	1			(2)#14	1	VFD	PLC-G
EXISTING		LOW LIFT PUMP #8 RUNNING	Х				(2)#14		MCC-1B	PLC-G
NEW		LOW LIFT PUMP #1 FAIL STATUS	X		1		(2)#14		MCC-1A	PLC-G
EXISTING		LOW LIFT PUMP #2 DRIVE FAIL STATUS	X	-	-		(2)#14		VFD	PLC-G
NEW		LOW LIFT PUMP #3 FAIL STATUS	X	-	-		(2)#14		MCC-1A	PLC-G
NEW		LOW LIFT PUMP #4 FAIL STATUS	X	1	1		(2)#14		MCC-1A	PLC-G
FUTURE		LOW LIFT PUMP #5 FAIL STATUS	X	-			(2)#14		MCC-1B	PLC-G
UTURE		LOW LIFT PUMP #6 FAIL STATUS	X		1		(2)#14		MCC-1B	PLC-G
XISTING		LOW LIFT PUMP #7 DRIVE FAIL STATUS	X	-	1		(2)#14		PLC-C2	PLC-G
JEW		LOW LIFT PUMP #8 FAIL STATUS	X	-	1		(2)#14		MCC-1B	PLC-G
XISTING		LOW LIFT PLIMP #1 RUN COMMAND	1	X	-	1	(2)#14		MCC-1A	PLC-G
XISTING		LOW LIFT PUMP #2 RUN COMMAND	-	X	-		(2)#14		VFD	PLC-G
XISTING		LOW LIFT PUMP #3 RUN COMMAND	-	X	-		(2)#14		MCC-1A	PLC-G
XISTING		LOW LIFT PUMP #4 RUN COMMAND	-	X	-		(2)#14		MCC-1A	PLC-G
TITURE		LOW LIFT PLIMP #5 PLIN COMMAND	1	X	-		(2)#14		MCC-1B	PLC-G
UTUPE			-	x	-		(2)#14		MCC-1B	PLC-G
VISTING			-	X	-	-	(2)#14		VED	PLC-G
VISTING			-	X	-	1-1	(2)#14		MCC-1B	PLC-G
VICTING			Y	^	-	-	(2)#14	-	CE-101 PANEL	PLC-G
LAISTING		LOW LIFT CARBON FEEDER GENERAL ALAKM	<u>^</u>	V	-	-	(2)#14		PICG	CE-101 DANEL
1EW		LOW LIFT CARBON FEEDER REMOTE START	-	^	v	-	(2)#14		CE 10 PANEL	PIC.C
EW		LOW LIFT CARBON FEED RATE	-	-	^	V	10 15P		PLCC	CE 101 DANICI
XISTING		LOW LIFT CARBON FEEDER RATE COMMAND	V	-	-	^	10 15P		MCC 2	DIC C
NEW		WASH WATER PUMP WWP-101 KUNNING	A V	-	-	-	(2)#14		MCC 2	PLC-C
NEW		WASH WATER PUMP WWP-101 IN AUTO POSITION	X	-	-	-	(2)#14		MCC-2	PLC-G
NEW		RAW WATER SAMPLE PUMP RWP-101 RUNNING	X		-		(2)#14		MCC-2	PLC-G
NEW		RAW WATER SAMPLE PUMP RWP-101 RUN COMMAND		X	-		(2)#14		MCC-2	PLC-G
NEW		RAW WATER SAMPLE PUMP RWP-101 IN AUTO POSITION	Х				(2)#14		MCC-2	PLC-G
VEW		SPRAY WATER PUMP SWP-102 RUNNING	Х				(2)#14		MCC-2	PLC-G
EW		SPRAY WATER PUMP SWP-102 IN AUTO POSITION	Х				(2)#14		MCC-2	PLC-G
IEW		EXHAUST FAN EF-105 RUNNING	Х				(2)#14		VFD-105	PLC-G
EW		EXHAUST FAN EF-105 RUN COMMAND		Х			(2)#14		VFD-105	PLC-G
EW		EXHAUST FAN EF-105 IN AUTO POSITION	Х				(2)#14		VFD-105	PLC-G
EW	2.44119.04119.0004	EXHAUST FAN EF-105 SPEED COMMAND			X		18 TSP		VFD-105	PLC-G
IEW		EYEWASH STATION IN USE	X				(2)#14		LOCAL STATION	PLC-G
1000			-	-	-					

NOTES: 1. DEVICE DESCRIPTION AND PLC ADDRESS TO BE DETEMINED DURING CONSTRUCTION BY THE OWNER. 2. CONTRACTOR SHALL COORDINATE WITH EQUIPMENT BEING PROVIDED AND INTERCONNECT DIAGRAMS AND PROVIDE I/O AS REQUIRED TO PROPERLY MONITOR AND CONTROL EQUIPMENT.

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NEW OR	DEVICE		TYPE				T		
EXISTING	DESCRIPTION	FUNCTION DESCRIPTION	DI	DO	AI /	AOWIRE	PLC ADDRESS	FROM	то
NEW		WTP ELECTRICAL ROOM TEMP STATUS			X I	18 TSP		TEMP SENSOR	PLC-A
NEW		MECHANICAL ROOM TEMP STATUS			X	18 TSP		TEMP SENSOR	PLC-A
NEW		WTP ON XFMR-3A WEST UTILITY POWER SOURCE	X			(2)#14		ATS-101	PLC-A
NEW		WTP ON GENERATOR GEN-101 STANDBY POWER SOURCE	X			(2)#14		ATS-101	PLC-A
NEW		WTP GENERATOR GEN-101 RUNNING	X			(2)#14		GEN-101	PLC-A
NEW		WTP GENERATOR GEN-101 REMOTE E-STOP		X		(2)#14		GEN-101	PLC-A
NEW		EXHAUST FAN EF-102 RUNNING	X			(2)#14		MCC-4	PLC-A
NEW		EXHAUST FAN EF-102 RUN COMMAND		X		(2)#14		MCC-4	PLC-A
NEW		EXHAUST FAN EF-102 IN AUTO POSITION	X			(2)#14		MCC-4	PLC-A
NEW		EXHAUST FAN EF-103 RUNNING	X			(2)#14		MCC-4	PLC-A
NEW	Service Station	EXHAUST FAN EF-103 RUN COMMAND		X		(2)#14		MCC-4	PLC-A
NEW	100	EXHAUST FAN EF-103 IN AUTO POSITION	X			(2)#14		MCC-4	PLC-A
NEW		EXHAUST FAN EF-104 RUNNING	X			(2)#14		MCC-4	PLC-A
NEW		EXHAUST FAN EF-104 RUN COMMAND		X		(2)#14		MCC-4	PLC-A
NEW		EXHAUST FAN EF-104 IN AUTO POSITION	X			(2)#14		MCC-4	PLC-A
NEW		BOILER B-101 WATER MAKE-UP FLOW SWITCH WATER LEAK	X			(2)#14		FLOW SWITCH	PLC-A

NOTES: 1. DEVICE DESCRIPTION AND PLC ADDRESS TO BE DETEMINED DURING CONSTRUCTION BY THE OWNER. 2. CONTRACTOR SHALL COORDINATE WITH EQUIPMENT BEING PROVIDED AND INTERCONNECT DIAGRAMS AND PROVIDE I/O AS REQUIRED TO PROPERLY MONITOR AND CONTROL EQUIPMENT.

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SECTION 26 90 05

CONTROL PANEL CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Panel and enclosure requirements for Process Control System.
- B. Items specified in this section shall conform to general requirements of Section 26 90 00.

1.2 RELATED SECTIONS

- A. Section 26 90 00 Process Instrumentation and Controls.
- B. Section 26 90 08 Miscellaneous Control Devices.
- C. Section 26 90 10 Modular Programmable Logic Controllers (PLC).

1.3 MAINTENANCE

- A. Extra Materials:
 - 1. Provide minimum of 5 or 10%, whichever is greater, of each type fuse used on project.
 - 2. Provide minimum of 5 or 10%, whichever is greater, of each type LED style pilot light or bulb for pilot lights used on project.
 - 3. Provide minimum of 5 or 10%, whichever is greater, of each color lens cap used on project.
 - 4. Provide minimum of 30% mounted spare terminals, to be shown as such on panel drawings.

PART 2 PRODUCTS

2.1 ENCLOSURE MANUFACTURERS

- A. Hoffman.
- B. Ritall.
- C. Saginaw.

2.2 GENERAL

- A. All panel construction shall comply with the requirements specified herein, unless specifically specified differently or shown differently on Plans.
- B. Panels shall be constructed using factory-fabricated enclosures.
- C. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to shipment to job-site.
- D. Standard Signal Interfaces: See Section 26 90 00.
- E. Wiring:
 - 1. In addition to NEC and NEMA requirements, wiring shall conform to following:
 - a. Power: 12 AWG stranded minimum, type MTW, 600 V.
 - b. Control: 16 AWG stranded minimum, type MTW, 600 V.
 - c. Analog Signal: Twisted pair, 18 AWG, Beldon 1120 or equal.
 - 2. Wire color code:
 - a. 480V ac hot conductor: Black; 480V ac neutral: Grey
 - b. Grounding conductor: Green.
 - c. 120V ac control conductor, powered from within panel: Red. 120V ac neutral: White.
 - d. 120V ac control conductor, powered from remote source: Yellow. 120V ac neutral: Grey.
 - e. DC (+) power conductor: Blue with white stripe.
 - f. DC (-) power conductor: Blue.
 - g. DC control conductor: Blue.
 - h. Twisted pair cable (-) signal conductor: White.
 - i. Twisted pair cable (+) signal conductor: Black.
 - 3. Design control panels to keep 480-vac power, 120-vac power and discrete signals, and analog and other low voltage signals separated.
 - a. Do not run 480-vac power, 120-vac power and discrete signals, or analog or other low voltage signals in the same conduit or wire-duct.
 - b. Where 480-vac power, 120-vac power and discrete signals, or analog or other low voltage signals must cross, they shall do so at right angles.
 - 4. Wiring Within Wire Duct:
 - a. Wherever feasible plastic wire duct with cover shall be used for routing of wire within control panel.
 - b. Size wire duct to be no more than 50% full.
 - c. Maintain 2" clearance between wire duct and terminals.
 - 5. Wiring outside of wire duct.
 - a. Wiring outside of ducts shall be restrained by use of plastic wire-ties.
 - b. Restrain wiring a minimum of every six inches.
 - c. Provide abrasion protection for wires passing through holes or across abrasive metal edges.
 - d. Adhesive type wire fasteners shall not be used. Hard screw type shall be employed.

- 6. Wiring of PLC I/O modules shall be through pre-wired cable assemblies as specified in Section 26 90 10. Cable assemblies shall have PLC I/O modulespecific wiring arms on one end and cable ends tinned for terminus on terminal blocks on the other.
- F. Terminations:
 - Wiring within control panel shall be continuous and terminated only at terminal 1. blocks or equipment terminals. Splices or butt connectors shall not be used within panel.
 - 2. No more than one wire shall be terminated at any one terminal block on the terminal strip. No more than two wires shall be terminated at any terminal on a component within the control enclosure.
 - 3. Make external connections by way of numbered terminal blocks on numbered terminal strips.
 - 4. When signals are powered from remote locations, switched terminal blocks shall be used for the powered conductor(s).
 - When signals are powered from within panel, fused terminal blocks shall be used 5. for the powered conductor(s).
 - 6. Provide integral bussing system on terminal block array where more than two terminations require common source or drain connection. Jumpered terminations shall not be acceptable.
 - 7. Include provisions for grounding of shields on shielded twisted pair cables entering or leaving panel. Cable shields shall be grounded at terminal block end only.
 - 8. Provide separate terminal strips for each of the following types of signals.
- G. Power Distribution:
 - 1. Panels having 480 vac power supply:
 - a. Provide internal main circuit breaker to isolate power to panel.
 - Provide circuit breakers for all motor starters provided. b.
 - If panel includes separate 120 vac control power supply, provide c. auxiliary contact to isolate control power when main circuit breaker is opened.
 - d. 480/120 control power transformer requirements:
 - Both primary leads shall be fused. e.
 - 1) First secondary lead shall be fused.
 - 2) Second secondary lead shall be grounded.
 - 2. Panels having 120 vac power supply:
 - a. Provide circuit breaker on power supply entering panel.
 - 3. Provide separately fused power supply to each major panel component.
 - Panels using modular or solid state I/O devices. 4.
 - Provide separately fused power circuit for panel powered I/O signals a. entering panel from field devices. Provide separate circuit for each module.
 - b. Include digital transient surge suppressor/varistor installed in parallel with output contact at terminal strip for each output signal driving an inductive load including:

- 2) Solenoids.
- 3) Motor starters.
- 4) Motors.
- H. Labels and Nameplates:

1.

- Panel Designation:
 - a. Engraved with ENGINEER'S tag number and description shown on the P&IDs and in Specifications.
 - b. Laminated white plastic with $\frac{1}{2}$ -in. high black characters.
 - c. Fastened with stainless steel screws or self-tapping fasteners.
- 2. Front of panel mounted devices.
 - a. Provide nameplate for each front of panel device with descriptive phrase using nomenclature as listed in Specifications.
 - b. Laminated white plastic with 3/16-in. high black characters.
 - c. Fastened with stainless steel screws or self-tapping fasteners.
- 3. Rear of panel mounted devices.
 - a. Provide nameplate for each rear of panel device with labels used on panel drawings.
 - b. Laminated white plastic with 1/8-in. high black characters.
 - c. Fastened with stainless steel screws or self-tapping fasteners.
- 4. Wiring.
 - a. Each conductor or twisted pair cable shall be labeled near its termination point.
 - b. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its termination point in addition to the overall jacket.
 - c. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination.
- I. Panel Finish
 - 1. Remove mill scale, grease, and oil.
 - 2. Primer thickness shall be 0.8 mil. minimum.
 - 3. Finish coat shall be two-part epoxy or baked dry powder, 3 mil. minimum dry film thickness.
 - 4. Color: manufacturer's standard gray.
- J. Conveniences
 - 1. Freestanding and floor mounted control panels shall be provided with dooractivated, internal fluorescent panel lighting units. One unit shall be provided for every 3 feet of panel width and shall be mounted on the inside, top of the panel.
 - 2. Freestanding and floor mounted control panels shall be provided with 15-amp, 120-volt, service outlet circuits within the back-of-panel area. The circuits shall be provided with three-wire, 120-volt, 15-ampere, duplex receptacles, one for every 3 feet of panel width and spaced evenly along the back-of-panel area.

2.3 PANEL CONSTRUCTION

- A. Enclosures shall conform to NEMA requirements as follows:
 - 1. NEMA 12.
 - 2. All panels shall be manufactured, listed, and labeled for UL 508 A
 - 3. All panels with intrinsically safe circuits shall be manufactured, listed, and labeled for UL698A.
- B. In addition to NEMA standards, conform to the following requirements:
 - 1. Minimum metal thickness: 14 Ga.
 - 2. Indoor Enclosures: Equip with rubber-gasketed doors with continuous metal hinges. Equip doors with 3-point lockable latches.
 - 3. Outdoor Enclosures: Equip with hinged dead-front inner doors and rubbergasketed, continuous metal hinged outer weather doors. Equip weather doors with 3-point lockable latches and gasketed, transparent panel for viewing of inner door mounted devices.
 - 4. Size to adequately dissipate heat generated by equipment mounted in or on panel. Heat dissipation shall be sufficient for internal panel temperature to not exceed temperature rating of internal panel components.
 - 5. Equip Outdoor Enclosures with thermostatically controlled heaters capable of maintaining internal panel temperature of 50 °F with 20 mph wind at ambient temperature of -20 °F. Heater shall operate at 110 vac, 60 Hz power.
 - 6. Provide all enclosures with thermostatically controlled cooling system. System shall be part of UL system design and certification.
 - 7. Provide cooling calculations and cooling system design for all panels that incorporate active electronics of any kind.
- C. Prior to final fabrication of panels, verify layout of front-of-panel devices with respect to rear-of-panel devices. Maintain minimum of 3 inches clearance between door and sub-panel mounted devices.

2.4 SOURCE QUALITY CONTROL

- A. In-Factory Inspection.
 - 1. Verify following in accordance with approved submittals:
 - a. Panel dimensions.
 - b. Equipment layout.
 - c. Wiring.
 - d. Wire and terminal identification.
 - 2. Verify proper access to equipment for maintenance.
 - 3. Verify proper access to field wire and fiber optic termination points.
 - 4. Inspect for neatness of wiring and wire harness construction.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panels in locations indicated on Drawings and in accordance with System Integrator and manufacturer's written instructions and approved submittals.
- B. Touch-up panel finish if marred during installation.

SECTION 26 90 08

MISCELLANEOUS CONTROL DEVICES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Control Devices.

1.2 RELATED SECTIONS:

- A. Section 26 24 19 Motor Control Centers.
- B. Section 26 29 23 Variable Frequency Motor Controllers.
- C. Section 26 90 00 Process Instrumentation and Control.
- D. Section 26 90 05 Control Panel Construction.

1.3 REFERENCES

- A. American National Standards Institute (ANSI).
- B. Institute of Electrical and Electronics Engineers (IEEE).
- C. Underwriters Laboratory (UL).

1.4 QUALITY ASSURANCE

- A. Standardization:
 - 1. Devices shall be latest and most modern design at time of bidding.
 - 2. As much as possible devices shall be products of one manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

PART 2 PRODUCTS

2.1 PUSHBUTTONS, SELECTOR SWITCHES AND PILOT LIGHTS

- A. Manufacturers:
 - 1. Allen Bradley.
 - 2. Square D.
 - 3. Cutler-Hammer.
 - 4. Or equal.
- B. Construction:
 - 1. Heavy duty.

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- 2. Watertight.
- 3. Oil-tight.
- 4. Flush panel mounting.
- 5. Size to mount in 30.5-mm diameter.
- 6. Match NEMA rating of related enclosure.
- C. Control Stations:
 - 1. Describes enclosures used to house field pilot devices.
 - 2. Control stations mounted outside of buildings must include locking cover mechanism over all control pushbuttons or handswitches.
 - 3. NEMA ratings:
 - a. NEMA 4X 316 stainless steel in indoor wet/corrosive locations or outdoors.
 - b. NEMA 12 in other areas.
 - 4. Nameplates:
 - a. Engraved laminated plastic.
 - b. Letters 3/16 in. high.
 - c. Black letters on white background.
 - d. Identify per equipment controlled, using names found on Drawings.
 - 5. Each control station shall be mounted at the elevation and within 10 feet of respective motor being controlled.
- D. Pushbuttons:

3.

- 1. Flush head unless specified elsewhere.
- 2. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Single pole, double throw or double pole, single throw.
 - d. Up to six tandem blocks.
 - Momentary contact unless specified elsewhere.
- 4. Non-illuminated.
- 5. Legend plates, as required, for type of operation or as specified elsewhere.
- E. Remote Emergency Stop:
 - 1. Jumbo red mushroom head.
 - 2. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Single pole, double throw or double pole, single throw.
 - d. Up to six tandem blocks.
 - 3. Push/pull.
 - 4. Maintained contact.
 - 5. Non-illuminated.
 - 6. Legend plates:
 - a. Extra large.
 - b. Red.
 - c. Emergency.

- F. Selector Switches:
 - 1. Maintained position unless specified elsewhere.
 - 2. Contact Blocks:
 - a. Double break silver contacts.
 - b. Ac Ratings: 7,200 va make, 720 va break.
 - c. Single pole, double throw or double pole, single throw.
 - d. Up to six tandem blocks.
 - 3. Operators:
 - a. Number of positions as specified elsewhere.
 - b. Standard knob type unless specified elsewhere.
 - 4. Legend plates as required for type of operation or specified elsewhere.
- G. Pilot Lights:
 - 1. LED Lamp.
 - 2. Transformer type.
 - 3. Bayonet, bulb.
 - 4. Colored lens as specified elsewhere.
 - 5. Interchangeable lenses.
 - 6. Transformer rated for 120 v, 60 Hz.
 - 7. Push to test.
 - 8. Legend plates as specified elsewhere.
- H. Nameplates:
 - 1. Engraved laminated plastic.
 - 2. Letters 3/16 in. high.
 - 3. Black letters on white background.
 - 4. Identify per equipment controlled, using names found on Drawings.

2.2 CONTROL RELAYS

- A. Manufacturers:
 - 1. Potter and Brumfield.
 - 2. Struthers Dunn.
 - 3. Or equal.
- B. Operating Data:
 - 1. Pickup Time: 13 ms maximum.
 - 2. Dropout Time: 10 ms maximum.
 - 3. Operating Temperature: -45°F to 150°F.
- C. AC Coil:
 - 1. 120 or 240 vac.
 - 2. Continuous rated.
 - 3. 3.5 va inrush maximum.
 - 4. 1.2 va sealed, maximum.
 - 5. 50 to 60 Hz.
 - 6. Minimum Dropout Voltage: 10% of coil rated voltage.

- D. DC Coil:
 - 1. 24 or 120 Vdc.
 - 2. Continuous rated.
 - 3. Minimum Coil Resistance:
 - a. 24 Vdc: 450 Ω.
 - b. 120 Vdc: 9,000 Ω.
- E. Contacts:
 - 1. Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
 - 2. Silver cadmium oxide.
 - 3. 4 form C.
 - 4. 120 vac.
 - 5. 10 amp make, 1.5 amp break, (inductive).
- F. Rated at 10 million operations.
- G. DIN rail mountable.
- H. Enclosed and protected by polycarbonate cover.
- I. Provide with check button and indicator.
- J. Provide relay-retaining clips.

2.3 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Phoenix Contact.
 - 2. Weidmuller.
 - 3. Or equal.
- B. 300V rating for 120V circuits and below, 600V rating for 480V circuits.
- C. Clamping screw or captive-cage type.
- D. Isolating end caps for each terminal.
- E. Identification on both terminals.
- F. Clip-mounted on DIN rail.
- G. Accept AWG 12 to 22.
- H. Feed-Through Terminals: 1. 20 Amp rating
- I. Switched Terminals:
 - 1. Knife disconnect with test sockets.
 - 2. 10 Amp rating.

- J. Fused Terminals:
 - 1. Hinged fuse removal/disconnect.
 - 2. 10 Amp rating.
 - 3. Include blown fuse indication.

2.4 ELECTRONIC CURRENT ISOLATOR

- A. Manufacturers:
 - 1. Phoenix Contact Model MCR Series.
- B. Solid-state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20 mAdc input signal and provide equal but isolated and power-boosted output.
- C. Mounting: DIN Rail.
- D. Temperature compensated, calibration-free.
- E. Signals: Input: 4-20 mAdc into 50 ohms. Output: 4-20 mAdc into output load up to 500 ohms.
- F. Isolation: Common mode up to 700 vac between input and output.
- G. Accuracy: 0.5% of span.
- H. Provide power supply specific to isolator.

2.5 PROXIMITY SWITCHES – INTRUSION

- A. Manufacturers:
 - 1. Sentrol.
 - 2. Or equal.
- B. Proximity switch for monitoring building or control panel door position.
- C. Solid State Hall Effect sensor with magnetic actuating bar.
- D. Switch shall be commercial type. Inductive, barrel type switches not acceptable.
- E. Provide dry contacts suitable for connection to PLC input, using logic amplifier or interposing conversion relay per manufacturers recommendations

2.6 TEMPERATURE SWITCHES – PANEL STATUS

- A. Manufacturers:
 - 1. Honeywell.
 - 2. Or equal.

- B. Adjustable temperature set point.
- C. Fixed differential type with automatic reset.
- D. SPDT snap action dry contacts suitable for connection to PLC input.
- E. Surface mount.
- F. Remote capillary tube as indicated on the drawings.

2.7 INLINE ETHERNET LIGHTNING AND SURGE PROTECTORS

- A. Manufacturers:
 - 1. APC.
 - 2. SixNet
 - 3. Phoenix Contact
 - 4. Or equal.
- B. Surge Protection and Filtering
 - 1. Peak Current Normal Mode 6.50 k Amps
 - 2. Peak Current Common Mode 0.25 k Amps
 - 3. NM Surge Response Time (ns) 1 ns
 - 4. Data line protection RJ45 10/100/1000 Base-T Ethernet protection
 - 5. Data line protected (multi-line only) 1-8
 - 6. Let through voltage rating < 60
- C. Environmental:
 - 1. Operating Environment $-15 65^{\circ}$ F (-15 65 C)
 - 2. Operating Relative Humidity 0 95%
 - 3. Storage Temperature -15 65 F (-15 65 C)
 - 4. Storage Relative Humidity 0 95%
- D. Conformance:
 - 1. Regulatory Approvals UL 497B.
 - 2. Standard Warranty Lifetime.
 - 3. UL 1449 TVSS Rating 330 V.

2.8 LINE VOLTAGE 120-480 VAC SURGE SUPPRESSION

- A. Manufacturers:
 - 1. Phoenix Contact FLT.
 - 2. Or equal.
- B. Type 1/Class I/B lighting current arrestor.
- C. DIN Rail mounted.
- D. 3 or 4 channel as required by application.

- E. Nominal discharge current: 100kA
- F. Lightning test current: peak value 100kA
- G. Protection level Up (L-PEN): <0.9 kV
- H. Response time (L-N) (L-L) (L-G): < 1 microsecond
- I. Provide for all control panels.

2.9 TEMPERATURE SWITCHES

- A. Manufacturers:
 - 1. Johnson Control.
 - 2. Or equal.
- B. Provide and install analog type temperature sensors for monitoring low and high temperature detection as shown and described on the drawings. Temperature sensor shall have local readout.

PART 3 EXECUTION

- 3.1 INSTALLATION
 - A. Install and wire in accordance with System Integrator's and/or Equipment manufacturer's written instructions and approved submittals, applicable requirements of the NEC, NECA "Standard of Installation," and recognized industry practices.
 - B. For temperature switches, install in locations indicated and as scheduled. Exact sensor location shall be per manufacturer's requirements and installed to be optimized for sensing temperatures in the location described. Sensors for classified locations shall include intrinsic barrier protection or be located outside of the area with remote bulb.

SECTION 26 90 10

MODULAR PROGRAMMABLE LOGIC CONTROLLER (PLC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Modular programmable logic controller (PLC) technology.

1.2 RELATED SECTIONS

A. Section 26 90 00 – Process Instrumentation and Controls

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's data sheets and catalog literature.
- C. Detailed Bill of Materials.

PART 2 PRODUCTS

- 2.1 GENERAL
 - A. Perform stand-alone monitoring and control and include the following as a minimum.
 - 1. Microprocessor based controller (PLC processor) to execute program instructions, store data, and control data transfer.
 - 2. PLC memory.
 - 3. I/O subsystem interfaces.
 - 4. Power supply, including power conditioning and surge protection.
 - 5. Communication interfaces.
 - 6. Programming interface.
 - B. Modular construction.

2.2 MANUFACTURERS

- A. All equipment specified in this Section shall be the product of a single manufacturer.
- B. Manufacturer:
 - 1. Rockwell Automation.
 - 2. No substitutions.

2.3 HARDWARE

- A. Microprocessor based controller (PLC processor): SLC-5/05 with Ethernet connection, no equals.
- B. PLC memory: 32 K. Provide EEPROM memory cartridge for program backup.
- C. I/O subsystem interfaces: The input/output subsystem shall consist of all the hardware for the CPU to communicate with the specified types of input and output modules. The input/output system shall consist of I/O racks and the I/O modules.
 - 1. I/O Racks (10 slot racks): 1746-A series.
 - 2. Discrete Input Modules (16 point): 1746-IA16.
 - 3. Discrete Relay Output Modules (8 point): 1746-OX8 or 1746-OW16.
 - 4. Analog Input Modules (Isolated, 8 point): 1746-NI8.
 - 5. Analog Output Modules (Isolated, 4 point): 1746-NO4I.
 - 6. Modbus/IP communication module to read power metering data over Ethernet.
- D. Programming Software: Software shall be RSLogix 500 latest version.
- E. Installed spare I/O Terminals: Provide 20% spare input and output terminals with a minimum of 8 extra spare points each on I/O Modules for discrete input, discrete output, analog input, and analog output.

2.4 WIRING AND TERMINATION SYSTEMS

- A. Wiring of PLC I/O modules shall be through cable assemblies and termination modules.
- B. Cable assemblies shall be pre-wired and shall have PLC I/O module-specific wiring arms on one end and cable connectors specific to an associated termination module on the other.
- C. Termination modules shall be high-density terminal block assemblies connecting to respective PLC I/O module via pre-wired cable assemblies.
- D. One termination module shall be dedicated to each PLC I/O module.
- E. Termination modules shall be specific to the respective I/O module.
- F. Provide sufficient terminations to accommodate active I/O pints, spares, and future expansion.
- G. All inputs and outputs shall be prewired to separate field terminal blocks within their respective panel.
- H. All PLC I/O shall be wired to terminal strip points with the PLC Panel.

2.5 PLC PROGRAMMING INTERFACE

A. Interface hardware and cables shall be provided to allow programming of PLC processor using OWNER'S personal computer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install and wire in accordance with System Integrator's and/or Equipment manufacturer's written instructions and approved submittals.

SECTION 27 13 43

COMMUNICATIONS SERVICES CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Copper cables, connectors, and faceplates.
- B. Coaxial cables, connectors, and faceplates.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Telecommunications Industry Association/Electronic Industries Alliance:
 - 1. TIA/EIA 568 Commercial Building Telecommunications Cabling Standard.
 - 2. TIA/EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces.
- D. Underwriters Laboratories, Inc.:
 - 1. UL 2043 Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Pathway: Conform to TIA/EIA 569, using raceway and cabinets as indicated on Drawings.
- B. Wiring: Complete from patch panel or control panel to each outlet or device using cables as indicated.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for each termination device, cable, and outlet device.
- C. Test Reports: Indicate procedures and results for specified field testing and inspection.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations and sizes of pathways and outlets.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in installing products specified in this section with minimum three years documented experience and with service facilities within 100 miles of project.
- C. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 DATA OUTLET JACKS

- A. Manufacturers:
 - 1. Krone.
 - 2. Systimax.
 - 3. Panduit.
- B. Product Description: Conform to TIA/EIA 568 requirements for cable connectors for specific cable types. Jacks shall be modular inserts, ivory color, 8 conductor, RJ45 jacks.

2.2 DATA OUTLET FACEPLATES

- A. Manufacturers:
 - 1. Krone.
 - 2. Systimax.
 - 3. Panduit.
- B. Product Description: Faceplates shall be modular type, ivory color, faceplate that will accept snap-in termination modules. Unused ports shall be filled with blank inserts.

2.3 DATA CABLE

- A. Manufacturers:
 - 1. Belden.
 - 2. Approved equal.
- B. Product Description: TIA/EIA 568, 100-ohm, Category 6E unshielded twisted pair plenum rated noncombustible cable with 4 pairs, 24 AWG copper conductor.

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C. Provide Category 6E patch cables with lengths as required for connection to data outlets and switches.

2.4 2-CONDUCTOR UNSHIELDED CABLE

- A. Manufacturers:
 - 1. Belden #9740.
 - 2. Approved equal.
- B. Product Description: 1-twisted pair, #18 AWG tinned copper (16x30) stranding cable with PVC insulation and chrome PVC jacket.

2.5 MULTI CONDUCTOR UNSHIELDED CABLE

A. Same classification and rating as Belden #9740, except for different quantity of pairs and size of wire as indicated on the Drawings.

2.6 2-CONDUCTOR SHIELDED CABLE

- A. Manufacturers:
 - 1. Belden #9460.
 - 2. Approved equal.
- B. Product Description: 1-twisted pair, #18 AWG tinned copper (16x30) stranding cable with polyethylene insulation with chrome PVC jacket. Cable shall have Beldfoil shield +55% tinned copper braid, 100% shield coverage.

2.7 MULTI CONDUCTOR SHIELDED CABLE

A. Same classification and rating as Belden #9460, except for different quantity of pairs and size of wire as indicated on the Drawings.

2.8 COAXIAL CABLE

- A. Manufacturers:
 - 1. Belden.
 - 2. Approved equal.
- B. Product Description: TIA/EIA 568, 50-ohm coaxial RG-6 cable with "F" type connector with universal attached ½" ferrule for RG-6 cable.

PART 3 EXECUTION

- 3.1 EXISTING WORK
 - A. Remove exposed abandoned communication cables and pathways, including abandoned cables and pathways above accessible ceiling finishes. Cut flush with walls and floors, and patch surfaces.

- B. Disconnect and remove abandoned communications equipment.
- C. Maintain access to existing communications equipment, cabling, and terminations and other installations remaining active and requiring access. Modify installation or provide access panel.
- D. Extend existing communications installations using materials and methods compatible with existing installations, or as specified.

3.2 INSTALLATION

- A. Install pathways in accordance with TIA/EIA 569.
- B. Install wire and cable in accordance with TIA/EIA 568.
- C. Install cabinets plumb and attach securely to building wall at each corner.
- D. Install polyethylene pulling string in each empty conduit over 10 feet in length or containing bends.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53.
- F. Ground and bond pathways, cable shields, and equipment in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Equipment Testing and Facility Startup: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test copper cables and terminations in accordance with TIA/EIA 568.

SECTION 31 05 13

SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Subsoil materials.
- B. Topsoil materials.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
 - 2. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S2:
 - 1. Excavated and reused material.
 - 2. Graded.
 - 3. Free of lumps larger than 3 inches and debris.

2.2 TOPSOIL MATERIALS

- A. Topsoil Type S4:
 - 1. Excavated and reused material.
 - 2. Graded.
 - 3. Loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils adapted to sustain plant life.
 - 4. Ph range of 6.0 to 7.0.
 - 5. Free of roots, rocks larger than ¹/₂ inch, subsoil, debris, large weeds and foreign matter.
 - a. Screening: Single screened.

2.3 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
- B. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials. Provide silt fence around stockpile.
- C. Remove excess excavated materials and topsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site next to excavation area.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Stockpile topsoil 8 feet high maximum.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- G. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

SECTION 31 05 16

AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coarse aggregate materials.
- B. Fine aggregate materials.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 - 2. AASHTO T180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

- 1. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- 2. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- 3. ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 4. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- 5. ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate Type A2 (Gravel): AASHTO M147; passing No. 6 sieve with liquid limit of not more than 25; plasticity index of not more than five in accordance with ASTM D4318.
- B. Coarse Aggregate Type A3 (Gravel): Crushed: Pit run washed stone; free of shale, clay, friable material and debris; graded in accordance with ASTM C136, ASTM D2487 Group Symbol GW; within the following limits:

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Sieve Size	Percent Passing
2 inches	100
1 inch	95
3/4 inch	95 to 100
5/8 inches	75 to 100
3/8 inches	55 to 85
No. 4	35 to 60
No. 16	15 to 35
No. 40	10 to 25
No. 200	5 to 10

- C. Aggregate Type A4 (Pea Gravel): Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM D2487 Group Symbol GM; to the following limits:
 - 1. Minimum Size: $\frac{1}{4}$ inch.
 - 2. Maximum Size: 5/8 inch.

2.2 FINE AGGREGATE MATERIALS

A. Fine Aggregate Type A6 (Sand): Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM D2487 Group Symbol SW; within the following limits:

Sieve Size	Percent Passing				
No. 4	100				
No. 14	10 to 100				
No. 50	5 to 90				
No. 100	4 to 30				
No. 200	0				

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Testing and inspection services.
- B. Coarse Aggregate Material Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, or AASHTO T180 as directed by the Engineer.
- C. Fine Aggregate Material Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, or AASHTO T180 as directed by the Engineer.
- D. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Stockpile excavated material meeting requirements for coarse aggregate materials and fine aggregate materials.
- B. Remove excess excavated materials, coarse aggregate materials, and fine aggregate materials not intended for reuse, from site.
- C. Remove excavated materials not meeting requirements for coarse aggregate materials and fine aggregate materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations as directed by Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavating topsoil.
- B. Excavating subsoil.
- C. Cutting, grading, filling, rough contouring, and compacting site for site structures and building pads.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

- 1. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- 2. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- 3. ASTM D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
- 4. ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 5. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- 6. ASTM D2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- 7. ASTM D2434 Standard Test Method for Permeability of Granular Soils (Constant Head).
- 8. ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 9. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: As specified in Section 31 05 13.
- B. Subsoil Fill: As specified in Section 31 05 13.
- C. Granular Fill: As specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service provided in the Contract Documents not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.

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- C. Stockpile in area designated on site to height not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.
- D. Remove excess topsoil not intended for reuse, from site.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work shall be performed in a workmanlike manner to avoid unnecessary damage.
- D. Remove excess subsoil not intended for reuse, from site.
- E. Stockpile excavated material in area designated on site in accordance with Section 31 05 13 and 31 05 16.
- F. Benching Slopes: Horizontally bench existing slopes greater than 1: 4 to key placed fill material to slope to provide firm bearing.
- G. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth.
 - 2. Structural Fill: Maximum 6 inches compacted depth.
 - 3. Granular Fill: Maximum 6 inches compacted depth.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Repair or replace items indicated to remain damaged by excavation or filling.

3.6 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557, ASTM D698, or AASHTO T180.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.8 SCHEDULES

- A. Subsoil Fill:
 - 1. To subgrade elevation.
 - 2. Compact uniformly to minimum 95 percent of maximum density.
- B. Topsoil Fill:
 - 1. To subgrade elevation.
 - 2. Compact uniformly to minimum 95 percent of maximum density.

SECTION 31 23 16

EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavating for site structures.
- B. Excavating for landscaping.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
 - 2. ASTM D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 4. ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with State and Municipality standard.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect utilities indicated to remain from damage.
- B. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- C. Protect existing structures, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
3.2 EXCAVATION

- A. Excavate subsoil to accommodate site structures and construction operations.
- B. Excavate to working elevation for piling work.
- C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.
- D. Slope banks with machine to angle of repose or less until shored.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- H. Notify Engineer of unexpected subsurface conditions.
- I. Remove excess and unsuitable material from site.
- J. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.
- K. Repair or replace items indicated to remain damaged by excavation.

3.3 **PROTECTION**

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

SECTION 31 23 17

TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavating trenches for utilities from 5 feet outside building to utility service.
- B. Compacted fill from top of utility bedding to subgrade elevations.
- C. Backfilling and compaction.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

- 1. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- 2. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- 3. ASTM D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
- 4. ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 5. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- 6. ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 7. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

- C. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- D. Materials Source: Submit name of imported fill materials suppliers.

1.5 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Illinois.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

- 2.1 FILL MATERIALS
 - A. Subsoil Fill: As specified in Section 31 05 13.
 - B. Granular Fill: As specified in Section 31 05 16.
 - C. Concrete: Backfill Controlled Low Strength according to WISDOT Special Provision Item 209.0200.S.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, woven.
 - 1. Alkzo Nobel Geosynthetic Co.
 - 2. Huesker, Inc.
 - 3. TC Mirafi.
 - 4. Tenax Corp.
 - 5. Tensar Earth Technologies, Inc.

PART 3 EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. Architect/Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

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Trenching 31 23 17 -2

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Call Local Utility Line Information service as indicated on the Drawings not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

- A. Excavate subsoil required for utilities to utility service.
- B. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yard, measured by volume. Remove larger material as specified in Section 31 23 18.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
- D. Do not advance open trench more than 200 feet ahead of installed pipe.
- E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe utilities.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls can not be sloped, provide sheeting and shoring to protect excavation as specified in this section.
- J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by until suitable material is encountered.

- K. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.
- L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- M. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.
- N. Remove excess subsoil not intended for reuse, from site.
- O. Stockpile excavated material in area designated on site in accordance with Sections 31 05 13 and 31 05 16.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place geotextile fabric prior to placing subsequent fill materials.
- D. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth.
 - 2. Structural Fill: Maximum 6 inches compacted depth.
 - 3. Granular Fill: Maximum 6 inches compacted depth.
- E. Employ placement method that does not disturb or damage foundation perimeter drainage and utilities in trench.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.

- G. Do not leave more than 50 feet of trench open at end of working day.
- H. Protect open trench to prevent danger to Owner and the public.

3.6 TOLERANCES

- A. Section 01 40 00 Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.08 feet from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 0.08 feet from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557, ASTM D698, or AASHTO T180.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- 3.8 PROTECTION OF FINISHED WORK
 - A. Section 01 70 00 Execution and Closeout Requirements: Protecting finished work.
 - B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.9 SCHEDULE

- A. Storm, Sanitary, Water, and Steam Piping:
 - 1. Cover pipe and bedding with Granular or Flowable Fill: To subgrade elevation.
 - 2. Compact uniformly to minimum 95 percent of maximum density.
- B. Duct Bank:
 - 1. Cover duct and bedding with Granular or Flowable Fille: To subgrade elevation.
 - 2. Compact uniformly to minimum 95 percent of maximum density.

SECTION 31 23 18

ROCK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removing identified and discovered rock during excavation.
- B. Expansive tools to assist rock removal.

1.2 DEFINITIONS

- A. Site Rock: Solid mineral material with volume in excess of 1/3 cu yd or solid material that cannot be removed with 3/4 cu yd capacity excavator.
- B. Trench Rock: Solid mineral material with volume in excess of 1/6 cu yd or solid material that cannot be removed with 1/4 cu yd capacity excavator.

PART 2 PRODUCTS

2.1 MATERIALS

A. Mechanical Disintegration Compound: Grout mix of materials that expand on curing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

- A. Excavate and remove rock by mechanical method.
 - 1. Drill holes and use expansive tools, wedges, or mechanical disintegration compound to fracture rock.
- B. Cut away rock at bottom of excavation to form level bearing.
- C. Remove shaled layers to provide sound and unshattered base for foundations.

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Rock Removal 31 23 18 - 1

- D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- E. Remove excavated materials from site.
- F. Correct unauthorized rock removal as directed by Architect/Engineer.
- 3.4 FIELD QUALITY CONTROL
 - A. Request visual inspection of foundation bearing surfaces by Architect/Engineer before installing subsequent work.

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dewatering system.
- B. Surface water control system.
- C. Monitoring wells.
- D. System operation and maintenance.
- E. Water disposal.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C33 Standard Specification for Concrete Aggregates.

1.3 DEFINITIONS

- A. Dewatering includes the following:
 - 1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and shafts.
 - 2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and shafts.
 - 3. Disposing of removed water.
- B. Surface Water Control: Removal of surface water within open excavations.

1.4 SYSTEM DESCRIPTION

- A. Provide dewatering and surface water control systems to permit Work to be completed on dry and stable subgrade.
 - 1. Install well points to dewater and relieve hydrostatic pressure within strata identified in subsurface investigation and located at approximate elevation.
- B. Provide monitoring wells and monitoring equipment to obtain meaningful observations of conditions affecting excavation, adjacent structures and adjacent water wells.

1.5 PERFORMANCE REQUIREMENTS

A. Design dewatering systems to:

- 1. Lower water table within areas of excavation to minimum 2 feet below bottom of excavation to permit Work to be completed on dry and stable subgrade.
- 2. Relieve hydrostatic pressures in confined water bearing strata below excavation to eliminate risk of uplift or other instability of excavation.
- 3. Prevent damage to adjacent properties, buildings, structures, utilities, and facilities from construction operations.
- 4. Prevent loss of fines, quick condition, or softening of foundation subgrade.
- 5. Maintain stability of sides and bottoms of excavations and trenches, face, walls, and bottoms of tunnels, and sides and bottoms of shafts.
- B. Design surface water control systems to:
 - 1. Collect and remove surface water and seepage entering excavation.

1.6 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Indicate dewatering system layout, well depths, well screen lengths, dewatering pump locations, pipe sizes and capacities, grades, filter sand gradations, surface water control devices, valves, and water disposal method and location.
 - 2. Indicate primary and standby power system location and capacity.
 - 3. Indicate layout and depth of monitoring wells, piezometers and flow measuring devices for system performance measurement.
 - 4. Include detailed description of dewatering and monitoring system installation procedures and maintenance of equipment.
 - 5. Include description of emergency procedures to follow when problems arise.
- C. Product Data: Submit data for each of the following:
 - 1. Dewatering Pumps: Indicate sizes, capacities, priming method, motor characteristics.
 - 2. Pumping equipment for control of surface water within excavation.
- D. Design Data:
 - 1. Indicate design values, analyses, and calculations to support design.
 - 2. Include description and profile of geology, soil, and groundwater conditions.
- E. Field Reports: Test and monitoring reports as specified in Field Quality Control article.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and depths of capped wells and piping abandoned in place.

1.8 QUALITY ASSURANCE

- A. Comply with authorities having jurisdiction for the following:
 - 1. Drilling and abandoning of wells used for dewatering systems.
 - 2. Water discharge and disposal from pumping operations.
- B. Obtain permit from authorities having jurisdiction for storm water discharge from construction sites.

1.9 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum three years documented experience and responsible for design, operation, and maintenance of dewatering system.
 - 1. Assume sole responsibility for dewatering and surface water control systems and for loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations.
- B. Design, install, and monitor operation of dewatering under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Illinois.

1.10 SEQUENCING

- A. Sequence work to obtain required permits before start of dewatering operations.
- B. Sequence work to install monitoring systems minimum 7 days before testing and operating dewatering systems.
- C. Sequence work to install dewatering and surface water control systems minimum 7 days before starting excavation, trenching, tunneling, and shaft drilling.

1.11 COORDINATION

- A. Coordinate work to permit the following construction operations to be completed on dry stable substrate.
 - 1. Excavation for structures specified in Section 31 23 16.
 - 2. Trenching for utilities specified in Section 31 23 17.

PART 2 PRODUCTS

- 2.1 DEWATERING EQUIPMENT
 - A. Select dewatering equipment to meet specified performance requirements.
 - B. Surface Water Pumps: Self priming, centrifugal semi-open clog resistant impeller; engine driven type; capacity as required based on application.

- 1. Furnish pumps with screened suction hose and discharge hoses as required to suit application.
- C. Riser Pipe:
 - 1. PVC, Schedule 40; 4 inches diameter, flush joint.
- D. Discharge Header Pipe:
 - 1. PVC, Schedule 40; 4 inches diameter, flush joint with rubber slip on joint sleeve and clamps.

2.2 MONITORING EQUIPMENT

- A. Piezometers: Standpipe or Pneumatic type for push in installation to monitor water elevation.
- B. Flow Measurement: Furnish devices as follows:
 - 1. Pitometer installed on discharge of pipe of from each well.
 - 2. Pitometer installed to measure flow from entire dewatering system.

2.3 ACCESSORIES

- A. Valves and Fittings: Furnish valves and fittings to isolate each well from header pipe and to prevent loss of pump prime.
- B. Filter Sand: ASTM C33; natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded to suit well screen.
- C. Grout: Mixture of portland cement and bentonite clay or sand suitable for sealing abandoned wells and piping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Conduct additional borings and investigations to supplement subsurface investigations identified in Section 00 31 00 as required to complete dewatering system design.
- B. Employ licensed land surveyor to provide following documentation:
 - 1. Survey existing adjacent buildings, structures, and improvements for position and elevation of principal elements before and after completion of dewatering operations.

3.2 PREPARATION

A. Protect existing adjacent buildings, structures, and improvements from damage caused by dewatering operations.

3.3 MONITORING WELLS

- A. Install monitoring wells at locations indicated on shop drawings as specified for dewatering wells.
- B. Test each monitoring well point to verify installation is performing properly.
- C. Install piezometers, calibrate, and test for proper operation.
- D. Protect monitoring well standpipes from damage by construction operations.
- E. Maintain accessibility to monitoring wells continuously during construction operations.
- F. Maintain monitoring wells until groundwater is allowed to return to normal level.

3.4 DEWATERING SYSTEM

- A. Install dewatering system in accordance with shop drawings.
- B. Locate system components to allow continuous dewatering operations without interfering with installation of permanent Work and existing public rights-of-way, sidewalks, and adjacent buildings, structures, and improvements.
- C. Drill wells in sizes and to depth indicated. Provide temporary surface casing when required to stabilize soil while advancing well.
- D. While drilling and installing well keep bore hole filled with natural or organic drilling fluid. Bentonite clay drilling fluid is not permitted.
- E. Attach well screen to riser pipe. Attach centralizers to riser pipe at maximum 20 feet spacing to keep screen and riser centered in bore hole. Insert well screen and riser pipe into well to elevation indicated.
- F. Install sand filter surrounding well screen.
- G. Develop wells by over pumping to remove clay, silt, and sand from well screen and immediate vicinity of bore hole.
- H. Test well for proper water flow through well screen and pumping rate for dewatering system operation. Repeat development until well meets performance requirements.
- I. Cover and seal top of well until pump is installed.
- J. Install pumps in accordance with manufacturer's instructions.
- K. Connect pumps to discharge header. Install valves to permit pump isolation.

3.5 SURFACE WATER CONTROL SYSTEM

- A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 13.
- B. Divert surface water and seepage water within excavation areas into sumps and pump water into storm drains in accordance with requirements of agencies having jurisdiction.
- C. Control and remove unanticipated water seepage into excavation.

3.6 SYSTEM OPERATION AND MAINTENANCE

- A. Operate dewatering system continuously until backfilling is complete.
- B. Conduct daily observation of dewatering system and monitoring system. Make required repairs and perform scheduled maintenance.
- C. Fill fuel tanks before tanks reach 25 percent capacity.
- D. Start emergency generators at least twice each week to check operating condition.
- E. When dewatering system cannot control water within excavation, notify Architect/Engineer and stop excavation work.
 - 1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
 - 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- F. Modify dewatering and surface water control systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- G. Correct unanticipated pressure conditions affecting dewatering system performance.
- H. Do not discontinue dewatering operations without Architect/Engineer's approval.

3.7 WATER DISPOSAL

A. Discharge water into existing storm sewer system.

3.8 SYSTEM REMOVAL

- A. Remove dewatering and surface water control systems after dewatering operations are discontinued.
- B. Remove piezometers and monitoring wells.
- C. Fill abandoned wells with sand.

- D. Cut off and cap abandoned wells minimum 36 inches below completed subgrade elevation.
- E. Fill abandoned piping with grout.
- F. Repair damage caused by dewatering and surface water control systems or resulting from failure of systems to protect property.

3.9 FIELD QUALITY CONTROL

- A. After dewatering system is installed, perform pumping test to determine when selected pumping rate lowers water level in well below pump intake. Adjust pump speed, discharge volume, or both to ensure proper operation of each pump.
- B. Monitor and record the following, daily, until steady state conditions occur. Then monitor and record conditions twice each week.
 - 1. Average discharge flow rate for each deep well, eductor header, and well point.
- C. Monitor and record the following, daily, until dewatering system is discontinued. Then monitor and record conditions weekly until Work is completed, monitoring wells are removed, or until directed by Architect/Engineer.
 - 1. Ground water elevation.
- D. Monitor ground water discharge for sand content. Sample and test water from each well weekly for sand content. Maximum permitted sand content 5 parts per million.
- E. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites. Sample and test water weekly for contaminates.
- F. Survey existing adjacent buildings, structures, and improvements weekly to detect movement in comparison to original elevations during dewatering operations.
 - 1. Notify Architect/Engineer immediately of measured movement.
- G. Submit initial installation reports including the following:
 - 1. Installation and development reports for well points and pumps.
 - 2. Installation and baseline reports for monitoring wells and piezometers.
 - 3. Test reports of monitoring well water analysis.
 - 4. Initial dewatering flow rates.
- H. Submit weekly monitoring reports including the following:
 - 1. Dewatering flow rates.
 - 2. Piezometer readings.
 - 3. Test reports of discharge water analysis.
 - 4. Maintenance records for dewatering and surface water control systems.

SECTION 31 23 23

FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Backfilling building perimeter to subgrade elevations.
- B. Backfilling site structures to subgrade elevations.
- C. Fill under slabs-on-grade.
- D. Fill for over-excavation.

1.2 **REFERENCES**

- A. ASTM International:
 - 1. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
 - 2. ASTM D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
 - 4. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with State and Municipality standard.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type S2 as specified in Section 31 05 13.
- B. Structural Fill: Type A1 as specified in Section 31 05 16.
- C. Granular Fill: Type A3 as specified in Section 31 05 16.
- D. Concrete: Backfill Controlled Low Strength as specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- B. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth.
 - 2. Structural Fill: Maximum 6 inches compacted depth.
 - 3. Granular Fill: Maximum 6 inches compacted depth.
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Backfill against supported foundation walls.
- G. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- H. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- I. Make gradual grade changes. Blend slope into level areas.
- J. Remove surplus backfill materials from site.

3.4 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556.
 - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Cleaning: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

SECTION 31 25 13

EROSION CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Erosion Controls.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T88 Standard Specification for Particle Size Analysis of Soils.
 - 2. AASHTO T180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Concrete Institute:
 - 1. ACI 301 Specifications for Structural Concrete.

C. ASTM International:

- 1. ASTM C127 Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
- 2. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 4. ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 5. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- D. Precast/Prestressed Concrete Institute:
 - 1. PCI MNL-116S Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not place grout when air temperature is below freezing.

C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 ROCK AND GEOTEXTILE MATERIALS

- A. Furnish materials in accordance with Town of Normal standards.
- B. Geotextile Fabric: Furnish in accordance with Town of Normal standards.

2.2 BLOCK, STONE, AGGREGATE, AND SOIL MATERIALS

- A. Coarse Aggregate: As specified in Section 31 05 16.
- B. Soil Backfill: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.3 PLANTING MATERIALS

- A. Seeding and Soil Supplements: As specified in Section 32 92 19.
- B. Mulch: As specified in Section 32 92 19.

2.4 PIPE MATERIALS

A. Pipe: Plastic.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
 - B. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.
 - C. Verify gradients and elevations of base or foundation for other work are correct.

3.2 DIVERSION CHANNELS

- A. Windrow excavated material on low side of channel.
- B. Compact to 95 percent maximum density.
- C. On entire channel area, apply soil supplements and sow seed as specified in Section 32 92 19.

D. Mulch seeded areas with hay as specified in Section 32 92 19.

3.3 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2: 1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
 - 1. During non-germinating periods, apply mulch at recommended rates.
 - 2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 32 92 19 at 90 percent of permanent application rate with no topsoil.
 - 3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 92 19 permanent seeding specifications.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.4 FIELD QUALITY CONTROL

- A. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- B. Compaction Testing: As specified in Section 31 23 23.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.5 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.

3.6 **PROTECTION**

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- C. Do not permit construction traffic over paving until 75 percent design strength of concrete has been achieved.
- D. Protect paving from elements, flowing water, or other disturbance until curing is completed.

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aggregate base course.

1.2 REFERENCES

A. ASTM International:

- 1. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- 2. ASTM D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
- 3. ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 4. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- 5. ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 6. ASTM D2940 Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
- 7. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- B. WISDOT Standard Specifications

1.3 QUALITY ASSURANCE

A. Furnish each aggregate material from single approved source throughout the Work.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

A. Coarse Aggregate: Type 1¹/₄-Inch Base.

Sieve Size	Percent Passing
1 ¹ / ₄ inches	95 - 100
³ / ₄ inches	70 – 93
No. 4	42 - 80
No. 10	16 – 48
No. 40	8-28
No. 200	2-12

2.2 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.
- B. Verify substrate has been inspected, gradients and elevations are correct.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Install geotextile fabric as directed by field engineer over subgrade in accordance with manufacturer's instructions.
 - 1. Lap ends and edges minimum 6 inches.
 - 2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.
- B. Place aggregate equal thickness layers to total compacted thickness indicated on Drawings.
 - 1. Maximum Layer Compacted Thickness: 6 inches.
 - 2. Minimum Layer Compacted Thickness: 3 inches.
- C. Roller compact aggregate to 95 percent maximum density.
- D. Level and contour surfaces to elevations, profiles, and gradients indicated.
- E. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- F. Maintain optimum moisture content of fill materials to attain specified compaction density.
- G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.
- B. Maximum Variation From Thickness: 1/4 inch.
- C. Maximum Variation From Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with ASTM D2922.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- C. Frequency of Tests: One test for every 1000 square yards compacted aggregate.

SECTION 32 31 13

CHAIN LINK FENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.
- B. Excavation for post bases.
- C. Concrete foundation for posts.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A121 Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - 2. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A392 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - 5. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 6. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 7. ASTM B429 Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 8. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete.
 - 9. ASTM F567 Standard Practice for Installation of Chain-Link Fence.
 - 10. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates.
 - 11. ASTM F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
 - 12. ASTM F1043 Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
 - 13. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
- B. Chain Link Fence Manufacturers Institute:
 - 1. CLFMI Product Manual.

1.3 SYSTEM DESCRIPTION

A. Fence Height: To match existing fence height.

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B. Line Post Spacing: At intervals not exceeding 10 feet.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- C. Manufacturer's Installation Instructions: Submit installation requirements.

1.5 QUALITY ASSURANCE

- A. Supply material in accordance with CLFMI Product Manual.
- B. Perform installation in accordance with ASTM F567.
- C. Perform Work in accordance with General, Standard and State Specifications.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.
- 1.7 DELIVERY, STORAGE AND HANDLING
 - A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
 - B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
 - C. Identify each package with manufacturer's name.
 - D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Anchor Fence Inc.
 - 2. Cyclone Inc.
 - 3. Page Aluminized Steel Corp.

2.2 MATERIALS

- A. Framing (Steel): ASTM F1083 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; coating conforming to ASTM F1043 Type A on pipe exterior and interior.
- B. Fabric Wire (Steel): ASTM A392 zinc coated wire fabric.
- C. Concrete: Normal Portland Cement, 2,500 psi strength at 28 days.

2.3 COMPONENTS

- A. Line Posts: match existing post.
- B. Corner and Terminal Posts: match existing post.
- C. Top and Brace Rail: match existing rail.
- D. Fabric: match existing diamond mesh interwoven wire.
- E. Tension Wire: match existing size.
- F. Tension Band: match existing size.
- G. Tension Strap: match existing size.
- H. Tie Wire: Aluminum alloy steel wire.

2.4 ACCESSORIES

- A. Caps: Cast steel galvanized sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, and accessories in accordance with ASTM F567.
- B. Set posts plumb, in concrete footings with top of footing 6 inches below finish grade. Slope top of concrete for water runoff.
- C. Line Post Footing Depth Below Finish Grade: ASTM F567.
- D. Corner and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- E. Brace each corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end posts.

- F. Install top rail through line post tops and splice with 6 inch long rail sleeves.
- G. Place fabric on outside of posts and rails.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- M. Install bottom tension wire or strap stretched taut between terminal posts.
- N. Connect to existing fence at existing terminal post.
- O. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.
- P. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.
- Q. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.
- R. Extend concrete footings 1 inch above grade, and trowel, forming crown to shed water.
- S. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

SECTION 32 91 13

SOIL PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with State and Municipality standards.

PART 2 PRODUCTS

- 2.1 SOIL MATERIALS
 - A. Topsoil: As specified in Section 31 05 13.
- 2.2 SOURCE QUALITY CONTROL
 - A. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify prepared soil base is ready to receive the Work of this section.
- 3.2 PREPARATION OF SUBSOIL
 - A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
 - B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
 - C. Scarify subsoil to depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.

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Soil Preparation 32 91 13-1

- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

SECTION 32 91 19

LANDSCAPE GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Final grade topsoil for finish landscaping.

1.2 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with State and Municipality standards.

PART 2 PRODUCTS

2.1 MATERIAL

A. Topsoil: Fill Type S4 as specified in Section 31 05 13.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify building and trench backfilling have been inspected.
- B. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, sidewalks, paving and curbs.

3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding is required to nominal depth of 6 inches. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to building to prevent damage.
- E. Lightly roll placed topsoil.
- F. Remove surplus subsoil and topsoil from site.

3.5 TOLERANCES

A. Top of Topsoil: Plus or minus $\frac{1}{2}$ inch.

3.6 PROTECTION OF INSTALLED WORK

A. Prohibit construction traffic over topsoil.

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fertilizing.
- B. Seeding.
- C. Mulching.
- D. Maintenance.

1.2 **DEFINITIONS**

A. Weeds: Vegetative species other than specified species to be established in given area.

1.3 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.5 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for two cuttings.

PART 2 PRODUCTS

2.1 SEED MIXTURE

- A. Seed Mixture: Provide fresh, clean new-crop seed that complies with the tolerance for purity and germination established by Official Seed Analysts of North America.
- B. Seed mix for grass areas:

Species	Pounds/Acre
Kentucky Bluegrass	100
Perennial Ryegrass	60
Creeping Red Fescue	40

2.2 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil.
- C. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify prepared soil base is ready to receive the Work of this section.

3.2 FERTILIZING

- A. Apply fertilizer at application rate recommended by soil analysis.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine used to apply seed.
- D. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- E. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

- A. Apply seed at rate as recommended by manufacturer evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- D. Immediately following seeding, apply mulch to thickness of 1/8 inches.
- E. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 MAINTENANCE

- A. Water to prevent grass and soil from drying out.
- B. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- C. Immediately reseed areas showing bare spots.
- D. Repair washouts or gullies.
- E. Protect seeded areas with warning signs during maintenance period.
SECTION 33 71 19

ELECTRICAL UNDERGROUND DUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rigid steel conduit.
- B. Plastic conduit.
- C. Underground duct markers.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.

B. Institute of Electrical and Electronics Engineers:

- 1. IEEE C2 National Electrical Safety Code.
- C. National Electrical Manufacturers Association:
 - 1. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 2. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 3. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 4. NEMA TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation.
 - 5. NEMA TC 9 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
 - 6. NEMA TC 10 PVC and ABS Plastic Communications Duct for Underground Installation.
 - 7. NEMA TC 14 Filament Wound Reinforced Thermosetting Resin Conduit and Fittings.
- D. Underwriters Laboratories Inc.:
 - 1. UL 651A Type EB and A Rigid PVC Conduit and HDPE Conduit.

1.3 SYSTEM DESCRIPTION

- A. Interconnected system of encased conduits, ducts, and handholes to distribute low-voltage power, control, telephone, and data communications.
- B. Conduit, duct routing, and handhole locations are shown in approximate locations unless dimensions are indicated. Route and locate to complete duct bank system.
- C. Use conduit type as indicated on Drawings.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit for the following:1. Conduit and tubing.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Record actual routing and elevations of underground conduit and duct, and locations and sizes of handholes.

1.6 COORDINATION

A. Coordinate Work with existing underground utilities and structures.

PART 2 PRODUCTS

- 2.1 RIGID STEEL CONDUIT
 - A. Rigid Steel Conduit: ANSI C80.1.
 - B. Fittings: NEMA FB 1, steel.
- 2.2 PLASTIC CONDUIT
 - A. Rigid Plastic Conduit: NEMA TC 2, Schedule 80 PVC, with fittings and conduit bodies to NEMA TC 3.

2.3 UNDERGROUND DUCT MARKERS

A. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Electric Service" in large letters.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- B. Verify locations of handholes prior to excavating for installation.

3.2 EXISTING WORK

- A. Abandoned duct bank to remain in place.
- B. Maintain access to existing duct bank and other installations remaining active and requiring access.

- C. Extend existing duct bank installations using materials and methods compatible with existing electrical installations.
- D. Clean and repair existing duct bank.

3.3 INSTALLATION - DUCT BANK

- A. Install duct to locate top of ducts at depths as indicated on Drawings.
- B. Install conduit and duct with minimum slope of 4 inches per 100 feet (0.33 percent). Slope conduit and duct toward manholes and away from building entrances.
- C. Cut conduit and duct square using saw or pipe cutter; de-burr cut ends.
- D. Insert conduit and duct to shoulder of fittings; fasten securely.
- E. Join nonmetallic conduit and duct using adhesive as recommended by manufacturer.
- F. Wipe nonmetallic conduit and duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- G. Install no more than equivalent of three 90-degree bends between pull points.
- H. Install fittings to accommodate expansion and deflection.
- I. Terminate conduit and duct at handhole entries using end bell.
- J. Stagger conduit and duct joints vertically in concrete encasement 6 inches minimum.
- K. Use suitable separators and chairs installed not greater than 4 feet on centers. Secure separators and chairs to trench bottom prior to concrete pour.
- L. Band conduits and ducts together before backfilling or placing concrete.
- M. Securely anchor conduit and duct to prevent movement during concrete placement.
- N. Place concrete in accordance with Section 03 30 00.
- O. Use mineral pigment to color concrete red.
- P. Install ducts with minimum 3 inch concrete cover at bottom, top, and sides.
- Q. Install two No. 4 steel reinforcing bars in concrete at top of ductbank. In areas where ductbank will be exposed in the future, provide No. 4 steel reinforcing bars throughout concrete ductbank spaced every 4 inches.
- R. Connect to existing concrete encasement using dowels.
- S. Connect to handhole wall and other concrete structures using dowels.

- T. Provide suitable pull string in each empty duct except sleeves and nipples.
- U. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
- V. Backfill trenches in accordance with Section 31 23 17.
- W. Interface installation of underground duct markers with backfilling specified in Section 31 23 15. Install below finished surface as indicated on Drawings.

END OF SECTION

SECTION 40 00 00

EQUIPMENT GENERAL PROVISIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing, and operation of all equipment and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents.
- B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise specified or shown.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards: All equipment, products, and their installation shall be in accordance with the following standards, as applicable, and as specified in each Section of these specifications:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. American Public Health Association (APHA).
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Mechanical Engineers (ASME).
 - 5. American Water Works Association (AWWA).
 - 6. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
 - 7. American Welding Society (AWS).
 - 8. National Fire Protection Association (NFPA).
 - 9. Federal Specifications (FS).
 - 10. National Electrical Manufacturers Association (NEMA).
 - 11. Manufacturer's published recommendations and specifications.
 - 12. General Industry Safety Orders (OSHA).
- B. The following standards have been referred to in this Section of the specifications:
 - 1. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
 - 2. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys

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3.	ANSI B46.1	Surfac	ce Texture
4.	ANSI S12.6	Metho	od for the Measurement of the Real-Ear Attenuation of Hearing Protectors
5.	ANSI/ASME B1.2	0.1	General Purpose Pipe Threads (Inch)
6.	ANSI/ASME B31.	1	Power Piping
7.	ANSI/AWWA D10	00	Welded Steel Tanks for Water Storage
8.	AWWA C206		Field Welding of Steel Water Pipe
9.	ASTM A 48	Speci	fication for Gray Iron Castings
10.	ASTM A 108		Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 SUBMITTALS

- A. Shop Drawings: The Contractor shall furnish complete shop drawings for all equipment specified in the various Sections, together with all piping, valves, and controls for review by the Engineer in accordance with Section 01 33 00.
- B. Tools: The Contractor shall supply one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright, finish wrench heads shall have work faces dressed to fit nuts. All tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled tool box of suitable design provided with a hinged cover.
- C. Spare Parts: The Contractor shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the Owner, only, after expiration of the guaranty period.
- D. Torsional Analysis:
 - 1. The Contractor shall submit to the Engineer a torsional and lateral vibration analysis of the following equipment, in accordance with Section 01 33 00. The analysis has to be performed by a specialist experienced in this type of work and approved by the Engineer.
 - (a) All engine drives.
 - (b) All blowers and compressors with drives of 100 horsepower and over.
 - (c) All vertical pumps with universal joints and extended shafts.

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- (d) All other equipment where specified.
- 2. The torsional natural frequency of the drive train must be avoided by + 25 percent by any exciting frequency of the equipment, throughout the entire operating range.
- E. Vibration Analysis: In his bid price the Contractor shall include at least two site visits of the abovementioned specialist, during construction and testing of the equipment, to analyze and measure the amount of equipment vibration and make his written recommendation for keeping the vibration at a safe limit.

1.4 QUALITY ASSURANCE

- A. Inspection, Startup, and Field Adjustment: The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:
 - 1. Assist the Contractor in the installation of the equipment.
 - 2. To inspect, check, adjust if necessary and approve the equipment installation.
 - 3. To start-up and field-test the equipment for proper operation, efficiency, and capacity.
 - 4. To perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the Engineer.
 - 5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. Costs: The costs of all inspection, startup, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the Contractor. The Owner will pay for costs of power and water. When available, the Owner's operating personnel will provide assistance in the field testing.
- C. Public Inspection: It shall be the responsibility of the Contractor to inform the local authorities, such as building and plumbing inspectors, fire marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, etc., to obtain all required permits and certificates, and pay all fees.
- D. Tolerances: Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30 feet or less in length, and not greater than 1/8-inch for members over 30 feet in length.

- E. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:
 - 1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.
 - 2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
 - 3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.
 - 4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. High Noise Level Location: The Contractor shall provide personal hearing protection, as specified herein, at each high noise level location. Said locations are defined as follows:
 - 1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2-hour exposure. Where such equipment is separated by a distance of more than 20 feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.
 - 2. Indoor Location:
 - (a) Any single equipment item, or any group of equipment items, located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.
 - (b) Any single equipment item, or any group of equipment items, located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.
- B. Personal Hearing Protection: The Contractor shall supply, in their original unopened packaging, three pairs of high attenuation hearing protectors. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the Contractor and mounted in an approved location near the noise producing equipment.
- C. Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Unless otherwise specified, the following load classifications shall apply in determining service factors:

Type of Equipment

Load Classification

Pump:

Centrifugal or Rotary Reciprocating

Mixer: Constant Density Variable Density Uniform Moderate Shock

Uniform Moderate Shock

- D. For service factors of electric motors, see Section 26 20 00. Where load classifications are not specified, best modern practice shall be used.
- E. Welding: Unless otherwise specified or shown, all welding shall conform to the following:
 - 1. Latest revision of ANSI/AWWA D100.
 - 2. Latest revision of AWWA C206.
 - 3. All composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
 - 4. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
 - 5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- F. Protective Coating: All equipment shall be painted or coated in accordance with Section 09900, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- G. Protection of Equipment: All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment

wrappers should be avoided, to prevent accumulation of condensate in gears and bearings. While in storage, Contractor shall rotate the drive shaft to ensure proper lubrication of bearings or other practice recommended by the manufacturer.

- H. Identification of Equipment Items: Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.
- I. Vibration Level: All equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations.
- J. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Engineer-approved shop drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Equipment Supports: All equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports must bear the signature and seal of an engineer registered in the State wherein the project is to be built, unless otherwise directed.
- B. Equipment Foundations: Equipment foundations shall be as per manufacturer's written recommendations. All mechanical equipment, tanks, control cabinets, etc., shall be mounted on minimum 4-inch high concrete bases, as shown on standard structural details, unless otherwise shown or specified.
- C. Shop Drawings: Shop drawings shall be submitted to the Engineer for review in accordance with the requirements of Section 01 33 00. Shop drawings will be considered incomplete unless clear, concise calculations are presented showing equipment anchorage forces and the capacities of the anchorage elements provided by the Contractor.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

2.4 FLANGES AND PIPE THREADS

A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1, and with requirements of Section 26 05 03.

2.5 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where

required for vertical shafts, 3-piece spacer couplings or universal type couplings for extended shafts shall be installed.

- B. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. Taper-lock bushings may be used to provide for easy installation and removal on shafts of various diameters.
- D. Where universal type couplings are shown, they shall be of the needle bearing type construction, equipped with commercial type grease fittings.

2.6 SHAFTING

- A. General: All shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. All shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.
- B. Materials: Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as shown or specified unless furnished as part of an equipment assembly.
 - 1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.
 - 2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.
 - 3. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.
- C. Differential Settlement: Where differential settlement between the driver and the driven equipment may be expected, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.7 BEARINGS

- A. General: Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
- B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and other important factors shall be considered in bearing selection.
- C. All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- D. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Bearing Life: Except where otherwise specified or shown, all bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so specified, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Тур	e of Service	Design Life (yrs)	L-10 Design Life (hr)
		(whichever	comes first)
1.	8-hour shift	10	20,000
2.	16-hour shift	10	40,000
3.	Continuous	10	60,000

- F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- G. Sleeve-type bearings shall have a Babbitt or bronze liner.

2.8 GEARS AND GEAR DRIVES

- A. Unless otherwise specified, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours and a minimum efficiency of 94 percent. Worm gears shall not be used, unless specifically approved by the Engineer.
- B. All gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, arranged for easy reading.
- C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
- D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.
- E. Oil level and drain location relative to the mounting arrangement shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be furnished when necessary.
- F. Where gear drive input or output shafts have to connect to couplings or sprockets supplied by others, the Contractor shall have the gear drive manufacturer supply matching key taped to the shaft for shipment.

2.9 DRIVE CHAINS

- A. Power drive chains shall be commercial type roller chains and meet ANSI Standards.
- B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.
- C. A minimum of one connecting or coupler link shall be provided with each length of roller chain.
- D. Chain and attachments shall be of the manufacturer's best standard material and suitable for the process fluid.

2.10 SPROCKETS

- A. General: Sprockets shall be used in conjunction with all chain drives and chain-type material handling equipment.
- B. Materials: Unless otherwise specified, materials shall be as follows:
 - 1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.
 - 2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.
 - 3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.
- C. All sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.
- D. Finish bored sprockets shall be furnished complete with keyseat and set screws.
- E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with taper-lock bushings as required.
- F. Idler sprockets shall be furnished with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws may be provided in both sides of the hub.

2.11 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.
- B. Unless otherwise specified, sheaves shall be machined from the finest quality gray cast iron.

- C. All sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.
- D. To facilitate installation and disassembly, sheaves shall be furnished complete with taper-lock or QD bushings as required.
- E. Finish bored sheaves shall be furnished complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.12 DRIVE GUARDS

A. All power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910). The guards shall be constructed of minimum 10 gage expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.13 FLEXIBLE CONNECTORS

- A. General: Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems.
- 2.14 INSULATING CONNECTIONS
 - A. General: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Sections 23 05 03.

2.15 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with the requirements of Sections 23 05 03.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane "Everseal," or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the Engineer.

2.16 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.17 SAFETY REQUIREMENTS

A. Where work areas are located within a flammable or toxic gas environment, suitable gas detection, ventilating, and oxygen deficiency equipment shall be provided. Workers shall be equipped with approved breathing apparatus.

PART 3 EXECUTION

3.1 COUPLINGS

- A. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application; installation shall be per equipment manufacturer's printed recommendations.
- 3.2 INSULATING CONNECTIONS
 - A. All insulating connections shall be installed in accordance with the manufacturer's printed instructions.
- 3.3 PIPE HANGERS, SUPPORTS, AND GUIDES
 - A. Hangers, supports, and guides shall be spaced in accordance with ANSI/ASME B.31.1 standard.

3.4 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with his subcontractors, to avoid later change orders.
- B. If the packaged system has any additional features (as safety interlocks, etc.), other than specified, the Contractor shall coordinate such features with the Engineer and furnish all material and labor necessary for a complete installation as required by the manufacturer, at no additional cost to the Owner.

END OF SECTION

SECTION 40 05 15

SUPPORTS, HANGERS, AND SLEEVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe hangers and supports.
- B. Saddles and shields.
- C. Hanger rods.
- D. Inserts
- E. Sleeves.
- F. Mechanical sleeve seals.
- G. Formed steel channel.

1.2 REFERENCES

- A. American Society of Mechanical Engineers, ASME:
 - 1. ASME B31.1 Power Piping
 - 2. ASME B31.5 Refrigeration Piping
 - 3. ASME B31.9 Building Services Piping
- B. American Society for Testing Materials, ASTM:
 - 1. ASTM F708 Design and Installation of Rigid Pipe Hangers.
- C. Manufacturers Standardization Society of the Valve and Fitting Industry, MSS:
 - 1. MSS SP58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP89 Pipe Hangers and Supports Fabrication and Installation Practices.
- D. Sheet Metal and Air Conditioning Contractor's National Association, Inc., SMACNA:
 1. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.

1.3 REGULATORY REQUIREMENTS

- A. Conform to all applicable codes for supporting of all products and systems.
- 1.4 QUALITY ASSURANCE
 - A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. ITT Grinnel Corp.
 - 2. B-Line Systems Inc.
 - 3. Creative Systems Inc.
 - 4. Globe Pipe Hanger Products Inc.
 - 5. ATO Inc./Fee & Mason Mfg. Co.
 - 6. Carpenter & Paterson Inc.

B. Standard Hangers:

- 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, and MSS SP89.
- 2. Hangers for Pipe Sizes ¹/₂ to 1 ¹/₂ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
- 3. Hangers for Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
- 4. Hangers for Hot Pipe Sizes 6 Inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
- 5. Multiple or Trapeze Hangers for 4 Inches and Smaller: Steel channels with welded spacers and hanger rods.
- 6. Multiple or Trapeze Hangers for Pipe Sizes 6 Inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll. For steam and condensate piping provide stand.
- 7. Wall Support for Pipe Sizes 3 Inch and Smaller: Cast iron hook.
- 8. Wall Support for Pipe Sizes 4 Inches and Larger: Welded steel bracket and wrought steel clamp.
- 9. Wall Support for Hot Pipe Sizes 6 Inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- 10. Vertical Support: Steel riser clamp.
- 11. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 12. Floor Support for Hot Pipe Sizes 6 Inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- 13. Copper Pipe Support: Copper-plated, carbon steel adjustable ring.
- C. Spring Hangers:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, and MSS SP89.

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- 2. Spring Cushion Hangers: ANSI Type 48.
- 3. Constant Supports: Selected to suit piping system; including auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.
- 4. Horizontal Type: MSS Type 54.
- 5. Vertical Type: MSS Type 55.
- 6. Trapeze Type: MSS Type 56.
- D. Miscellaneous:
 - 1. Hangers shall be sized to exactly fit pipe size for bare piping or to exactly around pipe insulation with saddle and shield for insulated piping.
 - 2. Use only one type by one manufacturer for each piping service.
 - 3. Provide copper plated components for copper piping systems

2.2 SADDLES AND SHIELDS

- A. Manufacturers:
 - 1. Fee & Mason Mfg. Co.
 - 2. Pipe Shields, Inc.
 - 3. B-Line Systems Inc.
- B. Provide factory fabricated correctly sized saddles or shields under piping hangers and supports for all insulated piping.
- C. Types:
 - 1. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
 - 2. Protection Shields: MSS Type 40; length recommended by manufacturer to prevent crushing insulation.
 - 3. Thermal Hanger Shields:
 - a. Constructed of 360 degree insert of high density, 100 psi, waterproofed calcium silicate, encased in 360 degree sheet metal shield.
 - b. Provide assembly of same thickness as adjoining insulation.

2.3 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Rod Length and Diameter: To fit application.

2.4 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
- B. Size inserts to suit threaded hanger rods.
- C. Inserts, cast insert nuts, insert knockouts, and sport type inserts shall be provided by the Contractor providing and installing the pipe.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Schedule 40 steel pipe or 16 gauge thick galvanized steel.
- C. Sleeves Ductwork: Galvanized steel.
- D. UL Labeled Sleeves: Prefabricated with insulation and fireproofing.
- E. Sleeves through Fire and Smoke Walls: NFPA 90A.
- F. Size sleeves to allow for expansion movement and to provide for continuous insulation.

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- 2.7 MISCELLANEOUS SUPPORT MATERIALS
 - A. Metal Framing: NEMA Standard ML 1.
 - B. Formed Steel Channel: Galvanized 12 gauge thick steel with holes 1 ¹/₂ inches on center.
 - C. Steel Plates, Shapes, and Bars: ANSI/ASTM A36.
 - D. Heavy Duty Steel Trapeze Hangers:
 - 1. Fabricate from steel shapes selected for loads specified.
 - 2. Weld Steel in accordance with AWS standards.
 - E. Pipe Guides: Factory-fabricated cast semi-steel or heavy fabricated steel; including bolted 2-section outer cylinder and base with 2-section guiding spider bolted tight to pipe.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

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- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Obtain permission for Architect/Engineer prior to using powder-actuated anchors.
- E. Do not drill or cut structural members without written permission of Architect/Engineer.

3.3 INSTALLATION – GENERAL

- A. Pipe Guides: Install pipe guides near expansion loop, expansion joints and ball joints, unless indicated otherwise.
- B. Steel Joists: Connect all hangers and attachments to bottom chord of all steel joists and beams.
- C. Insulated Piping:
 - 1. Clamps:
 - a. Attach clamps, including spacers, to piping with clamps projecting through insulation.
 - b. Do not exceed ASME B31 pipe stresses.
 - 2. Shields:
 - a. Where low-compressive-strength insulation vapor barriers are specified on cold or chilled water piping, install coated protective shields.
 - b. For pipe 8 inches or over, install wood block supports and shields.
 - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.4 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.5 INSTALLATION – PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with $1\frac{1}{2}$ inch minimum vertical adjustment.

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- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at floor.
- H. Where piping is installed in parallel and at same elevation, provided multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hanger and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.6 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing or firestopping insulation as required and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel or plastic escutcheons at finished surfaces.

3.7 BUILDING ATTACHMENT INSTALLATION

- A. Space attachments within maximum piping span indicated in MSS SP-69.
- B. Install additional building attachments when supporting additional concentrated loads; including valves, flanges, guides, strainers, expansion joints and at changes in piping direction.
- C. Anchors:
 - 1. Install anchors at locations preventing stresses from exceeding ASME B31; and preventing transfer of loading and stresses to connected equipment.
 - a. Install anchors at ends of principal pipe-runs and at intermediate points in pipe-runs between expansion loops and bends.
 - b. Preset anchors to accommodate both expansion and contraction of piping.
 - 2. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure; in compliance with ASME B31.
 - 3. Anchors for Expansion Compensators: Install anchors in accordance with expansion unit manufacturer's recommendations.

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3.8 ADJUSTING AND CLEANING

- A. Adjust hangers and supports to bring piping and ductwork to correct levels and elevations.
- B. Place grout under supports and equipment bases to bring supports and bases to correct levels, elevations and alignment.
- C. Clean adjacent surfaces from damage by material installation.

3.9 SCHEDULES

A.	Pipe Hanger Spacing		
	Pipe Size	Max. Hanger Spacing	Hanger Rod Diameter
	(Inches)	(Feet)	(Inches)
	1/2	7	3/8
	3/4	7	3/8
	1	7	3/8
	1-1/4	7	3/8
	1-1/2	9	3/8
	2	10	3/8
	2-1/2	11	1/2
	3	12	1/2
	4	14	5/8
	PVC (All Sizes)	6	3/8
	C.I. Bell and		
	Spigot (or No-Hub)	5	5/8
	And at Joints		

END OF SECTION

SECTION 40 10 00

POTASSIUM PERMANGANATE SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Storage tank.
- B. Mixers.
- C. Chemical metering pumps.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Submit detailed dimensions for materials and equipment, including anchoring requirements, fasteners, and other details.
- C. Product Data: Submit information concerning materials of construction, fabrication, and protective coatings.
- D. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.
- E. Operation and Maintenance Manuals: Submit O&M manuals according to Section 01 33 00.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

PART 2 PRODUCTS

2.1 STORAGE TANKS

- A. Provide the following, or equal:
 - 1. Type:
 - 2. Part Number:
 - 3. Volume of Tanks, each, gallons:
 - 4. Tank Diameter, inches

Storage / Mixing Tank B7863 628 48

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- 5. Tank Height, inches
- 6. Liquid Storage Material:
- 7. Liquid Storage Material, Specific Gravity:
- 8. Construction Material:
- 9. Manufacturer, or equal:

84 Potassium Permanganate 1.30 Fiberglass Design Tanks 612 W. Blackhawk Street Sioux Falls, SD 57104-0321 888-830-0061 Fax: 605-965-1630

2.2 MIXERS

A. Provide the following, or equal:

1.	Type:	Lightnin Batch Mixers, USA B	luebook Ed. #120
2.	Catalog Page and Mode	el Number:	pg. 159, MD-45928
3.	Quantity of Mixers:		1
4.	Shaft and Impeller Mate	erial:	316 Stainless Steel
5.	Power Source:		460 / 230 V
6.	Motor Type:		TEFC
7.	Motor Horsepower:		0.25
8.	Shaft Diameter, inches		3/4
9.	Shaft Length, inches		72

2.3 CHEMICAL METERING PUMPS

A. Provide the following, or equal:

1.	Туре:	Positive displacement, self-compensating, mechanical diaphragm, direct drive chemical feed pump
2.	Manufacturer:	Wallace and Tiernan Encore 700
3.	Flowrate:	12 gph at 175 psi
4.	Motor Horsepower:	0.5 (inverter duty type)
5.	Quantity:	2
6.	Liquid Feed Material:	Potassium Permanganate
7.	Accessories:	Provide foot valve with strainer, pressure relief valve, back pressure valve and pulsation dampener (Valcom or equal) on discharge piping compatible with liquid feed material for each chemical metering pump. Provide speed indicating controller for automatic and manual control of pump.
8.	Power Source:	120 V, 1 phase

2.4 WARRANTIES

A. Warranties shall be provided for all products for minimum one year after delivery.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment and accessories where indicated on Drawings and in accordance with manufacturer's instructions.
- B. Provide and connect piping and accessories to make system operational, ready for startup.

END OF SECTION

SECTION 40 27 00

PROCESS PIPING AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping and fittings.

1.2 SUBMITTALS

- A. Shop Drawings and Product Data: Submit the following, in accordance with Section 01 33 00:
 - 1. Detailed layout drawings for all process pipelines.
 - 2. Product data for gaskets.
 - 3. Product data and details for joints in steel pipe.
 - 4. Piping specialties, installation details, and jointing details.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 60 00. Exercise care in transporting and handling pipe and fittings in order to avoid damage to materials or coatings. Lifting shall be by hoist or on skids when hand lifting is not feasible. Dropping shall not be permitted. Store pipe as recommended by the manufacturer. Damaged pipe and fittings shall be replaced.

PART 2 PRODUCTS

- 2.1 MATERIAL SELECTION
 - A. Piping shall be the type indicated on the Schedule included herein.
- 2.2 PVC (POLYVINYL CHLORIDE) PIPE (SCHEDULE 80)
 - A. Pipe: Schedule 80 PVC pipe shall be manufactured from PVC 1120 and shall conform to ASTM D1785. Nominal size shall be as indicated on the Drawings. Pipe and fittings shall be NSF approved for the usage to which they will be applied.
 - B. Joints: Joints in Schedule 80 PVC pipes as scheduled shall be solvent weld type and shall conform to ASTM D2855.
 - C. Fittings: Fittings shall be manufactured of the same material as the pipe and shall have the same type of joints. Schedule 80 fittings shall conform to ASTM D2467.
 - D. Provide adapters as required to join PVC pipe to pipe, fittings, and equipment of other materials.

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- E. Provide unions at all connections to equipment.
- F. Solvent Cement: Solvent cement, cleaner and primer shall be as recommended by the pipe manufacturer and shall conform to ASTM standards.

2.3 PIPING SCHEDULES

- A. The inside and outside piping schedules at the end of this section enumerate the piping to be used on this project.
- B. Abbreviations used in the schedule are as follows:

Pipe Materia	<u>uls</u>
DI	Ductile Iron
PVC	Polyvinyl Chloride (Schedule or SDR)
SS	Stainless Steel
ST	Black or Galvanized
CU	Copper
HDPE	High Density Polyethylene
PCCP	Prestressed Concrete Cylinder Pipe
RCP	Reinforced Concrete Pipe
Joints	
B&S	Bell and Spigot
MJ	Mechanical Joint
PO	Push-On Joint
Sc	Screwed
Sl	Sleeve Type Coupling
SW	Solvent Welded
F	Flanged
Т	Threaded
RRG	Restrained Retainer Gland
GPTC	Grooved Pipe Type Couplings
S	Solder
Coatings and	1 Linings
B	Bituminous
BC	Bituminous - Cold Application
CL	Cement-Mortar Lined
G	Galvanized
Р	Painted
U	Un-Lined
S	Solder
INSL	Insulated

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. In general, cutting through floors, walls, and partitions shall be avoided and will be permitted only where absolutely necessary. Structural members shall not be cut. Where cutting, drilling, and patching of completed construction and finishes is required, patch shall match the undisturbed construction and finish.
- B. All lengths of pipe shall be dimensioned accurately to measurements established at the site, and shall be worked into place without springing or forcing.
- C. The Contractor shall cut all pipe and drill all holes that may be necessary. Cut sections of pipe shall be reamed or filed to remove all burrs. The pipe interior and joints shall be thoroughly cleaned before being installed and kept clean during construction.
- D. All changes in direction shall be made with fittings or approved joint deflection. Bending of pipe except copper is prohibited.
- E. Any transition from one pipe size to another shall be made with a reducing fitting. Reducing bushings are prohibited except where specifically indicated on the Drawings.
- F. Where practical all exposed pipe shall be run parallel to or at right angles to walls and other exposed pipes except where it is clearly indicated on the Drawings that the piping should be run at some other angle. Care shall be taken not to weaken any portion of the structure.
- G. Make adequate provision for expansion and contraction of piping.
- H. Pipe embedment and backfilling shall closely follow the installation and jointing of pipe in the trench, to prevent floating of the pipe by water which may enter the trench, and to prevent longitudinal movement caused by thermal expansion or contraction of the pipe. Not more than 25 feet of pipe shall be exposed at any time ahead of the backfilling in any section of trench.

3.2 GRAVITY FLOW PIPING

- A. Pipe shall be installed true to the lines and grades.
- B. Pipe shall be laid progressively up grade, with bell upstream, in a manner to form close, concentric joints with smooth bottom inverts.

3.3 PLUGS

- A. Installed piping systems shall be temporarily plugged at the end of each day's work, or other interruption to progress on a given line. Plugging shall be adequate to prevent entry of small animals or persons into the pipe or the entrance or insertion of deleterious materials.
- B. Standard plugs shall be inserted into all dead-end pipes, tees, or crosses; spigot ends shall be capped; flanged and mechanical joint ends shall have blind flanges of metal.

- C. Plugs installed for pressure testing shall be blind flanges fully secured and blocked to withstand the test pressure.
- D. Where plugging is required because of contract division or phasing for later connection, the ends of such lines shall be equipped with a permanent type plug or blind flange. Installation or removal of such plugging shall be considered incidental to the work.

3.4 CONCRETE CRADLES, ENCASEMENT, REACTION BLOCKS AND RESTRAINING

- A. Concrete cradles, encasement and reaction blocks shall be as indicated on the Drawings. Concrete thrust blocks shall be provided on pressure piping at all changes in direction unless restrained retaining gland fittings are specified in the Piping Schedule. All concrete cradles, anchors, and reaction blocks shall be of Class B concrete, as specified in Division 3.
- B. Reaction or thrust blocks shall be constructed at all tees, plugs, caps, and at bends deflecting 22-1/2 degrees or more. Thrust blocks shall be installed on any slopes exceeding 10 degrees from horizontal; using one block at least 3 cubic feet in volume for each successive three lengths of pipe on such slope.
- C. Blocks shall be poured between undisturbed soil and fittings. Concrete shall be so placed that pipe joints and fitting joints will be accessible for repair. The dimensions of concrete thrust blocks shall be as indicated on the Drawings, but in no case less than 2 cubic feet in volume.
- D. Mega-lugs may be used for pipe fitting and mega-lug restraints shall be installed in accordance with manufacturers recommendations based on prevailing soil conditions and test pressures.

3.5 SEPARATION OF NON-POTABLE AND POTABLE WATER LINES

- A. Horizontal Separation
 - 1. Potable and non-potable lines shall be separated at least 10 feet horizontally.
- B. Vertical Separation: Whenever potable and non-potable lines cross, they shall be vertically separated with the potable line at least 18 inches above the top of the non-potable lines. This vertical separation shall be maintained for that portion of the non-potable line located 10 feet either side of the potable line.
- C. Conflicts
 - 1. Where it is impossible to obtain proper horizontal and vertical separation as stipulated above, the non-potable line shall be constructed of mechanical joint ductile iron pipe within 10-feet of the potable line, and both shall be pressure tested to assure watertightness before backfilling.
 - 2. In making such crossings, it is preferable to center a minimum 20-foot length of the non-potable line under the potable line to be crossed so that the joints will be equidistant from the potable line and as remote therefrom as possible. Where a non-potable line must cross over a potable line, a vertical separation of 18 inches between the bottom of the non-potable

line and the top of the potable line shall be maintained, along with means to support non-potable lines to prevent their settlement and potential breakage of the potable line.

3.6 JOINTS

- A. Mechanical Joints: Pipe with mechanical joints shall be laid according to the manufacturer's specifications. Socket and gasket shall be clean and gasket shall be properly centered before joint is made.
- B. Push-On Type Joints: Any foreign matter in the gasket seat shall be removed, the rubber gasket wiped clean, flexed and placed in the socket. A thin film of lubricant shall be applied to the inside surface of the gasket which will come in contact with entering plain end pipe. Joint assembly shall then be completed by forcing the plain end of the entering pipe past the gasket until it makes contact with the bottom of the socket.
- C. Apply a complete coating of primer to the outside surface of the pipe end and to the mating inside surface of the socket. Apply a liberal coat of solvent cement to the pipe and socket. Immediately after application of cement, insert the pipe to the full depth of the socket while rotating the pipe or fitting 1/4 turn to evenly spread the cement. Hold joint together for a minimum of 10 to 15 seconds to ensure pipe does not back out of socket. Immediately after joining, wipe all excess cement from the pipe and fittings leaving only a small bead of cement around the circumference of the joint. The joint shall be allowed to set for a minimum one half hour before handling.
- D. Due to the explosive hazard, the following safety precautions shall be observed in conjunction with the use of solvent weld plastic pipe:
 - 1. Air shall be permitted to circulate through the pipeline to permit solvent vapor to escape.
 - 2. When flushing or filling pipelines, admit water slowly to prevent compression of the gases within the pipe.

Service	Size (inches)	Material	Joint	Test Pressure (psi)	Design Class	Remarks
Potassium Permanganate Carrier Pipe	2	PVC	Т	125	SCH 80	-

END OF SECTION

SECTION 40 27 02

PROCESS VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Valves.
- 1.2 QUALITY ASSURANCE
 - A. Responsibility: The valve manufacturer shall be responsible for compatibility and the required performance of valves and operators. Wherever possible, valves and operators shall be delivered as a complete assembly.

1.3 SUBMITTALS

- A. Shop Drawings and Product Data: Submit shop drawings and product data in compliance with Section 01 33 00 for all valves, and valve operators showing general dimensions, construction details and full descriptive literature which includes materials of construction, material specification and grade and indicating all valve parts. Shop drawings shall indicate valve operator locations.
- B. For check valves, indicate valve dimensions including lay lengths and counterweights. Indicate orientation of counterweights.
- C. Indicate valve linings and coatings. Submit manufacturer's catalog data.
- D. Certifications: Valve manufacturer shall furnish certification that each valve has been subjected to a hydrostatic water pressure twice the pressure class and that each valve is free of defects. Valves shall be tested in both the open and closed positions.
- E. Special Tools: Furnish one set of all special tools necessary for installation, normal maintenance, and adjustment.
- F. Operation and Maintenance Manuals: Submit operation and maintenance instruction bulletins for all valves, hydrants and valve operators in compliance with Section 01 33 00.

PART 2 PRODUCTS

2.1 GENERAL

- A. All valves shall be of standard manufacture and of highest quality materials and workmanship.
- B. All values of a particular type shall be the product of one manufacturer regularly engaged in the continuous production of that size and type of value.
- C. Valves shall be suitable for working pressure as required and as specified for the pipeline in which it is installed. Manufacturer's name, service, and pressure class shall be cast into the body.

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Process Valves 40 27 02-1

- D. Unless otherwise indicated or specified, all valves two inches and smaller shall be all brass or bronze; valves over two inches shall be iron body, fully bronze or bronze mounted.
- E. Where required for satisfactory operation of valves, provide valve operators, extension stems, stem guides, cast iron valve boxes, floor boxes, chain wheel with chain, handwheels, operator floor stands, position indicators, and other valve appurtenances. All manual valve operators located 6 feet or greater above the floor shall be provided with a chain wheel with chain unless otherwise noted. Extension stems shall be complete with guide bearings, wrench nut, and tee handle wrench. All machinery stuffing boxes shall be packed with material selected for the service intended. Maintain all packing until final acceptance by the OWNER. Valve operator location shall be as required for easy access and operation and shall be subject to approval by the OWNER.
- F. Exposed valves shall be painted in compliance with Section 09 90 00.

2.2 GATE VALVES (NON-POTABLE WATER)

- A. Gate Valves Two and One-Half Inches and Smaller: Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80; Class 125, body and bonnet of ASTM B62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing and malleable iron handwheel. Provide Class 150 valves meeting above where system pressure requires.
- B. All valves three inches or larger shall be resilient wedge gate valves with cast iron body, fully bronze mounted, non-rising stem with upper and lower thrust collars. Waterways shall be smooth. Gate valves shall be furnished with O-ring stem seals. Number, size and design shall conform to the AWWA Standard for R/W Valve O-Ring Stem Seals. All valves shall open by turning counterclockwise. Valves shall meet or exceed AWWA C-509.
- C. The materials of construction shall be: Body Cover and Baffle of Cast Iron; Float and all other trim shall be of stainless steel with the exception of the Buna-N Seat and adjustable Viton Orifice Button.
- D. Acceptable gate valve manufacturers are Clow, Waterous, or American.

2.3 HORIZONTAL SWING CHECK VALVES (NON-POTABLE WATER)

- A. Horizontal swing check valves shall be of the horizontal, single disc, swing type designed to allow a full diameter passage and to operate with a minimum loss of pressure. Check valves 1/8 through 3 inches shall meet the requirements of Fed. Spec. WW-V-51. Except as specified herein, check valves 4-inches through 24-inches shall meet the requirements of AWWA C508.
- B. Valves shall be iron body with the following materials of construction:

Item	Material	Specification
Body, cover, disc, lever arm	Cast iron	ASTM A126, Class B
Disc arm	Ductile iron or Cast iron	ASTM A536 or ASTM A126, Class B

Seat	Bronze or Stainless Steel	ASTM B148 or B62 or ASTM A276, Type 304 or A-157-C9
Disc seat	Buna-N	
Hinge shaft Cushion cylinder	Stainless Steel Bronze or Stainless Steel	Type 303, 304 or 410 ASTM B148 or B62 or Type 316

- 1. The valve shall permit flow in only one direction, close tightly when the discharge pressure exceeds the inlet pressure, and shall close without a slam or hammering action. All internal parts, including the disc seat, shall be easily replaced in the field without removing the valve from the pipeline.
- 2. Valve ends shall be flanged ANSI A21.10/AWWA C110. Minimum working differential pressure across the disc shall be 150 psi.
- 3. Valves shall be coated the same as adjacent piping. Line the interior metal parts, excluding seating areas and bronze and stainless pieces with 10 mils minimum, fusion-bonded epoxy, Scotchkote 134 or equal.

2.4 THROTTLING VALVE (NON-POTABLE WATER)

A. Provide the following, or equal:

1.	Type: Asahi PVC Globe Style Needle	Valve, USA Bluebook Ed. #119
2.	Catalog Page and Model Number:	pg. 1462, MC-27520
3.	Quantity:	1
4.	Size, in:	1-1/2
5.	Valve Construction:	PVC
6.	Seals:	FKM
7.	Max psi Rating:	150
8.	Location: Upstream of rotameter (mou	nted on chlorinator skid)

2.5 BALL VALVES

A. Provide the following, or equal:

1.	Type:	Spears True Union 2000 Industrial PVC Ball Valves
		USA Bluebook Ed. #119

7.	Chemical:	Potassium permanaganate
6.	Max psi Rating:	235
5.	Seals:	EPDM
4.	Seat:	PTFE
3.	Valve Construction:	PVC
2.	Catalog Page:	pg. 1437

2.6 CHECK VALVES

- A. Provide the following, or equal:
 - 1. Type: Asahi/America PVC Ball Check Valves, USA Bluebook Ed. #119
 - 2. Catalog Page:
 - 3. Valve Construction:
 - 4. Disk:
 - 5. Max psi Rating:
 - 6. Chemical:

PVC EPDM 150 Potassium permanganate

pg. 1464

PART 3 EXECUTION

3.1 GENERAL

- A. Make connections between valves and piping as specified in Section 15060.
- 3.2 EXPOSED VALVES
 - A. Exposed valves shall be installed in a vertical position where possible. Unless otherwise indicated or directed by the Engineer, valve stems shall never be below a horizontal position.
- 3.3 VALVE OPERATION
 - A. Open and close each valve observing full operation prior to installing successive lengths of pipe.

END OF SECTION