

**Greater New Haven Water Pollution Control Authority
Protecting the Environment**



PROJECT: Woodbridge Pump Station Rehabilitation

PROJECT NUMBER: SSF 2021-01

BID OPENING: 10:00 A.M.
Wednesday, June 29, 2022

PROJECT ENGINEER: WESTON & SAMPSON ENGINEERS
ATTN: MATTHEW JERMINE, PE
212 BROOK STREET, SUITE 103
ROCKY HILL, CT

jermine.Matthew@wseinc.com



GREATER NEW HAVEN
WATER POLLUTION CONTROL AUTHORITY
260 EAST STREET
NEW HAVEN, CT 06511
PHONE: 203.466.5280 FAX: 203.772.2027
WEB: WWW.GNHWPCA.COM
EMAIL: ENGINEERING@GNHWPCA.COM

EMERGENCY NUMBER: 203-466-5260

Greater New Haven Water Pollution Control Authority

Board of Directors

Joyce Alton	New Haven
Russell Cyr	Hamden
Salvatore Decola	New Haven
Robert Falcigno	East Haven
Michael Fimiani	New Haven
Jeffrey D. Ginzberg	Woodbridge
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Clayton Williams, Vice-Chairman	New Haven

Management and Staff

Sidney J. Holbrook	Executive Director
Gabriel Varca	Director of Finance and Administration (Treasurer)
Thomas Sgroi, P.E.	Director of Engineering
Gary Zrelak	Director of Operations
Charlie Biggs	Maintenance Administrator

Any individual, firm or corporation formally submitting a Proposal for any Authority Project must have in their possession a copy of the Greater New Haven Water Pollution Control Authority Standard Specifications dated September 2017. This document can be obtained upon payment of One Hundred Dollars (\$ 100.00) from the Office of the Director of Finance and Administration located at 260 East Street, New Haven, Connecticut 06511.

Greater New Haven Water Pollution Control Authority

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Appendix C	Bid Package Forms (Bound Separately) <ul style="list-style-type: none"> • Schedule of Bid Items • Itemized Proposal • Statement of Qualifications
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NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

Greater New Haven Water Pollution Control Authority

INVITATION TO BID FOR CONSTRUCTION

WOODBIDGE PUMP STATION REHABILITATION (PROJECT SSF 2021-01)

Sealed bids will be received at the Office of the Director of Finance and Administration of the Greater New Haven Water Pollution Control Authority located at 260 East Street, New Haven, CT 06511 for the **Woodbridge Pump Station Rehabilitation** until **10:00 a.m. on Wednesday June 29th, 2022** at which time and place said bids will be opened publicly at 260 East Street, New Haven, Connecticut or via video conference and read aloud.

A non-mandatory pre-bid meeting will be held at 10:00 a.m. on Wednesday June 15th, 2022 at the Woodbridge Pump Station located at 66 Ansonia Road, Woodbridge, Connecticut (approximately 150 feet west of Brookside Drive). All questions from bidders must be received by the Authority to engineering@gnhwpc.com by email only before 4:00 p.m. on Wednesday June 22nd, 2022.

The information for Bidders, Proposal, Form of Contract, Plans and Specifications may be examined at the Office of the Director of Finance and Administration at the above address. Anyone submitting a bid for this project must have in their possession a copy of **THE GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY STANDARD SPECIFICATIONS dated September 2017**. The document can be obtained upon payment of One Hundred Dollars (\$100.00). The Plans and a "bid package" containing the Invitation; Labor Rates; Proposal; Special Specifications and Notes can be obtained upon payment of One Hundred Twenty Dollars (\$120.00).

A certified check or bid bond in the amount of fifteen percent (15%) of the total bid amount must accompany the bid. Said checks or bid bonds will be returned to the unsuccessful bidders upon Award of the Contract to the selected firm and execution of the Agreement. If any bid is not accompanied by a bid bond or check at the specified time for the bid opening, the incomplete bid will not be read and this action will constitute automatic rejection of the bid.

The successful bidder will be required to furnish a performance bond and a labor and materials payment bond in the form as attached to the Bid Documents for the amount of the total bid. A certified check cannot be substituted for either bond. The Greater New Haven Water Pollution Control Authority reserves the right to alter quantities and to accept or reject any or all bids or any portion of any bids, for any or no reason, including unavailability of appropriated funds as it may deem to be in its best interests.

All bidders are to note that the award of this Contract is subject to the following conditions and contingencies:

1. The approval of such governmental agencies as may be required by law.
2. The appropriation of adequate funds by the proper agencies.

Gabriel Varca
Director of Finance and Administration

Greater New Haven Water Pollution Control Authority

NOTICE TO CONTRACTOR

STANDARD SPECIFICATIONS & SPECIAL SPECIFICATIONS

All work (and related appurtenant work) included in this Contract will be performed in accordance with the Greater New Haven Water Pollution Control Authority STANDARD SPECIFICATIONS referenced hereto and an integral part hereof, including the General Provisions and Technical Specifications,

The technical requirements of Division II (Construction Details) and Division III (Materials Section) of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817 (including the latest issue of addendums and supplemental specifications) shall be made a part of these contract documents by reference, unless otherwise specified in the Contract Documents. Specifications for additional or supplemental work not covered by the STANDARD SPECIFICATIONS, such as drainage structures, bituminous concrete, concrete for structures, pavement markings, turf establishment or other incidental construction, will be performed in accordance with Form 817 requirements.

Special provisions that may replace, modify, supplement or otherwise revise the STANDARD SPECIFICATIONS are presented in Section § 800 Special Specifications and Notes of the Contract Documents. Section § 800 should be reviewed by the Contractor for any supplemental specifications, additional specifications or special provisions that may alter, be in addition to, or supersede the requirements of the STANDARD SPECIFICATIONS.

Items not specifically identified for payment in the Schedule of Bid Items shall be assumed to be included in the work effort of, and payment for, other bid items that are identified and shall not be paid or requested for payment separately.

The Contractor selected to perform this project shall obtain the referenced documents and shall maintain a set of all contract documents, including the STANDARD SPECIFICATIONS and Form 817, on the job site throughout the duration of the Contract.

SAMPLE

Certificate of Insurance						Issue Date (MM/DD/YY)			
PRODUCER				INSURERS AFFORDING COVERAGE				NAIC #	
INSURED <i>Contractor's Name</i>				INSURER	A				
				INSURER	B				
				INSURER	C				
				INSURER	D				
				INSURER	E				
COVERAGES									
THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.									
CO LTR	TYPE OF INSURANCE			POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	Limits		
	GENERAL LIABILITY <input type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS MADE <input checked="" type="checkbox"/> OCCUR. <input checked="" type="checkbox"/> ISO FORM CG 00 01 12 04 <input checked="" type="checkbox"/> XCU HAZARDS COVERAGE GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POL-ICY <input checked="" type="checkbox"/> X <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC			POLICY NUMBER PER PROJECT AGGREGATE ENDORSEMENT			EACH OCCURRENCE \$ 1,000,000 PRODUCTS-COMP/OP AGG. \$ 2,000,000 PERSONAL & ADV INJURY \$ GENERAL AGGREGATE \$ 2,000,000 FIRE DAMAGE (Any one fire) \$ MED. EXPENSE (Any one person) \$		
	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> OCCUR <input type="checkbox"/> HIRED AUTOS <input type="checkbox"/> NON-OWNED AUTOS <input type="checkbox"/> GARAGE			POLICY NUMBER PER PROJECT ENDORSEMENT			COMBINED SINGLE LIMIT PER ACCIDENT \$ 1,000,000 \$ \$ \$		
	EXCESS LIABILITY <input checked="" type="checkbox"/> INCLUDED UMBRELLA FORM <input checked="" type="checkbox"/> OCCUR			POLICY NUMBER PER PROJECT ENDORSEMENT			EACH OCCURRENCE 2,000,000 AGGREGATE \$ 2,000,000		
	WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY <input type="checkbox"/> IN CL. THE PROPRIETOR, PARTNERS, EXECUTIVE OFFICERS ARE:			POLICY NUMBER COVERAGE APPLIES IN STATE OF JOBSITE OPERATION UNDER THIS SPECIAL CONTRACT IF NO COVERAGE IS INCLUDED HERE NEEDED			<input checked="" type="checkbox"/> STATUTORY LIMITS EACH ACCIDENT FOR BODILY INJURY \$ 250,000 DISEASE-POLICY LIMIT \$ 1,000,000 EACH EMPLOYEE FOR BODILY INJURY BY DISEASE \$ 250,000		
DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS 1. All operations performed under [Project Name] project, Street Address, City, State Zip. Project Number _____. The following are included as Additional Insured (Endorsement ISO Form CG 20 10 11 85 or equivalent) for all coverages except Workers' Compensation: The Greater New Haven Water Pollution Control Authority, its directors, officers, employees, subsidiaries & affiliates; [list any others as identified by the contract documents ("Additional Insureds")]. 2. All policies except workers' compensation are primary and non-contributing with any insurance maintained by Additional Insureds. 3. All policies contain an express waiver of subrogation rights against Additional Insureds. 4. For commercial general liability and excess liability coverages Additional Insureds are covered for liability arising out of named insured's ongoing and completed operations. 5. Listing of all endorsements to all policies identified on this certificate is attached hereto and incorporated herein. 6. All policies are occurrence based and project specific.									
CERTIFICATE HOLDER					CANCELLATION				
The Greater New Haven Water Pollution Control Authority 260 East Street New Haven, CT 06511 Attn: Gabriel Varca					SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED ** BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT.				
					AUTHORIZED REPRESENTATIVE				

**NON-RENEWED OR MATERIALLY CHANGED

SECTION 800

SPECIAL SPECIFICATIONS AND NOTES

1. GENERAL

Any references herein to the "General Provisions" and the "Technical Specifications" are to those sections of GNHWPCA's Standard Specifications.

2. LIQUIDATED DAMAGES

For each calendar day that any work remains uncompleted after the date specified for the completion of the work provided in the Contract, the amount of FIVE HUNDRED DOLLARS AND NO CENTS (\$500.00) per calendar day will be deducted from any money due the Contractor, not as a penalty but as liquidated damages, provided, however that due account shall be taken of any adjustment of the contract time of completion of the work as provided for elsewhere in the Specifications.

3. SCOPE OF WORK

The Woodbridge Pump Station Rehabilitation Project consists of all work depicted and described by these contract documents, more generally described as and including the following:

- A. The obtainment of building permits through the Town of Woodbridge Building Department.
- B. The obtainment of a ConnDOT Encroachment Permit for work within the State right-of-way.
- C. Maintain continuous conveyance of wastewater at the site throughout the project duration.
- D. Provide all necessary bypass pumping as required to facilitate the improvements.
- E. Improvement to the Pump Station's wastewater pumping systems, including but not limited to:
 - 1) Demolition of the existing dry pit pump chamber.
 - 2) Installation of 2 (two) new submersible pumps.
 - 3) Replacement of existing wastewater piping valves, and fittings as indicated on the Project Drawings.
 - 4) Installation of new precast concrete valve chamber and doghouse manhole.
 - 5) Replacement of VCP and ACP piping connected to the wet well.
 - 6) Reconstruction of upper portion of wet well to extend to finished grade for the installation

of new hatches.

- 7) Site improvements including grading, concrete slabs, fencing, and trees.
- 8) New electric service, new generator, and other electrical upgrades as identified.

F. Installation of new Pump Station controls, including but not limited to:

- 1) Installation of new support structures for electrical enclosures.
- 2) Installation of new electrical enclosures for: electric company meter, primary service disconnect, automatic transistor switch, duplex pump controls, cellular telemetry system.
- 3) Installation of new underground primary service from utility company.
- 4) Installation of new cables from new control panel to existing pumps in wet well.
- 5) Removal of existing electrical equipment.
- 6) Stage work as necessary to maintain flows during construction.

4. COORDINATION WITH OWNER'S OPERATIONS

- A. Coordinate all activities and/or scheduling outages with both the Authority's Engineering and Operations Departments. Calls must be made to all of the following:
- 1) Operations front desk: (203) 466-5280
 - 2) Charlie Biggs, Maintenance Administrator: (203) 410-3488
 - 3) Tom Sgroi, Director of Engineering (or as assigned): (203) 466-5280

5. INFORMATION AVAILABLE TO BIDDERS

The following items are available for review by the prospective bidder, and are included as part of the bid package:

- A. The plan set entitled "Woodbridge Pump Station Rehabilitation Project SSF 2021-01" prepared by Weston & Sampson Engineers, Inc.
- B. It is the responsibility of the bidder, before submitting a bid, to thoroughly review the Contract Documents, Specifications, and other information provided by the Authority, as indicated above, as well as to visit the site to determine any extraneous conditions which may affect the cost, progression, and/or performance of the Work.

6. LABOR AND EMPLOYMENT REGULATIONS

Wage rates for the Woodbridge Pump Station Rehabilitation Project as determined by the State of Connecticut Department of Labor to be the "Prevailing Wages Rates", as published in Appendix A of these specifications.

7. PROJECT INSURANCE REQUIREMENTS

The GNHWPCA and Weston & Sampson Engineers, Inc. shall be included under "Additional Insured" on all insurance policies required, and as specified in the specifications, for all policies except Workers Compensation.

8. MODIFICATION OF GENERAL PROVISIONS

A. Section §107-06 Insurance

1) The insurance limits set forth in Section 107-06 are hereby modified as follows:

- a. Workers' Compensation and Employer's Liability insurance:
 - Workers' compensation - statutory limits
 - Employer's Liability each accident \$ 250,000
 - Employer's Liability disease - each employee \$ 250,000
 - Employer's Liability disease - policy limit \$1,000,000
- b. Commercial General Liability:
 - Each occurrence \$ 1,000,000
 - Aggregate \$ 2,000,000
- c. Business Automobile Liability:
 - Each accident - combined single limit \$ 1,000,000
- d. Owner's and Contractor's Protective Liability insurance in the name of the Greater New Haven Water Pollution Control Authority: N/A
- e. Contractor's Protective Liability and Public Liability and Property Damage Liability Insurance:
 - Each occurrence \$ 2,500,000
 - General Aggregate \$ 2,000,000
- f. Railroad Protective Public Liability and Property Damage Liability Insurance: N/A
- g. Umbrella Excess Liability:
 - Each occurrence \$ 2,000,000
- h. Equipment Installation Floater: N/A

2) Section §107-06.10, Termination or Change of Insurance, is replaced with the following:

Each insurance policy shall be endorsed to provide that the insurance company shall notify the Authority by certified mail at least thirty (30) days in advance of any cancellation or material change. Such notice provision shall

be absolute and unequivocal. The words "endeavor to" and "but failure to mail such notice shall impose no obligation or any liability of any kind upon the company, its agents or representatives" shall be deleted from the certificate form's cancellation provision.

3) The following sections shall be added:

§107-06.18 The period of completed operations coverage for purposes of Commercial General Liability and Excess Umbrella Liability coverage shall be two (2) years after completion and acceptance of the entirety of the work.

§107-06.19 No deductible for any policy shall exceed the sum of \$25,000 without the prior approval of the Authority.

§107-06.20 Certificates of Insurance that are to be provided by the Contractor shall fully evidence compliance with the insurance requirements specified in the Standard Specifications, and as noted hereon.

B. Section §109-01 Estimates and Payment

- 1) The second paragraph shall be modified to read as follows: "In computing amounts in estimates or Work done, the unit prices published in the Schedule of Values that has been accepted by the Engineer shall be used."

9. MODIFICATION OF TECHNICAL SPECIFICATIONS

Item 516 Sanitary Sewer Flow Control and Bypass Pumping

In addition to the requirements of Technical Specification, Item 516, the bypass pumping system shall have sufficient capacity to pump a peak flow of 250 gallons per minute at 132 ft total dynamic head. Contractor shall submit bypass pumping plan to the Engineer & GNHWPCA for approval. Decibel measurement shall be at a distance of 20 feet from the nearest residence.

The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing location, ready for use in the event of primary pump failure. Also, a backup power supply source shall be provided.

The maintenance and protection of vehicular and pedestrian access to the adjacent property must be maintained at all times. Temporary ramps, etc. must be provided (as needed) to maintain access over any bypass piping that may cross adjacent driveway.

SPECIAL SPECIFICATIONS

The following special specifications are hereby incorporated and made a part of the Greater New Haven Water Pollution Control Authority Standard Specifications:

<u>Section</u>	<u>Description</u>
00801	Allowance Procedure
00810	Performance Bond
00815	Payment Bond
01330	Submittals
01751	Startup and Testing for Sewer Pump Stations
01760	O&M Manuals
01770	Asset Management Information
02112	Removal of Underground Nonfriable Asbestos Cement Pipe
02240	Dewatering
02300	Earthwork
02370	Erosion and Sedimentation Control
02532	Valves and Appurtenances
02536	Precast Concrete Vault and Appurtenances
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16131	Cabinets and Enclosures
16140	Wiring Devices
16231	Packaged Engine Generators

16289	Surge Protection for Low-Voltage Electrical Power Circuits
16410	Enclosed Switches and Circuit Breakers
16414	Automatic Transfer Switches
16442	Panelboard

Appendix A Asset Management Forms

Appendix B Prevailing Wage Rates

- Prevailing Wage Poster
- Connecticut State Statute 31-55a
- Contracting Agency Form
- Contract Wage Certification Form
- Payroll Certification for Public Works Projects Form
- Payroll Certification for Public Works Projects Form (Sample)
- Information Bulletin about Occupational Classifications
- Building Rates
- Heavy Construction Rates
- Footnotes

Appendix C Bid Package Forms (Bound Separately)

- Schedule of Bid Items
- Itemized Proposal
- Statement of Qualifications

Appendix D Project Plans (Bound Separately)

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

SECTION 00801

§ 109-16 ALLOWANCE PROCEDURE

Bid allowances are included in base bids as estimates for work that will be completed under the base construction contract, but the exact costs or scope are indeterminate at the time of bid. These amounts are later adjusted to actual costs, once the work is completed. The total of all allowances shall not exceed ten percent of the project's construction value.

Allowances shall be specifically included and listed on the schedule of bid items.

Treatment of mark-ups for allowances is as follows:

- Allowances are a part of the base contract work; no additional mark-up is credited to the contractor for work performed within the allowance by the contractor or any subcontractor.
- Work performed in excess of an allowance is subject to normal general contractor mark-ups in accordance with the Contract General Provisions, Section §109-04 Extra and Force Account Work.

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

BOND NO. _____

SECTION 00810

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That _____ as Principal, and _____, as Surety, located at _____ (Business Address), a surety insurer chartered and existing under the laws of the State of _____ and authorized to do business in the State of Connecticut, are held and firmly bound unto the Greater New Haven Water Pollution Control Authority, as Oblige, in the sum of _____ (\$_____) for the payment whereof we bind ourselves, our heirs, executors, personal representatives, successors and assigns, jointly and severally.

WHEREAS, Principal has entered into a contract dated as of the ____ day of _____, 20__ with Oblige for _____

in accordance with drawings and specifications, which contract is incorporated by reference and made a part hereof, and is referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS BOND is that of Principal:

1. Performs the Contract at the times and in the manner prescribed in the Contract; and
2. Pays Oblige any and all losses, damages, expenses, costs, direct or indirect, and attorney's fees, including costs of any mediation, arbitration, litigation or appellate proceedings, that Oblige sustains because of any default by Principal under the Contract, including, but not limited to, all delay damages, whether liquidated or actual, incurred by Oblige;

then this Bond is void; otherwise it remains in full force and effect and Surety shall be fully liable for performance of the Principal's obligations provided thereunder.

In the event of a declaration of default of Principal by Oblige under the Contract, the Surety shall, within twenty (20) days of receipt of notice of such default, either: (1) tender the Oblige the full amount of the penal sum of this Bond; or (2) undertake to perform or complete the remaining Contract obligations itself through its agents or through independent contractors.

00810-1

If Surety denies liability, in whole or in part, it shall notify the Obligee, in writing, citing the detailed reasons therefor, within fifteen (15) days of receipt of the aforesaid declaration of default of Principal.

The Surety, for value received, hereby stipulates and agrees that no changes, extensions of time, or additions to the terms of the Contract, or other work to be performed hereunder, or the specifications referred to therein shall in anyway affect its obligations under this Bond, and it does hereby waive notice of any such changes, extensions of time, alterations, or additions to the terms of the Contract, to the work thereunder or to the specifications.

In no event will the Surety be liable in the aggregate to Obligee for more than the penal sum of this Performance Bond, regardless of the number of suits that may be filed by Obligee.

Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the State of Connecticut and shall be instituted within the applicable statute of limitations for contract actions after Principal defaults.

IN WITNESS WHEREOF, the above parties have executed this instrument this ____ day of _____, 20__, the name of each party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Signed, sealed and delivered
in the presence of:

PRINCIPAL

Witnesses as to Principal:

By: _____

Name: _____

Its: _____

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me this _____ day of _____, 20____ by _____, as _____ of _____, a _____ [corporation/limited liability company/partnership], on behalf of the [corporation/limited liability company/partnership]. [He/She/ is personally known to me or what has produced _____ as identification and who [did] [did not] take an oath.

My Commission Expires:

Notary Public (Signature)

(AFFIX NOTARY SEAL)

(Printed Name)

(Title or Rank)

(Serial Number, if any)

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00810-3

ATTEST:

SURETY:

Witnesses as to Surety:

(Printed Name)

(Business Address)

(Authorized Signature)

(Printed Name)

Witnesses as to Attorney-in-Fact:

As Attorney-in-Fact
(Attach Power of Attorney)

(Business Address)

(Printed Name)

(Telephone Number)

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STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me this _____ day of _____, 20____ by _____, as _____ of _____, a _____ [corporation/limited liability company/partnership], on behalf of the [corporation/limited liability company/partnership]. [He/She/ is personally known to me or what has produced _____ as identification and who [did] [did not] take an oath.

My Commission Expires:

Notary Public (Signature)

(AFFIX NOTARY SEAL)

(Printed Name)

(Title or Rank)

(Serial Number, if any)

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

00810-5

BOND NO. _____

SECTION 00815

PAYMENT BOND (incorporating C.G.S. § 49-41)

KNOW ALL MEN BY THESE PRESENTS: That by this Bond, we, _____ (hereinafter called the "Principal") and _____ (hereinafter called the "Surety"), located at _____, a surety insurer chartered and existing under the laws of the State of _____ and authorized to do business in the State of Connecticut, are held and firmly bound unto the Greater New Haven Water Pollution Control Authority (hereinafter called "Owner") in the sum of _____ (\$ _____) for the payment whereof we bind ourselves, our heirs, personal representatives, executors, successors and assigns, jointly and severally.

WHEREAS, Principal and the Owner have reached a mutual agreement (hereinafter referred to as the "Contract") for the purpose of _____, said Contract being made a part of this Bond by this reference.

NOW, THEREFORE, THE CONDITION OF THIS BOND is that if the Principal:

1. Promptly makes payments to all claimants supplying the Principal with labor, materials or supplies, as used directly or indirectly by the Principal in the prosecution of the work provided for in the Contract; and
2. Pays the Owner for all losses, damages, expenses, costs, and attorneys' fees, including the costs of any mediation, arbitration, litigation or appellate proceedings, that the Owner sustains because of a default by the Principal under paragraph 1 of this Bond, then this Bond is void; otherwise this Bond remains in full force and effect.

BE IT FURTHER KNOWN:

Any changes in or under the Contract and compliance or noncompliance with formalities connected with the Contract or alterations which may be made in the terms of the said Contract, or in the work to be done under it, or the giving by the Owner of any extension of time for the performance of the said Contract, or any other forbearance on the part of the Owner or Principal to the other, shall not affect the obligation of the Principal and the Surety, or either of them, their heirs, personal representatives, successors or assigns under this Bond, notice to the Surety of any such changes, alterations, extensions or forbearance being hereby waived.

This Bond is issued in accordance with and expressly incorporates herein the requirements of Conn. Gen. Stat. § 49-41.

IN WITNESS WHEREOF, the above parties have executed this instrument this ____ day of _____, 20__, the name of each party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Signed, sealed and delivered in the presence of:

Witnesses as to Principal:

PRINCIPAL:

By: _____

Name: _____

Its: _____

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me this ____ day of _____, 20__ by _____, as _____ of _____, a _____ corporation/limited liability company /partnership], on behalf of the _____ corporation/limited liability company/partnership]. [He/She/It personally known to me or who has produced _____ as identification and who [did] [did not] take an oath.

My Commission Expires: _____

Notary Public (Signature)

(AFFIX NOTARY SEAL)

(Printed Name)

(Title or Rank)

(Serial Number, if any)

ATTEST:

SURETY:

Witnesses as to Surety:

(Printed Name)

(Business Address)

(Authorized Signature)

(Printed Name)

OR

Witnesses as to Attorney-in-Fact:

As Attorney-in-Fact
(Attach Power of Attorney)

(Business Address)

(Printed Name)

(Telephone Number)

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me this _____ day of _____, 20____
by _____, as _____ of _____, a Surety, on behalf of the
Surety. [He/She] is personally known to me or who has produced _____ as
identification and who [did] [did not] take an oath.

My Commission Expires:

(AFFIX NOTARY SEAL)

Notary Public (Signature)

(Printed Name)

(Title or Rank)

(Serial Number, if any)

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The Contractor shall provide the Engineer with submittals as required by the contract documents.
- B. The Schedule of Values for all Work shall include 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 the basis for progress payments during the performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of work.

1.02 RELATED WORK:

- A. Divisions 1 – 16 of these specifications that require submittals.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL:

- A. As required by the General Conditions, Contractor shall submit a schedule of values and schedule of shop and working drawing submittals.
- B. The Contractor shall submit the shop and working drawing submittals either electronically or hard copy.

3.02 ELECTRONIC SUBMITTALS:

- A. In accordance with the accepted schedule, the Contractor shall submit promptly to the Engineer by email (McKennaK@wseinc.com) or on USB flashdrive (mail to Weston & Sampson Engineers, attention: Kevin McKenna - ENG21-0385), one electronic copy in Portable Document Format (PDF) of shop or working drawings required as noted in the specifications, of equipment, structural details and materials fabricated especially for this Contract.
- B. Each electronic copy of the shop or working drawing shall be accompanied by the Engineer's standard shop drawing transmittal form, included as Exhibit 1 of this section (use only for electronic submittals), on which is a list of the drawings, descriptions and

numbers and the names of the Owner, Project, Contractor and building, equipment or structure.

- C. The Contractor shall receive a shop drawing memorandum with the Engineer's approval or comments via email.

3.04 SHOP AND WORKING DRAWINGS:

- A. Shop and working drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish of shop coat, grease fittings, etc., depending on the subject of the drawings. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for this Contract.
- B. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24-inch by 36-inch sheets, except those, which are made by changing existing standard shop or working drawings. All drawings shall be clearly marked with the names of the Owner, Project, Contractor and building, equipment or structure to which the drawing applies, and shall be suitably numbered. Each shipment of drawings shall be accompanied by the Engineer's (if applicable) standard shop drawing transmittal form on which is a list of the drawings, descriptions and numbers and the names mentioned above.
- C. Only drawings that have been prepared, checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Contract Documents in all respects. Shop drawings shall be reviewed and marked with the date, checker's name and indication of the Contractor's approval, and only then shall be submitted to the Engineer. Shop drawings unsatisfactory to the Contractor shall be returned directly to their source for correction, without submittal to the Engineer. Shop drawings submitted to the Engineer without the Contractor's approval stamp and signature will be rejected. Any deviation from the Contract Documents indicated on the shop drawings must be identified on the drawings and in a separate submittal to the Engineer, as required in this section of the specifications and General Conditions.
- D. The Contractor shall be responsible for the prompt submittal and resubmittal, as necessary, of all shop and working drawings so that there will be no delay in the work due to the absence of such drawings.
- E. The Engineer will review the shop and working drawings as to their general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the drawings during the review do not relieve the Contractor from compliance with

requirements of the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. The review of the shop drawings is general and shall not relieve the Contractor of the responsibility for details of design, dimensions, code compliance, etc., necessary for interfacing with other components, proper fitting and construction of the work required by the Contract and for achieving the specified performance. The Engineer will review submittals two times: once upon original submission and a second time if the Engineer requires a revision or corrections. The Contractor shall reimburse the Owner amounts charged to the Owner by the Engineer for performing any review of a submittal for the third time or greater.

- F. With few exceptions, shop drawings will be reviewed and returned to the Contractor within 30 days of submittal.
- G. No material or equipment shall be purchased or fabricated especially for this Contract nor shall the Contractor proceed with any portion of the work, the design and details of which are dependent upon the design and details of equipment or other features for which review is required, until the required shop and working drawings have been submitted and reviewed by the Engineer as to their general conformance and compliance with the project and its Contract Documents. All materials and work involved in the construction shall then be as represented by said drawings.
- H. Two copies of the shop and working drawings and/or catalog cuts will be returned to the Contractor. The Contractor shall furnish additional copies of such drawings or catalog cuts when he needs more than two copies or when so requested.

3.05 SAMPLES:

- A. Samples specified in individual Sections include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual

effect, graphic symbols, and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the work.

- B. The number of samples submitted shall be as specified. Submittal and processing of samples shall follow the procedures outlined for shop and working drawings unless the specifications call for a field submittal or mock-up.
- C. Acceptance of samples will be acknowledged via a copy of the transmittal noting status. When samples are not acceptable, prompt resubmittal will be required.

3.06 OPERATING AND MAINTENANCE MANUALS AND SPARE PARTS LISTS:

- A. Where reference is made in technical specification sections to operating and maintenance manuals and/or spare parts lists, the Contractor shall submit four hard copies and one electronic PDF copy to the Engineer for review in accordance with the instructions furnished under "Shop and Working Drawings." If the submittal is complete and does not require any changes, an acknowledgement (copy of transmittal) will be returned noting status. If the submittal is incomplete or does require changes, corrections, additions, etc., two copies of the submittal will be returned with a copy of transmittal noting status. Four copies of the final operating and maintenance manuals and/or spare parts list shall be delivered to the Engineer prior to or with the equipment when it is delivered to the job site. For systems requiring field adjustment and balancing, such as heating and ventilating, the Contractor shall submit separate test results and adjustment data on completion of the work, to be incorporated into the system manual.
- B. The information included in the manual shall be as described in the specification sections, but as a minimum shall contain clear and concise instructions for operating, adjusting, lubricating and maintaining the equipment, an exploded assembly drawing identifying each part by number and a listing of all parts of the equipment, with part numbers and descriptions required for ordering spare parts. Spare parts lists shall include recommended quantity and price.
- C. Operating and maintenance manuals shall be in durable loose-leaf binders, on 8½-inch by 11-inch paper, with diagrams and illustrations either on 8½-inch by 11 inch or multiple foldouts. The instructions shall be annotated to indicate only the specific equipment furnished. Reference to other sizes or models of similar requirement shall be deleted or neatly lined out.

END OF SECTION

EXHIBIT 1 TO SECTION 01330 SUBMITTALS

SHOP DRAWING TRANSMITTAL FORM

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

Shop Drawing Transmittal				Weston & Sampson Engineers, Inc.			
Instruction for Preparing Transmittal No action will be taken on any item unless accompanied by this form. TRANSMITTAL NOS. to be consecutive (1, 2, 3, etc.). Each resubmittal of same item shall use same number with suffix letter (A, B, etc.). SPEC. SECT. NO: Only one spec. section no. to each transmittal. DESCRIPTION: Complete identification of document or group of documents. SOURCE: Originator of document(s) being submitted.				DRAWING NO: Identification of document(s). CONTRACT DRAWING REFERENCE: Contract drawing number(s) showing details of document(s). SPECIAL INSTRUCTIONS: Special cases and emergencies, changes in distribution and special handling requests, etc. should be entered here. SIGNATURE OF CONTRACTOR: Signature of individual who reviews and approves material prior to submittal to engineer.			
THIS SECTION TO BE COMPLETED BY CONTRACTOR							
TRANSM. NO.		SPEC. SECT. NO.		DATE		CONTRACTORS JOB NO.	
PROJECT NAME & CONTRACT NO.				LOCATION			
T O	Weston & Sampson Engineers, Inc. 712 Brook Street, Suite 103 Rocky Hill, CT 06067			F R O M			
						BY W&S	
ITEM NO.	DESCRIPTION			SOURCE	DRAWING NO. CATALOG NO. BROCHURE, ETC	NO. OF COPIES	CONTRACT DRAWING REF.
1							
2							
3							
4							
THIS CERTIFIES THAT ALL ITEMS SUBMITTED HERewith HAVE BEEN CHECKED BY THE CONTRACTOR, ARE IN CONFORMANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, EXCEPT AS NOTED, AND ARE APPROVED BY THE CONTRACTOR FOR THIS PROJECT.						SIGNATURE & TITLE	
THIS SECTION TO BE COMPLETED BY W&S							
ACTION CODE: 1. FURNISH AS SUBMITTED 2. FURNISH AS NOTED 3. REVISE AND RESUBMIT 4. REJECTED- SEE REMARKS 5. ACKNOWLEDGEMENT 6. SUBMITTAL NOT REQUIRED, RETURNED WITHOUT REVIEW						a. INSTALLATION SHALL PROCEED ONLY WHEN ACTION CODE IS 1 OR 2 b. ACTION CODED 3 SHALL BE RESUBMITTED WITHIN TIME LIMIT SET IN CONTRACT c. REVIEW DOES NOT RELIEVE CONTRACTOR FROM RESPONSIBILITY OF COMPLIANCE WITH ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS	
						Weston & Sampson Engineers, Inc.	

SECTION 01751

STARTUP AND TESTING FOR SEWER PUMP STATIONS

PART 1 – GENERAL

1.01 WORK INCLUDED:

- A. This Section covers the startup and testing services required for the pump station(s) during system startup as specified herein.

1.02 SYSTEM DESCRIPTION:

- A. The Contractor shall perform pump station startup to the satisfaction of the Engineer. Startup and testing shall not be initiated until all required certifications and other required documentation has been submitted, as described herein.
- B. The purpose of the startup test is to provide a final operational checkout of all equipment prior to beneficial use by the Owner. This shall include both manual and automatic operation as well as instrumentation and alarm operations and simulations..
- C. This startup and testing is not to be utilized as a general debugging of the system. All equipment shall be started, tested, balanced, and calibrated prior to conducting the startup and testing described in this specification section. All the following equipment shall be tested prior to performing the actual acceptance test:
 - a. Pumps and Motors
 - b. Telemetry Equipment
 - c. Instrumentation and Alarms
 - d. Liquid Level Controls
 - e. Standby Generating System and Automatic Transfer Switch
 - f. Miscellaneous Equipment - Sump Pumps, etc.
- D. As most components of each pump station are interrelated, Substantial Completion of the project shall not be certified until successful completion of startup.

1.03 SEQUENCING:

- A. Startup, testing, operator training and other like services to be provided under the technical sections of the specifications are not to be performed during startup without written authorization from the Engineer.
- B. Full load standby generator testing shall be conducted and satisfactorily completed prior to the performance of startup testing.

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Submit the following to the Engineer for review a minimum of two (2) weeks prior to commencement of startup:
1. Written certification by a representative of the manufacturer that each piece of equipment has been installed properly and is ready for operation.
 2. Written certification by a representative of the equipment manufacturer that all equipment requiring calibration has been properly calibrated.
 3. Written certification by a representative of the instrumentation control and telemetering system manufacturer that all systems are fully functional and operational.
 4. A schedule of the testing, including staffing, and specific testing and operation of individual equipment items.
 5. Submit a copy of the attached forms indicating that all required equipment is installed and has been operated and tested by the Contractor and the manufacturer's representative(s).
 6. Generator Load Bank test results with sound monitoring data per Section 16 - Electrical.
- B. At the conclusion of the acceptance test, all information recorded during the test shall be forwarded to the Engineer in accordance with Section 01330 SUBMITTALS.

PART 2 – PRODUCTS - NOT APPLICABLE

PART 3 – EXECUTION

3.01 PREPARATION:

- A. Prior to commencement of testing, the Engineer shall be given fourteen (14) days' written notice.
- B. The Contractor shall complete final debugging prior to startup.
- C. All telemetry equipment shall be operational prior to testing.
- D. The testing shall be performed.
- E. Part of the testing shall be accomplished on standby power.

3.02 TEST PROCEDURES:

- A. It is the responsibility of the Contractor to insure that all equipment is completely operational throughout the test; provide the Engineer with proper technical assistance

as required to completely test all equipment and alarms; provide adequately trained personnel who can operate the pump station on an on/off basis so that the equipment is not damaged, whether the Engineer or Owner is present or not during that portion of the test.

- B. The Engineer shall during the test period direct the Contractor's supervision of the testing of all equipment, associated alarms and devices; to vary the operation of the equipment as necessary, and to pump as required.
- C. The Contractor shall provide a sufficient supply of water, at no additional cost to the Owner, to allow the pumps to operate during the entire test, so that the full range of pump operation is tested under varying incoming flows.
- D. All generator field tests shall be conducted in accordance with the appropriate technical specifications for Generators.
- E. The minimum duration of the testing shall be as shown below:

Pump Stations -

Submersible – 4 hours

Testing will be performed as long as is required for the Engineer to be satisfied that all equipment functions properly under expected conditions of service.

- F. The Contractor shall be back-charged for all Contractor-requested visits made to the site by the Engineer for the purpose of startup and testing when the Engineer determines that testing may not proceed due to unavailability of needed Contractor/subcontractor/vendor personnel at the site or the Contractor's failure to have any equipment properly functional at the time of the Engineer's visit.

3.03 STOPPING OF TEST:

- A. The Engineer shall stop the testing for any of the following reasons:
 - 1. Failure of critical system, including:
 - a. Pumps and Motors
 - b. Telemetry Equipment
 - c. Instrumentation
 - d. Standby Generating System and Automatic Transfer Switch
 - 2. Failure of any of the above systems to operate on standby power.
- B. If the test is stopped for any reason, the test shall be restarted from the beginning. The Contractor shall pay all costs associated with the Owner and Engineer supervising additional testing as required.

3.04 EXPENDABLES:

- A. Unless otherwise indicated, the General Contractor shall be responsible for providing all fuel during construction and providing a full tank of fuel oil if applicable at no additional cost to the Owner, at beneficial occupancy.

END OF SECTION

Document1

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

DATE/TIME: _____

INSPECTOR(S): _____

JOB NAME: _____

STATION NAME: _____

LOCATION: _____ENGINEER: _____

CONTRACTOR : _____

SUB-CONTRACTOR(s): _____

_____ PURPOSES ONLY

DESCRIBE STATION LAYOUT: _____

LIQUID BEING PUMPED: _____

COMMENTS: _____

NOT FOR REFERENCE

Prepared by: _____ Contractor: _____

Date: _____

Startup Witnessed by: _____
Weston & Sampson Engineers, Inc.

Date: _____

MOTOR No. _____

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

VOLTAGE: _____ PHASE: _____ AMPS: _____

HORSEPOWER: _____ HERTZ: _____

CONDITION OF CABLE JACKET: GOOD: _____ FAIR: _____ POOR: _____

GROUND RESISTANCE? _____

SUPPLY VOLTAGE: L1:L2 _____ L2:L3 _____ L3:L1 _____

AMPERAGE PUMP MOTOR: (BLACK) L1: _____ (RED) L2: _____ (WHITE) L3: _____

PUMP # _____

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

GPM: _____ TDH: _____ SINK: _____

GAUGE READINGS: SUCTION PRESSURE (ft/psi): _____
DISCHARGE PRESSURE (ft/psi): _____

RUNNING TIME METER (hours): _____

CONDITION OF EQUIPMENT: GOOD: _____ FAIR: _____ POOR: _____

FLOW TEST: START LEVEL: _____ FINISH LEVEL: _____

TIME SPAN: _____ GALLONS/INCH: _____

GALLONS/MIN: _____ PRESSURE: _____

SHUT-OFF PSI: _____ DISCHARGE LINE FULL? _____

VIBRATION

MOTOR: UPPER BEARING: _____ (inches/sec)
LOWER BEARING: _____ (inches/sec)

PUMP: UPPER BEARING: _____ (inches/sec)
LOWER BEARING: _____ (inches/sec)

Prepared by Contractor's Representative: _____ Date: _____

PUMP CONTROL PANEL

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

TYPE: _____ AMP RATING: _____

OVERLOAD TYPE: _____

SIZE: _____ AMP RATING: _____

DO PROTECTIVE DEVICES COMPLY WITH PUMP MOTOR AMP RATING? _____

MOTOR STARTERS/VFD: _____

ARE WIRES LABELED (TAGGED)? _____

ALARMS:

HIGH WATER: _____ PUMP FAIL: _____

LOW WATER: _____ MOISTURE: _____

TEMPERATURE: _____ OTHER: _____

TYPE: _____

Prepared by Contractor's Representative: _____ Date: _____

MOTOR CONTROL CENTER (MCC) (IF APPLICABLE)

MANUFACTURER: _____ SERIAL NUMBER: _____

MAIN: _____

DESCRIBE LAYOUT: _____

DRAWING LAYOUT OF MCC:

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

Prepared by Contractor's Representative: _____ Date: _____

LIQUID LEVEL CONTROLS

MANUFACTURER: _____

MODEL NUMBER: _____ SERIAL NUMBER: _____

FLOAT SWITCHES: _____

IF FLOATS, DESCRIBE OPERATION: _____

IF BUBBLER SYSTEM, DESCRIBE OPERATION: _____

LEVEL CONTROL COMPRESSOR:

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____

TANK: _____

DRAIN: _____

COMMENTS: _____

Prepared by Contractor's Representative: _____ Date: _____

STAND-BY GENERATOR (IF APPLICABLE)

ENGINE

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____

GENERATOR

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____ RATING: _____

AUTOMATIC TRANSFER SWITCH

MANUFACTURER: _____

MODEL: _____ SERIAL NUMBER: _____

CHECK THE FOLLOWING WHEN RUNNING (be sure to note units):

RPM: _____
VOLTS(AC): _____ (VOLTS)
AMPS (AC): _____ (AMPS)
FREQUENCY: _____ (HERTZ)
OIL TEMP: _____ (DEGREES)
OIL PRESSURE: _____
WATER TEMP: _____ (DEGREES)
RUN TIME: _____ (HOURS)

LEAKS OR UNUSUAL ACTIVITY? EXPLAIN: _____

COMMENTS: _____

Prepared by Contractor's Representative: _____ Date: _____

MISCELLANEOUS EQUIPMENT

FLOW METER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

HEATER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

VENTILATION SYSTEM

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

DEHUMIDIFIER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

SUMP PUMP

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: GPM: _____ TDH: _____
HP: _____ AMP: _____ VOLT: _____

OTHER

MANUFACTURER: _____
MODEL NUMBER: _____ SERIAL NUMBER: _____
RATING: AMP: _____ VOLT: _____

COMMENTS: _____

Prepared by Contractor's Representative: _____ Date: _____

SECTION 01760

OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. This section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK:

- A. General Requirements in their entirety (Section 00700 through Section 01770)
- B. Individual Technical Specification Sections Specific for Operation and Maintenance Data.
- C. Section 01329, SUBMITTALS FOR OPERATION AND MAINTENANCE MANUALS
- D. Section 01330, SUBMITTALS

1.03 FORMAT:

- A. Prepare data in form of an instructional manual.
- B. Binders: Commercial quality, 8 1/2 x 11 inch three-ring binders with hardback, washable, plastic covers; two inch maximum ring size. When multiple binders are used, correlate data into related, consistent groupings. Provide a table of contents in each binder.
- C. Cover: Identify each binder cover and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTION; list title of Project facility; identify subject matter of contents.
- D. Arrange contents by systems under section numbers and sequence of Table of Contents.
- E. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data - on 20-pound paper.
- G. Drawings: Provide with reinforced punched, binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Submit certification that the data and drawings provided pertain exactly to the model, size, and series product and equipment installed in the work.
- I. All documents will be electronically scannable.

J. All products, systems, and drawings must be cross-referenced with tag ID numbers.

K. The manual for each piece of equipment shall be a separate document with the following specific requirement:

1. Contents:

Table of Contents and Index

Brief description of each system and components

Starting and stopping procedures

Special operating instructions

Routine maintenance procedures

Manufacturer's printed operating and maintenance instructions, parts list, illustrations, and diagrams

One copy of each wiring diagram

One copy of each approved shop drawing and each Contractor's coordination and layout drawing

List of spare parts, manufacturer's price, and recommended quantity

Name, address and telephone number of local service representatives.

2. Material

Loose leaf on 60 pound, punched paper

Holes reinforced with plastic cloth or metal

Page size, 8 ½ x 11 inches

Diagrams, illustrations and attached foldouts as required, of original quality, reproduced by dry copy method

Covers: oil, moisture and wear resistant 9 x 12 size

1.04 QUALITY ASSURANCE:

- A. Prepare instructions and data by personnel experienced in maintenance and operations of described products.

1.05 CONTENTS, EACH VOLUME (BINDER):

- A. Table of Contents: Provide title of Contract, schedule of products and systems, indexed to content of the volume. A listing of all relevant tag ID numbers for each volume shall be placed immediately after the Table of Contents.
- B. For each product or systems: List names, addresses, and telephone numbers of subcontractors and suppliers, including local source of suppliers and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- E. Text: As required to supplement product data, provide logical sequence of instructions for each procedure incorporating manufacturer's instructions.
- F. Warranties, Guarantees, and Bonds: Bind copy of each
- G. See O&M Manual Review Checklist at end of this specification section.

1.06 MANUAL FOR MATERIALS AND FINISHES:

- A. Building Products, Applied Materials, and Finishes: Include product data with catalog number, size composition, and color and texture designations. Provide information for re-ordering custom manufactured products.
- B. 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.
- C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional Requirements: As specified in individual product specification sections.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. 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 commercial number of replaceable parts.
- B. Data submitted on all equipment shall include complete maintenance instructions (including preventive and corrective maintenance) and parts lists in sufficient detail to facilitate ordering replacements.
- C. All products, systems, equipment, electrical wiring, instrumentation wiring, personnel protection systems wiring, presented in this manual will have tag numbers corresponding to contract drawings and specifications. In the event, numbers do not exist; the Engineer will specify a series of numbers.
- D. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.
- E. Include color-coded wiring diagrams as installed.
- F. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequence. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter and any special operating instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required. Cross-reference lubricants to products offered by at least three major lubricant suppliers.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

- O. Include test and balancing reports, calibration data, alignment records, and other information.
- P. Additional Requirements: as specified in individual product specification sections.
- Q. Provide a listing in table of Contents for design data with tabbed flysheet and space for insertion of data.
- R. Incorporation of all Physical Checkout information obtained through the field-testing and correction phases of the Work. Input must be specific to the actions and information obtained during those phases.

1.08 SUBMITTALS:

- A. Submit draft and final copies of operation and maintenance manuals as described in Section 01329 SUBMITTAL OF OPERATION AND MAINTENANCE MANUALS.
- B. Contractor to be responsible for completing GNHWPCA Asset Management Forms included in Appendix B as part of O&M Manual Submission.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

Note to Specifier: Review the attached Checklist and add items that are required or delete items not relative to this project.

**OPERATION AND MAINTENANCE MANUAL
REVIEW CHECKLIST**

- | | |
|--|--------------------------|
| 1. Name, address, telephone/fax number of the manufacturer | <input type="checkbox"/> |
| 2. Name, address, contact name, telephone/fax of local representative | <input type="checkbox"/> |
| 3. Name, address, telephone/fax number of the contractor | <input type="checkbox"/> |
| 4. Exploded view/general arrangement of materials of construction | <input type="checkbox"/> |
| 5. Description of operation/operating principal | <input type="checkbox"/> |
| 6. Project specific Operating parameters | <input type="checkbox"/> |
| 7. Wiring Diagrams (If Applicable) | <input type="checkbox"/> |
| 8. Troubleshooting checklist | <input type="checkbox"/> |
| 9. Recommended spare parts list with prices, and ordering instructions | <input type="checkbox"/> |
| 10. Model number and the serial number of the model provided | <input type="checkbox"/> |
| 11. Performance curves or tabulated data | <input type="checkbox"/> |
| 12. Routine Maintenance instructions/service instructions with recommended Intervals | <input type="checkbox"/> |
| 13. Assembly and disassembly instructions | <input type="checkbox"/> |
| 14. Recommended lubricates and lubrication schedule. | <input type="checkbox"/> |
| 15. Approved copies of Shop Drawings are to be included in the manual | <input type="checkbox"/> |
| 16. Startup/break-in and adjustment instructions | <input type="checkbox"/> |
| 17. Warranty information | <input type="checkbox"/> |

Reviewed By: _____
Weston & Sampson Engineers

Date: _____

END OF SECTION

SECTION 01770
ASSET MANAGEMENT INFORMATION

PART 1 GENERAL

1.01 DEFINITIONS

- A. Preliminary Asset Summary Information: Initial and subsequent submissions for Engineer's review.
- B. Final Asset Summary Information: Engineer-accepted data, submitted as specified herein.
- C. Preliminary Maintenance Summary Information: Initial and subsequent submissions for Engineer's review.
- D. Final Maintenance Summary Information: Engineer-accepted data, submitted as specified herein.
- E. Maintenance Tasks: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.02 SEQUENCING AND SCHEDULING

- A. Asset Data:
 - 1. Preliminary Asset Summary Information: Submit no later than 30 days after equipment installation. Preliminary Asset Summary Information requires approval by the Engineer prior to manufacturer's startup.
 - 2. Final Asset Summary Information: Submit no later than 30 days after manufacturer startup.
- B. Maintenance Data:
 - 1. Preliminary Maintenance Summary Information: Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer. Preliminary Maintenance Summary Information requires approval by the Engineer prior to manufacturer's startup.
 - 2. Final Maintenance Summary Information: Submit no later than 30 days after manufacturer startup.

1.03 SUBMITTALS

- A. All information submitted to the Engineer for review shall be prepared and submitted in accordance with Section 01 33 00.
- B. Prepare Preliminary Information:
 - 1. Submit completed Asset Summary Form and Maintenance Summary Form in an electronic format.
 - a. See Attachments A & B for examples.
 - 2. Submit attachments in an electronic format.
- C. Prepare Final Information in a Compilation Format:
 - 1. Compile all Engineer-accepted preliminary Asset Summary Information and Maintenance Information into separate hard-copy, hard-bound sets, with USB for electronic files.
 - 2. Each set shall consist of the following:
 - a. Engineer approved Asset Summary Form, hardcopy and Excel file format
 - b. Engineer approved Maintenance Summary Form, hardcopy and Excel file format
 - c. Attachments
 - 1) Engineer approved Startup Report
 - 2) Engineer approved O&M Manual, PDF format divided into files not to exceed 50 mb.
 - 3) Digital Photograph of Installed Asset not to exceed 1 mb.

1.04 DATA FOR EQUIPMENT AND SYSTEMS

- A. Asset Summary Forms:
 - 1. Compile individual Asset Summary Forms for each applicable equipment item, respective unit or system, and for components or sub-units.
 - 2. Format:
 - a. An electronic copy of the Asset Summary Form can be provided by the Engineer upon request.
 - b. Each Asset Summary Form may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size pages.
 - d. All files submitted to the Engineer shall be in Excel and/or PDF Format. Files submitted shall be fully functional and viewable in most recent version of Adobe Acrobat. No handwritten forms will be accepted.
 - 3. Required Information

- a. All relevant fields on the Asset Summary Form are to be filled out in their entirety before submission to the engineer for review. Incomplete forms will not be accepted by the engineer.
- b. Information fields on the form that are not relevant to the installed equipment are to be entered with "Not Applicable".
- c. Engineer holds the right to determine information relevance or to request additional information based on equipment/asset type.

B. Maintenance Summary Forms:

1. Compile individual Maintenance Summary Forms for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
 - a. An electronic copy of the Maintenance Summary Form can be provided by the Engineer upon request.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size pages.
 - d. All files submitted to the Engineer shall be in PDF Format. Files submitted shall be fully functional and viewable in most recent version of Adobe Acrobat. No handwritten forms will be accepted.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.

1.05 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are part of this Specification.

1. Forms: Asset Summary Form, Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02112

REMOVAL OF UNDERGROUND NONFRIABLE ASBESTOS CEMENT PIPE

PART 1 - GENERAL

1.01 GENERAL:

A. Definitions –

“Friable” – material can be crushed, pulverized, or reduced to powder, when dry, by hand pressure.

“Non-friable” – material that cannot be crushed or pulverized under hand pressure.

B. This section specifies requirements for the removal of nonfriable (pipe that has been below the groundwater level or is in otherwise saturated soils will generally be nonfriable because it has been saturated/wet) asbestos-cement pipe during trenching and excavation operations associated with the installation of new water or sewer pipes, where existing AC pipes may be encountered.

C. All asbestos cement pipe that is shown on the drawings and which is removed during construction is the responsibility of the Contractor, for removal, transportation and proper disposal.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS:

A. The Contractor shall submit to the Engineer the following listed items at least 14 days before work is to proceed. No asbestos pipe removal work activities shall commence until the Engineer reviews these items, unless otherwise waived.

Submittal No. 1

Plan of Action and Standard Operating Procedure: Submit a detailed plan of the procedures proposed for use in complying with all applicable regulations and the requirements of this specification.

Submittal No. 2

Name, location, and copies of applicable licenses for primary and secondary landfill for disposal of asbestos-containing or asbestos-contaminated waste.

Submittal No. 3

Within 30 days of receipt of asbestos waste at the approved landfill, the Contractor shall submit to the Engineer the original copy of the "Waste Shipment Record" acknowledging disposal of all associated waste material from the Contract showing delivery date, quantity, and appropriate signature of Contractor, transporter, and landfill's authorized representative.

1.04 GENERAL APPLICABILITY OF CODES, REGULATIONS AND STANDARDS:

- A. All applicable federal, state and municipal codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. All regulations by governing agencies in their most recent version are applicable. Provisions contained in this specification that are more stringent than applicable codes, regulations and standards shall govern for this project.

PART 2 - PRODUCTS

2.01 MATERIALS, TOOLS, AND EQUIPMENT:

- A. Wetting Materials: For wetting before disturbance of asbestos-containing materials use either amended water or a removal encapsulant. The material must be odorless, non-flammable, non-toxic, non-irritating, and non-carcinogenic. It shall be applied as a mist using a low-pressure sprayer recommended by the manufacturer.
 - 1. Amended Water: Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the asbestos containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.
 - 2. Removal Encapsulant: Provide a penetrating type encapsulant designed specifically for removal of asbestos containing material. Use a material which results in wetting of the asbestos-containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.
- B. Encapsulant: A material that surrounds or embeds asbestos fibers in an adhesive matrix, to prevent release of fibers.
 - 1. Bridging Encapsulant: An encapsulant that forms a discrete layer on the surface of an in situ asbestos matrix.

2. Penetrating Encapsulant: An encapsulant that is absorbed by the in situ asbestos matrix without leaving a discrete surface layer.
 3. Removal Encapsulant: A penetrating encapsulant specifically designed for removal of asbestos-containing materials rather than for in situ encapsulation.
- C. Polyethylene Sheet: Provide flame resistant polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mils thick as required, frosted or black as indicated.
- D. Duct Tape: Provide duct tape in 2-inch or 3-inch widths as indicated, with an adhesive, which is formulated to aggressively stick to sheet polyethylene, is waterproof, and will adhere to other materials.
- E. Spray Cement: Provide spray adhesive in aerosol cans that is specifically formulated to stick tenaciously to sheet polyethylene.
- F. Waste Containers: Provide 6 mil thick leak-tight polyethylene bags labeled as follows:
- DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
- If the waste material contains sharp edges or may otherwise puncture polyethylene bags, provide properly labeled drums or other closed containers for storage, transportation, and disposal.
- G. Warning Signs And Labels: Shall comply with 29 CFR 1926.59(k), and all other federal, state, or local codes and regulations.
- H. Brushes: All brushes shall have nylon bristles. Wire brushes are excluded from use due to their potential to shred asbestos fibers into small fibers. Wire brushes may be used on pipe joint applications upon prior written notice to the Engineer.

PART 3 – EXECUTION

3.01 GENERAL

- A. Nonfriable asbestos cement pipe shall be handled, transported, and disposed of in a way that prevents it from becoming friable and releasing asbestos fibers. AC pipe cannot be shattered, crumbled, pulverized, sanded, chipped, or ground.

- B. Nonfriable AC pipe may not be used as fill; it shall be disposed of at a landfill that is state-approved to accept asbestos waste. Landfills may require special packaging and labeling in order to accept the AC pipe.
- C. AC pipe shall not be removed from the excavation if it is not necessary to disturb it during the installation of the new pipeline.
- D. AC pipe shall never be handled unless it is wet. Dry pipe shall be wet down with a suitable wetting material prior to handling it.

3.02 AC PIPE REMOVAL DURING EXCAVATION:

- A. This section is provided for removal of AC pipe in excavation areas.
- B. Removal Of Non-Friable Asbestos Materials:
 - 1. Carefully excavate, by hand, a sufficient area around the pipe to perform the work. Any asbestos debris that is present or generated by these activities will be promptly wetted and placed into 6-mil asbestos waste bags before continuing with the work.
 - 2. Once excavation is complete, place one layer of 6-mil polyethylene sheeting on sidewalls and bottom of trench under the AC pipe to be removed.
 - 3. Thoroughly encapsulate AC pipe with an acceptable penetrating encapsulant per manufacturer guidelines.
 - 4. Remove AC pipe as follows:

Cut sections of pipe will be removed from the trench and immediately wrapped and sealed in two layers of 6-mil asbestos waste bags. Packaged waste will then be placed into acceptable waste transportation vehicle. Whenever possible, the Contractor will limit cutting of asbestos cement materials and dismantle materials in intact sections. Removal should be up to Contractor's means and methods in accordance with applicable laws and regulations.

3.03 AC PIPE LEFT IN PLACE

- A. Ends of AC pipe to be left in the excavation shall be encapsulated. AC pipe is not to be crushed and left in place. Any crushed pieces must be removed and properly disposed of.

3.04 AC PIPE DISPOSAL PROCEDURES

- A. The Contractor shall package, label, and remove all AC pipe as specified below. Packaging shall be accomplished in a manner that minimizes waste volume, but insures waste containers shall not tear or break. Transportation and disposal of the containerized waste at an approved landfill shall be the responsibility of the Contractor.
- B. Waste Labeling:
1. Warning labels, having waterproof print and permanent adhesive in compliance with OSHA, EPA and Department of Transportation requirements shall be affixed to or printed on the sides of all waste bags or transfer containers. Warning labels shall be conspicuous and legible.
 2. In compliance with NESHAPS, 40 CFR, Part 61.150, all waste containers or bags shall be labeled with the following generator information:
 - a. Name of waste generator.
 - b. Location where waste was generated.

END OF SECTION

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SECTION 02240

DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of equipment and instrumentation for control of the system.

1.02 RELATED WORK (NOT USED)

1.03 SYSTEM DESCRIPTION:

- A. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.

1.04 QUALITY ASSURANCE:

- A. The Contractor is responsible for the adequacy of the dewatering systems.
- B. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom, unless otherwise required by the Engineer, so that all excavation bottoms are firm and dry.
- C. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes and appurtenances to be built therein have been completed to the extent that they will not be floated or otherwise damaged.
- D. The dewatering system and excavation support (see Section 02252, SUPPORT OF EXCAVATION) shall be designed so that lowering of the groundwater level outside the excavation does not adversely affect adjacent structures, utilities or wells.

1.05 SUBMITTALS:

- A. In accordance with Section 01330, Contractor shall submit a plan indicating how it intends to control the discharge from any dewatering operations on the project, whether it is discharge of groundwater from excavations or stormwater runoff during the life of the project.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 DEWATERING OPERATIONS:

- A. All water pumped or drained from the work shall be disposed of in a manner that will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work. All disposal of pumped water shall conform to the provisions of Section 01570 ENVIRONMENTAL PROTECTION and Section 00890 PERMITS.
- B. Dewatering facilities shall be located where they will not interfere with utilities and construction work to be done by others.
- C. Dewatering procedures to be used shall be as described below:
1. Crushed stone shall encapsulate the suction end of the pump to aid in minimizing the amount of silt discharged.
 2. For dewatering operations with relatively minor flows, pump discharges shall be directed into hay bale sedimentation traps lined with filter fabric. Water is to be filtered through the hay bales and filter fabric prior to being allowed to seep out into its natural watercourse.
 3. For dewatering operations with larger flows, pump discharges shall be into a steel dewatering basin. Steel baffle plates shall be used to slow water velocities to increase the contact time and allow adequate settlement of sediment prior to discharge into waterways.
 4. Where indicated on the contract drawings or in conditions of excess silt suspended in the discharge water, silt control bags shall be utilized in catch basins.
- D. The Contractor shall be responsible for repair of any damage caused by his dewatering operations, at no cost to the Owner.

END OF SECTION

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SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall make excavations of normal depth in earth for trenches and structures, shall backfill and compact such excavations to the extent necessary, shall furnish the necessary material and construct embankments and fills, and shall make miscellaneous earth excavations and do miscellaneous grading.

1.02 RELATED WORK (NOT USED)

1.03 REFERENCES:

American Society for Testing and Materials (ASTM)

ASTM C131 Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM C136 Method for Sieve Analysis of Fine and Coarse Aggregates.

ASTM C330 Specification for Lightweight Aggregate for Structural Concrete.

ASTM D1556 Test Method for Density of Soil in Place by the Sand Cone Method.

ASTM D1557 Test Methods for Moisture-density Relations of Soils and Soil Aggregate Mixtures Using Ten-pound (10 Lb.) Hammer and Eighteen-inch (18") Drop.

ASTM D2922 Test Methods for Density of Soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth).

Connecticut Department of Transportation Standard Specification for Highways and Bridges (Form 817).

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Samples of all materials proposed for the project shall be submitted to the Engineer for review. Size of the samples shall be as approved by the Engineer.

1.05 PROTECTION OF EXISTING PROPERTY:

- A. The work shall be executed in such manner as to prevent any damage to facilities at the site and adjacent property and existing improvements, such as but not limited to streets, curbs, paving, service utility lines, structures, monuments, bench marks, observation wells, and other public or private property. Protect existing improvements from damage caused by settlement, lateral movements, undermining, washout and other hazards created by earthwork operations.
- B. In case of any damage or injury caused in the performance of the work, the Contractor shall, at its own expense, make good such damage or injury to the satisfaction of, and without cost to, the Owner. Existing roads, sidewalks, and curbs damaged during the project work shall be repaired or replaced to at least the condition that existed at the start of operations. The Contractor shall replace, at his own cost, existing benchmarks, observation wells, monuments, and other reference points which are disturbed or destroyed.
- C. Buried drainage structures and pipes, observation wells and piezometers, including those which project less than eighteen inches (18") above grade, which are subject to damage from construction equipment shall be clearly marked to indicate the hazard. Markers shall indicate limits of danger areas, by means which will be clearly visible to operators of trucks and other construction equipment, and shall be maintained at all times until completion of project.

1.06 DRAINAGE:

- A. The Contractor shall provide, at its own expense, adequate drainage facilities to complete all work items in an acceptable manner. Drainage shall be done in a manner so that runoff will not adversely affect construction procedures nor cause excessive disturbance of underlying natural ground or abutting properties.

1.07 FROST PROTECTION AND SNOW REMOVAL:

- A. The Contractor shall, at its own expense, keep earthwork operations clear and free of accumulations of snow as required to carry out the work.
- B. The Contractor shall protect the subgrade beneath new structures and pipes from frost penetration when freezing temperatures are expected.

PART 2 - PRODUCTS

2.01 MATERIAL:

A. GRAVEL BORROW:

Gravel Borrow shall satisfy the requirements listed in CONN DOT Article M. 02.01-2, Grading A.

B. SAND BORROW:

Sand borrow shall satisfy the requirements listed for fine aggregate in CONN DOT Article M.03.01-2.

C. CRUSHED STONE:

Crushed stone shall satisfy the requirements listed in CONN DOT Article M.02.06, Grading "C".

D. PEASTONE:

Peastone shall be smooth, hard, naturally occurring, rounded stones meeting the following gradation requirements:

Passing 5/8 inch square sieve opening	- 100%
Passing No. 8 sieve opening	- 0%

E. BACKFILL MATERIALS:

1. Class B Backfill:

Class B backfill shall be granular, well graded friable soil; free of rubbish, ice, snow, tree stumps, roots, clay and organic matter; with 30 percent or less passing the No. 200 sieve; no stone greater than two-third (2/3) loose lift thickness, or six inches, whichever is smaller.

2. Select Backfill:

Select backfill shall be granular, well graded friable soil, free of rubbish, ice, snow, tree stumps, roots, clay and organic matter, and other deleterious or organic material; graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3"	100
No. 10	30-95
No. 40	10-70
No. 200	0-10

F. PROCESSED GRAVEL:

1. Processed gravel shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials. The

coarse aggregate shall have a percentage of wear, by the Los Angeles Abrasion Test, of not more than 50.

2. The gradation shall meet the following requirements:

<u>Sieve Designation</u>	<u>Percentage Passing</u>
3 in.	100
1 1/2 in.	70-100
3/4 in.	50-85
No. 4	30-60
No. 200	0-10

3. The approved source of bank-run gravel material shall be processed by mechanical means. The equipment for producing crushed gravel shall be of adequate size with sufficient adjustments to produce the desired materials. The processed material shall be stockpiled in such a manner to minimize segregation of particle sizes. All processed gravel shall come from approved stockpiles.

PART 3 - EXECUTION

3.01 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION:

- A. Contractor shall take the necessary steps to avoid disturbance of subgrade during excavation and filling operations, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials, dewatering and other acceptable control measures.
- B. All excavated or filled areas disturbed during construction, all loose or saturated soil, and other areas that will not meet compaction requirements as specified herein shall be removed and replaced with a minimum 12-inch layer of compacted crushed stone wrapped all around in non-woven filter fabric. Costs of removal and replacement shall be borne by the Contractor.
- C. The Contractor shall place a minimum of 12-inch layer of special bedding materials and crushed stone wrapped in filter fabric over the natural underlying soil to stabilize areas which may become disturbed as a result of rain, surface water runoff or groundwater seepage pressures, all at no additional cost to the Owner. The Contractor also has the option of drying materials in-place and compacting to specified densities.

3.02 EXCAVATION:

A. GENERAL:

1. The Contractor shall perform all work of any nature and description required to accomplish the work as shown on the Drawings and as specified.

2. Excavations, unless otherwise required by the Engineer, shall be carried only to the depths and limits shown on the Drawings. If unauthorized excavation is carried out below required subgrade and/or beyond minimum lateral limits shown on Drawings, it shall be backfilled with gravel borrow and compacted at the Contractor's expense as specified below, except as otherwise indicated. Excavations shall be kept in dry and good conditions at all times, and all voids shall be filled to the satisfaction of the Engineer.
3. In all excavation areas, the Contractor shall strip the surficial topsoil layer and underlying subsoil layer separate from underlying soils. In paved areas, the Contractor shall first cut pavement as specified in paragraph 3.02 B.1 of this specification, strip pavement and pavement subbase separately from underlying soils. All excavated materials shall be stockpiled separately from each other within the limits of work.
4. The Contractor shall follow a construction procedure which permits visual identification of stable natural ground. Where groundwater is encountered, the size of the open excavation shall be limited to that which can be handled by the Contractor's chosen method of dewatering and which will allow visual observation of the bottom and backfill in the dry.
5. The Contractor shall excavate unsuitable materials to stable natural ground where encountered at proposed excavation subgrade, as required by the Engineer. Unsuitable material includes topsoil, loam, peat, other organic materials, snow, ice, and trash. Unless specified elsewhere or otherwise required by the Engineer, areas where unsuitable materials have been excavated to stable ground shall be backfilled with compacted special bedding materials or crushed stone wrapped all around in non-woven filter fabric.

B. TRENCHES

1. Prior to excavation, trenches in pavement shall have the traveled way surface cut in a straight line by a concrete saw or equivalent method, to the full depth of pavement. Excavation shall only be between these cuts. Excavation support shall be provided as required to avoid undermining of pavement. Cutting operations shall not be done by ripping equipment.
2. The Contractor shall satisfy all dewatering requirements specified in Section 02240 DEWATERING, before performing trench excavations.
3. Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, and depths of cover indicated on the Drawings. Trench widths shall be as shown on the Drawings or as specified.

4. Where pipe is to be laid in bedding material, the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is not disturbed.
5. If pipe is to be laid in embankments or other recently filled areas, the fill material shall first be placed to a height of at least 12-inches above the top of the pipe before excavation.
6. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed.
7. If, in the opinion of the Engineer, the subgrade, during trench excavation, has been disturbed as a result of rain, surface water runoff or ground water seepage pressures, the Contractor shall remove such disturbed subgrade to a minimum of 12 inches and replace with crushed stone wrapped in filter fabric. Cost of removal and replacement shall be borne by the Contractor.

C. BUILDING AND FOUNDATION EXCAVATION:

1. Excavations shall not be wider than required to set, brace, and remove forms for concrete, or perform other necessary work.
2. After the excavation has been made, and before forms are set for footings, mats, slabs, or other structures, and before reinforcing is placed, all loose or disturbed material shall be removed from the subgrade. The bearing surface shall then be compacted to meet the requirements of this specification.
3. If, in the opinion of the Engineer, the existing material at subgrade elevation is unsuitable for structural support, the Contractor shall excavate and dispose of the unsuitable material to the required width and depth as required by the Engineer. If, in the opinion of the Engineer, filter fabric is required; the Contractor shall place filter fabric, approved by the Engineer, as per manufacturer's recommendations. Crushed stone shall then be placed in lifts and compacted to required densities. Backfill shall be placed to the bottom of the proposed excavation.

3.03 BACKFILL PLACEMENT AND COMPACTION:

A. GENERAL:

1. Prior to backfilling, the Contractor shall compact the exposed natural subgrade to the densities as specified herein.
2. After approval of subgrade by the Engineer, the Contractor shall backfill areas to required contours and elevations with specified materials.

3. The Contractor shall place and compact materials to the specified density in continuous horizontal layers, not to exceed nine (9) inches in uncompacted lifts. The degree of compaction shall be based on maximum dry density as determined by ASTM Test D1557, Method C. The minimum degree of compaction for fill placed shall be as follows:

<u>Location</u>	<u>Percent of Maximum Density</u>
Below pipe centerline	95
Above pipe centerline	92
Below pavement (upper 3 ft.)	95
Embankments	95
Below pipe in embankments	95
Adjacent to structures	92
Below structures	95

4. The Engineer reserves the right to test backfill for conformance to the specifications and Contractor shall assist as required to obtain the information. Compaction testing will be performed by the Engineer or by an inspection laboratory designated by the Engineer, engaged and paid for by the Owner. If test results indicate work does not conform to specification requirements, the Contractor shall remove or correct the defective Work by recompacting where appropriate or replacing as necessary and approved by the Engineer, to bring the work into compliance, at no additional cost to the Owner. All backfilled materials under structures and buildings shall be tested for compliance with the requirements of this specification.
5. Where horizontal layers meet a rising slope, the Contractor shall key each layer by benching into the slope.
6. If the material removed from the excavation is suitable for backfill with the exception that it contains stones larger than permitted, the Contractor has the option to remove the oversized stones and use the material for backfill or to provide replacement backfill at no additional cost to the Owner.
7. The Contractor shall remove loam and topsoil, loose vegetation, stumps, large roots, etc., from areas upon which embankments will be built or areas where material will be placed for grading. The subgrade shall be shaped as indicated on the Drawings and shall be prepared by forking, furrowing, or plowing so that the first layer of the fill material placed on the subgrade will be well bonded to the subgrade.
8. Where called for on the Drawings, Lightweight Fill shall be placed and compacted as recommended by the manufacturer. The exact number of passes shall be approved by the Engineer to insure stability of the layer. As soon as the compaction of each layer has been completed, the next layer shall then be placed. The

Contractor shall take all necessary precautions during construction activities in operations on or adjacent to the Lightweight Fill to insure that the material is not over-compacted. Construction equipment, other than for compaction, shall not operate on the exposed Lightweight Fill. The top surface of the Lightweight Fill lying directly below the gravel course shall be chinked by additional rolling of the Lightweight Fill to prevent infiltration of fines.

B. TRENCHES:

1. Bedding as detailed and specified shall be furnished and installed beneath the pipeline prior to placement of the pipeline. A minimum bedding thickness shall be maintained between the pipe and undisturbed material, as shown on the Drawings.
2. As soon as practicable after pipes have been laid, backfilling shall be started.
3. Unless otherwise indicated on the Drawings, select backfill shall be placed by hand shovel in 6-inch thick lifts up to a minimum level of 12 inches above the top of pipe. This area of backfill is considered the zone around the pipe and shall be thoroughly compacted before the remainder of the trench is backfilled. Compaction of each lift in the zone around the pipe shall be done by use of power-driven tampers weighing at least 20 pounds or by vibratory compactors. Care shall be taken that material close to the bank, as well as in all other portions of the trench, is thoroughly compacted to densities required.
4. Class B backfill shall be placed from the top of the select backfill to the specified material at grade (loam, pavement subbase, etc.). Fill compaction shall meet the density requirements of this specification.
5. If the materials above the trench bottom are unsuitable for backfill, the Contractor shall furnish and place backfill materials meeting the requirements for trench backfill, as shown on the drawings or specified herein.
6. Should the Engineer order crushed stone for utility supports or for other purposes, the Contractor shall furnish and install the crushed stone as required.
7. In shoulders of streets and roads, the top 12-inch layer of trench backfill shall consist of crushed or uncrushed gravel, satisfying the requirements listed in CONN DOT standard specification M02.04.
8. Subbase shall consist of bank or crushed gravel meeting the requirements of CONN DOT standard specification M.02.02.

C. BACKFILLING UNDER BUILDINGS AND FOUNDATIONS:

Material to be used as structural fill under structures shall be special bedding material or gravel borrow, as shown on the Drawings or as required by the Engineer. Where gravel borrow fill is required to support proposed footings, walls, slabs, and other structures, the material shall be placed in a manner accepted by the Engineer. Compaction of each lift shall meet the density requirements of this specification.

D. BACKFILLING ADJACENT TO STRUCTURES:

1. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads to which they will be subjected. Excavated material approved by the Engineer may be used in backfilling around structures. Backfill material shall be thoroughly compacted to meet the requirements of this specification.
2. Contractor shall use extra care when compacting adjacent to pipes and drainage structures. Backfill and compaction shall proceed along sides of drainage structures so that the difference in top of fill level on any side of the structure shall not exceed two feet (2') at any stage of construction.
3. Where backfill is to be placed on only one side of a structural wall, only hand-operated roller or plate compactors shall be used within a lateral distance of five feet (5') of the wall for walls less than fifteen feet (15') high and within ten feet (10') of the wall for walls more than fifteen feet (15') high.

3.04 DISPOSAL OF SURPLUS MATERIALS:

- A. No excavated material shall be removed from the site of the work or disposed of by the Contractor unless approved by the Engineer.
- B. Surplus excavated materials, which are acceptable to the Engineer, shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill. Upon written approval of the Engineer, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits; all at no additional cost to the Owner.
- C. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner, at appropriate locations, and in accordance with arrangements made by him. Disposal of all rubble shall be in accordance with all applicable local, state and federal regulations.

END OF SECTION

SECTION 02370

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. Furnish all labor, materials, tools and equipment, and perform all operations necessary for erosion and sedimentation control work indicated on contract drawings and as specified herein.

1.02 RELATED WORK (NOT USED)

1.03 PROJECT CONDITIONS:

- A. Earthmoving activities in the project area shall be conducted in such a manner as to prevent accelerated erosion and the resulting sedimentation.
- B. The Contractor shall implement and maintain erosion and sedimentation control measures as shown on the contract drawings or as required by the Owner or Engineer from the start of construction until provisional acceptance of seeded areas, to effectively prevent accelerated erosion and sedimentation.

1.04 SUBMITTALS IN ACCORDANCE WITH SECTION 01330, SUBMITTALS:

- A. The Contractor shall submit to the Engineer certification that the materials used for silt fence and straw wattle construction meet the specifications.

1.05 GENERAL METHODOLOGY:

- A. Erosion and sedimentation control methods shall consider all factors which contribute to erosion and sedimentation including, but not limited to, the following:
 - 1. Topographic features of the Project area.
 - 2. Types, depth, slope and areal extent of the soils.
 - 3. Proposed alteration of the area.
 - 4. Amount of run-off from the Project area and the upgradient watershed areas.
 - 5. Staging of earthmoving activities.

6. Temporary control measures and facilities for use during earthmoving.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Straw wattle shall consist of 99.9% weed-free wheat, oat, barley, or rice straw, compacted. Diameter may vary +/- 13 percent. Wattle netting shall be non-woven photodegradable HDPE with a 1 year UV inhibitor.
- B. Silt Fence shall be a woven polypropylene and/or polyester material, which meets or exceeds the minimum average roll values requirements tabulated below:

Fabric Property	Test Method	Fabric Requirement
Tensile strength, lbs	ASTM D-4632 Grab	100 minimum
Elongation at 50% minimum tensile strength	ASTM D-4632 Grab	50% maximum
Permittivity, sec ⁻¹	ASTM D-4491	0.1 minimum
Apparent opening size, mm	ASTM D-4751	0.84 maximum
Ultraviolet degradation at 500 hours	ASTM D-4355	minimum 70% strength retained

- C. Mulch, if used to protect the hydroseed from erosion, shall consist of cured straw free from primary noxious weed seeds, twigs, debris and rough or woody materials. Mulch shall be free from rot or mold and shall be acceptable to the Engineer or Owner. Alternately, mulch shall be specially processed cellulose homogeneous fiber containing no growth or germination-inhibiting factors. Processed cellulose fiber shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a slurry when sprayed on the ground. The material shall allow homogeneous absorption and percolation of moisture. The manufacturer shall show the air-dry weight content on each package of the cellulose

fiber. Mulch shall be utilized on all newly graded subgrade and topsoil areas that cannot be seeded within five (5) days.

PART 3 - EXECUTION

3.01 CONSTRUCTION SEQUENCE:

- A. Construction of erosion control measures as depicted on drawings will be completed prior to any site work.
- B. Sediment barriers shall be used at locations shown on the drawings. Sediment barriers are temporary berms, diversions, or other barriers that are constructed to retain sediment on-site by retarding and filtering stormwater runoff.
- C. All temporary erosion control measures will be maintained throughout the course of site construction activities until provisional acceptance of the site vegetation by the Engineer or Owner, at which time the Contractor shall remove all remaining temporary erosion control structures, and properly dispose of accumulated sediment on-site in areas approved by the Owner.
- D. The Engineer or Owner may order additional erosion and sediment controls be installed. The Contractor shall comply with Engineer or Owner's request and immediately install the required controls.
- E. The Contractor shall inspect all erosion control measures after any storm event to ensure they are in proper working order.

3.02 CONSTRUCTION METHODS:

- A. Silt fences and/or straw wattles shall be installed at the site downgradient of work areas as required by Owner or Engineer in the field. The silt fence shall be installed in accordance with manufacturer's instructions. Straw wattles shall be placed at locations shown on the contract drawings or approved by the Engineer. The base of all straw wattles and silt fencing shall be embedded to the depths shown on the contract drawings.
- B. Straw mulch, if used, shall be applied at a rate of 100-lbs/1000 ft².
- C. On slopes, the Contractor shall provide protection against washouts by an approved method. Any washout, which occurs either in the Contractor's work area or in areas topographically below his work, shall be regraded and reseeded at the Contractor's expense until an accepted vegetative stand is established.

END OF SECTION

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SECTION 02532

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers furnishing and installation of all outside valves and appurtenances as indicated on the drawings and as specified herein.

1.02 RELATED WORK (NOT USED)

1.03 REFERENCES:

The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM D429 Test Methods for Rubber Property - Adhesion to Rigid Substrates

American Water Works Association (AWWA)

AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings

AWWA C509 Resilient Seated Gate Valves for Water Supply Service

AWWA C515 Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service

AWWA C550 Protective Interior Coatings for Valves and Hydrants

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Shop drawings shall be submitted for valves and appurtenances, indicating type of joint, and lining and coating, etc., in accordance with the specifications.
- B. Shop drawings shall consist of manufacturer's scale drawings, or catalog cuts, including descriptive literature with complete characteristics and specifications, and code requirements.

PART 2 - PRODUCTS

2.01 RESILIENT SEATED GATE VALVES:

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REFERENCE COPY ONLY
- A. Resilient seated, wedge type gate valves shall be manufactured to meet all applicable requirements of AWWA C509 or C515. Valves 12-inches and smaller shall be bubble-tight at 250 psi water working pressure, tested in both directions.
 - B. Valve bodies shall be of cast or ductile iron and shall have non-rising threaded bronze stems acting through a bronze stem nut. Opening nuts shall be 2-inches square and shall open **LEFT**. All buried valves shall have mechanical joint ends in compliance with AWWA C111.
 - C. Valve wedges shall be of cast iron with resilient seating surfaces permanently bonded to the wedges in strict accordance with ASTM D429 or attached to the face of the wedges with stainless steel screws. Each valve shall have a smooth, unobstructed water way free from sediment pockets.
 - D. Valves shall have low friction, torque-reduction thrust bearings. All O-rings and gaskets shall be removable without taking the valves out of service.
 - E. Valve body, bonnet and O-ring plate shall be coated both on interior and exterior with fusion bonded epoxy meeting applicable requirements of AWWA C550.
 - F. Resilient seated gate valves shall be as manufactured by Clow Corporation, Oskaloosa, IA; Mueller Co., Chattanooga, TN; Kennedy Valve, Elmira, NY; or be an approved equal.

2.02 VALVE BOXES:

- A. Each valve shall be provided with a box. Covers shall be close fitting and substantially dirt-tight. The top of the cover shall be flush with the top of the box rim and marked "Sewer".
- B. Valve boxes shall be of cast iron and of the adjustable threaded or sliding, heavy pattern type. They shall be so designed and constructed as to prevent direct transmission of traffic loads to the pipe or valve. The upper section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section and stuffing box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the backfill. The boxes shall be adjustable through at least 6-inches vertically without reduction of lap between sections to less than 4-inches.
- C. The inside diameter of boxes shall be at least 4-1/2-inches and the lengths shall be as necessary to suit the ground elevation and the depth of each valve.

2.03 INSERTION VALVES:

- A. Insertion valves shall consist of a ductile iron or ASTM A-36 steel fusion bonded epoxy coated to 10-12 mils in accordance with AWWA C-213. The valves shall conform to the requirements herein specified for gate valves and shall be furnished with a 2-inch square operating nut. The contractor shall be responsible for verifying the outside diameter of the pipe where the valve will be inserted.

- B. Before backfilling, all exposed portions of bolts used to hold the two halves of the sleeve together shall be heavily coated with two coats of bituminous paint comparable to Inertol No. 66, Special Heavy. Sleeves shall be furnished with a rubber gasket that fits 360 degrees around the pipe at each end.
- C. Insertion valves shall be as manufactured by Hydra-Stop, Inc., Blue Island, IL; Romac Industries, Inc, Seattle, Washington; or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. All material shall be carefully inspected for defects in workmanship and material, and all debris and foreign matter shall be cleaned out of valve openings and seats. Operating mechanisms shall be operated to check for proper functioning, and all nuts and bolts shall be checked for tightness.
- B. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.
- C. All valves shall be carefully installed and supported in their respective positions, free from all distortion and strain. Care shall be taken to prevent damage or injury to the valves and appurtenances during handling and installation.
- D. Valve boxes shall be set plumb, flush with the ground or paved surface, and centered directly over the operating nut of the valves. Earth fill shall be carefully tamped around the valve box to a distance of 4 feet on all sides of the box or to undisturbed trench faces if less than 4 feet.
- E. Valves shall be operational and accessible at all times during construction and warranty period. The Contractor shall verify the proper operation of all valves in the presence of the Engineer and/or Owner following completion of the project and prior to the acceptance of Substantial Completion.

END OF SECTION

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SECTION 02536

PRECAST CONCRETE VAULT AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section covers precast vaults complete, including, but not limited to, bases, walls, mortar, frames and covers, as shown on the Drawings and as specified herein.
- B. The Contractor shall furnish all labor, materials, tools and equipment necessary to furnish complete factory-built, precast concrete structures. The structures shall be in manageable sections, completely ready for assembly, as indicated on the drawings and as specified herein, and pretested at the factory before shipment to the jobsite.

1.02 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM	A48	Gray Iron Castings
ASTM	A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM	C32	Sewer and Vault Brick (Made from Clay or Shale)
ASTM	E177	Test Method for Steady - State Heat Flux Measurements and Thermal Transmission Properties by means of the Guarded-Hot-Plates
ASTM	C207	Hydrated Lime for Masonry Purposes
ASTM	C478	Precast Reinforced Concrete Vault Sections
ASTM	C923	Resilient Connectors Between Reinforced Concrete Vault Structures and Pipes
ASTM	C150	Portland Cement
ASTM	C1227	Standard Specifications for Precast Septic Tank - Watertightness. Testing

American Association of State Highway Transportation Officials (AASHTO)

AASHTO M198 Joints for Circular Concrete Sewers and Culvert Pipe Using Flexible Watertight Gaskets

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01330 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer literature and shop drawings of the materials of this section shall be submitted to the Engineer for review. Shop drawings shall indicate locations and dimensions of proposed penetrations.
- B. Test reports as required shall be submitted to the Engineer.

1.04 QUALITY ASSURANCE:

- A. The precast concrete structure manufacturer shall have a minimum of ten (10) years successful experience in the design and the assembly of factory-built, prefabricated precast structures.
- B. The Engineer shall have the right to inspect or test any materials during fabrication in the factory. At the option of the Engineer, certified tests of materials may be accepted in lieu of field tests.
- C. Precast concrete structures shall be as manufactured by Old Castle Precast, Avon, CT; United Concrete Products, Yalesville, CT; or approved equal.
- D.
 - E. A Registered Professional Structural Engineer holding a currently valid license in the State of Connecticut shall prepare the precast concrete structure designs. Structural design calculations for the precast concrete structures shall be prepared and dated, live stamped and signed by a registered professional Engineer, in the State of Connecticut, and shall be submitted for approval prior to fabrication.

1.05 GUARANTEE:

- A. The structure manufacturer shall guarantee all precast concrete structures against defective materials or workmanship for a period of five years after the date of project completion. If any material or workmanship proves to be defective within five (5) years, they shall be replaced or repaired by the precast concrete structure manufacturer at no additional cost to the owner.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Precast structures will be considered suitable for handling to transport to the Contract site after the concrete has cured to a minimum strength of 80 percent of the design strength.
- B. Ship equipment and material complete, except where partial disassembly is required by

transportation regulations or for protection of components.

- C. The package pumping station sections shall be shipped F.O.B. jobsite by the package pumping station manufacturer. The package pumping station manufacturer shall provide all necessary lifting fixtures, hardware and cables for lifting, off-loading and setting the building without incurring damage to the walls or roof.
- D. Delivery of precast structures shall be coordinated with installation or shall be unloaded with proper equipment along the line of Work, outside excavation limits near as practicable to point of final placement. They shall be stored off the ground on wood blocks, pallets or other appropriate means away from brush, poison oak or ivy and in an accessible area for inspection. Excavated or other material shall not be placed over or against the stored precast structures.
- E. Contractor shall receive, off load, store, and safeguard all equipment and materials at the job site.
- F. Precast structures and appurtenances shall be unloaded and handled with crane or equipment of adequate capacity, equipped with appropriate slings, and lifting devices to protect the material from damage.
- G. If damage occurs and is deemed repairable, it shall be repaired as directed by the Engineer in accordance with approved manufacturer's recommendations. If damage is not repairable in the opinion of the Engineer, such items of material will be rejected and shall be removed and replaced at the Contractor's expense.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. Precast sections shall conform in shape, size, dimensions, materials, and other respects to the details indicated on the drawings or as required by the Engineer.
- B. The hatch frame and cover shall be the standard frame and cover as specified. The frame and cover shall be set by the Contractor to conform accurately to the grade of the finished pavement, existing ground surface, or as indicated on the drawings.
- C. The Contractor to field verify configuration of mating surface of the new vault section to the existing joint.

2.02 PRECAST CONCRETE SECTIONS:

- A. All precast concrete sections shall conform to ASTM C478 with the following exceptions and additional requirements:

1. The wall thickness of precast sections shall be as designated on the drawings, meeting the following minimum requirements:

<u>Section</u>	<u>Minimum Wall Thickness, in.</u>
Roof	8
Walls	6

2. Type II cement shall be used except as otherwise approved.
 3. Sections shall be steam cured and shall not be shipped until at least five days after having been cast.
 4. Minimum compressive strength of concrete shall be 5000 psi at 28 days.
 5. No more than two lift holes may be cast or drilled in each section.
 6. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of the barrel.
 7. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
 8. Steel reinforcement shall be Grade 60 and conform to ASTM A615 with a minimum of 1-inch cover.
 9. Design loading shall be AASHTO HS-20-44.
 10. The outside surfaces of the vault shall be thoroughly sealed with bituminous coating as herein specified prior to shipping.
- B. Precast sections shall be manufactured to contain wall and roof openings of the minimum size to receive the ends of the pipes and such openings being accurately set to conform to line and grade of the pipelines. Subsequent cutting or tampering in the field, for the purpose of creating new openings or altering existing openings, will not be permitted except as required by the Engineer.
- C. The Engineer reserves the right to reject any precast section and the rejected unit shall be tagged and removed from the job site immediately.
- D. The Engineer may also require the testing of concrete sections as outlined under Physical Requirements in ASTM C478 with the Contractor bearing all testing costs.
- E. All internal and external exposed edges or access points of the precast concrete structures / wetwell and drywell pumping station units shall be provided with a 3/4" chamfer. The 3/4" chamfer shall be integrally cast at the precast concrete manufacturer's facility. Precast concrete structures which are not provided with a 3/4" chamfer shall be rejected,

removed from the project area, disposed of by the contractor and replaced at no additional cost to the Owner. Field applied chamfers such as mechanical grinding shall not be acceptable.

2.03 BRICK MATERIALS:

- A. The brick shall be sound, hard, and uniformly burned brick regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. Brick shall comply with ASTM C32, for Grade SS, hard brick, except that the mean of five tests for absorption shall not exceed 8 percent by weight.
- B. Rejected brick shall be immediately removed from the work and brick satisfactory to the Engineer substituted.

2.04 MORTAR, CEMENT, HYDRATED LIME AND SAND:

- A. The mortar shall be composed of portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as required by the Engineer and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for Grade SS Brick shall be mixed in the volume proportions of 1:1/2:4-1/2; Portland cement to hydrated lime to sand.
- B. Cement shall be Type II Portland cement as specified for concrete masonry.
- C. Hydrated lime shall be Type S conforming to ASTM C207.
- D. The sand shall comply with the specifications for "Fine Aggregate", for concrete masonry except that all of the sand shall pass a No. 8 sieve.

2.05 JOINTS:

- A. Joint gaskets to be flexible self-sealing butyl rubber joint sealant installed according to manufacturer's recommendations. For cold weather applications, use adhesive with joint sealant as recommended by manufacturer.
- B. Acceptable Materials:
 - 1. Kent-Seal No. 2, Con-Seal, Ram-Nek or equivalent.
- C. Joints between precast sections shall conform to related standards and manufacturer's instructions. Joints shall be water-tight.
- D. Supplier to field verify the configuration of mating surface of the new vault section to the existing joints.

2.06 ALUMINUM VAULT LADDERS:

- A. Aluminum ladders shall be fastened to concrete with stainless steel or aluminum toggle or expansion bolts, and fasteners shall be in the locations shown on the shop drawings.
- B. Ladders shall be solid stock and all-welded construction. Rungs shall be 3/4-inch diameter fitted into holes in 1/4-inch by 2-inch rails and welded all around. Tops of ladder rails shall have rounded corners or vinyl coverings to prevent injury. Aluminum ladders shall include brackets, fasteners, bracing and support.

2.07 OPENINGS:

- A. All wall penetrations in new precast concrete sections shall be formed at the manufacturing plant utilizing cast in place 316 stainless steel pipe sleeves with water stops.
- B. Provide openings for all penetrations entering the structure or shown on the Contract Documents. Additional holes which may be required for a complete and functional system shall be provided at no additional cost.
- C. Opening Size: To provide a uniform annular space suitable for Link-Seal modular seals installation between the outside wall of pipe and cast-in-place sleeve.
- D. Opening Location: To permit setting of the entering pipes at the correct elevations.
- E. Openings shall have a flexible watertight union between pipe and the structure.
- F. Link-Seal modular seals by GRT, a division of EnPro Industries.

2.08 ALUMINUM FLOOR DOOR:

- A. Access frames and covers shall have a 1/4-inch thick, one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor and bituminous coating applied to the exterior of the frame. Door panels shall be 1/4-inch thick aluminum diamond plate, reinforced to withstand H-20 load ratings. Doors shall open to 90 degrees and automatically lock with a stainless steel hold open arm with aluminum release handle. Doors shall incorporate enclosed stainless steel compression spring assists and shall close flush with the frame. Lifting handle, hinges, and all fastening hardware shall be stainless steel. Unit shall lock with stainless steel slam locks with removable keys. Hatches shall include a special keyed cylinder lock with access through a weather-tight removable deckplate.
- B. Floor door shall be watertight and a 1-1/2-inch drainage coupling shall be located in the channel frame.

- C. Floor door shall be installed as shown on the drawings. Unit shall be furnished completely fabricated. Hatch cover and frame shall be manufactured by Bilco Co., New Haven, CT; Incryo/Milnor, Lima, OH; Halliday Products, Orlando, FL; U.S.F. Fabrication, Hialeah, FL; or an approved equal.
- D. The manufacturer shall guarantee against defects in material or workmanship for a period of five (5) years from the date of Owner's acceptance.
- E. 2-inch thick polystyrene insulation shall be firmly adhered to the interior cover.
- F. Fall protection, meeting OSHA requirements, shall be hinged hatch safety grate with compression springs and safety latch.
- G. Contractor shall ensure that aluminum floor doors are of adequate size and configuration to allow free passage of submersible pumps (Section 11304).

2.08 BITUMINOUS DAMPPROOFING:

- A. Liquid Asphalt Damp proofing: Non-fibrated asphalt emulsion primer coat followed by fibrated asphalt emulsion top coat for below grade wall damp proofing.

Primer coat: BASF MasterSeal 610 or equal

Top coat: BASF MasterSeal 614, or equal.

2.09 ACCESSORIES:

- A. Gasket material shall be top grade (100% solids, vulcanized) butyl rubber and shall meet or exceed AASHTO M 198.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Precast Sections
 - 1. Precast reinforced concrete sections shall be set so as to be vertical and with sections in true alignment.
 - 2. Butyl rubber joint sealant shall be installed between each concrete section.
 - 3. All holes in sections used for their handling shall be thoroughly plugged with mortar. The mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense

and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. Brickwork

1. The brick shall be moistened by suitable means, as required, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
2. Each brick shall be laid as headers in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as required.

C. Castings

1. Frames shall be set with the tops conforming accurately to the grade on the drawings or as required by the Engineer.
2. Frames shall be set as shown on the drawings and in a full bed of mortar so that the space between the top of the concrete section or brick headers and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to be flush with the top of the flange and have a slight slope to shed water away from the frame.
3. Covers shall be left in place in the frames except while work is being performed on them.

D. Accessories

Accessories shall be installed in accordance with manufacturer's instructions.

3.02 CLEANING

All new vaults shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 02830

METAL PICKET FENCE

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The contractor shall provide all labor, materials and accessory items necessary for the installation of the metal fence system defined herein.

1.02 SYSTEM DESCRIPTION:

- A. The manufacturer shall supply a total ornamental fencing system of the design, style, strength and picket spacing defined herein. The system shall include all components; pickets, rails, posts, gates and hardware as required.

1.03 QUALITY ASSURANCE:

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and the materials and techniques specified.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced.

American Society for Testing and Materials (ASTM)

ASTM	B117	Practice for Operating Salt-Spray (Fog) Apparatus.
ASTM	D523	Test Method for Specular Gloss.
ASTM	D714	Test Method for Evaluating Degree of Blistering in Paint.
ASTM	D822	Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
ASTM	A653/	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
ASTM	D1654	Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
ASTM	D2244	Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
ASTM	D2794	Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
ASTM	D3359	Test Method for Measuring Adhesion by Tape Test.
ASTM	F2408	Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.05 SUBMITTALS:

- A. Six (6) sets of manufacturers literature of the materials specified herein shall be submitted to the Engineer for review.
- B. Six (6) sets of shop drawings of the fence shall be submitted to the Engineer for review. The color shall be determined by Owner.

1.06 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

PART 2 - PRODUCTS

2.01 SUPPLIER

- A. The ornamental metal fencing system shall conform to Maverick – C (Commercial) Barcelona, 3-Rail style, manufactured by Iron World Fencing, in Laurel, Maryland, Ameristar Montage Commercial Steel Ornamental Fencing Classic, 3-Rail style, manufactured by Ameristar Fence Products, Inc. in Tulsa, Oklahoma, or approved equal.

2.02 MATERIALS

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft² (184 g/m²), Coating Designation G-60.
- B. Material for pickets shall be 3/4" square x 18 Ga. tubing. The rails shall be steel channel, 1.5" x 1.4375" x 14 Ga. Picket holes in the rail shall be spaced 4.675" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. ForeRunner rails shall be pre-punched to accept pickets. Grommets shall be inserted into the pre-punched holes in the rails and pickets shall be inserted through the grommets so that pre-drilled picket holes align with the internal upper raceway of the ForeRunner rails (Note: This can best be accomplished by using an alignment template). Retaining rods shall be inserted into each ForeRunner rail so that they pass through the pre-drilled holes in each picket, thus completing the panel assembly.
- B. The manufactured framework shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a

minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be (Black). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.

Table 1 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117 & D1654	Corrosion Resistance over 1000 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).
Weathering Resistance	D822, D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 50% loss of gloss or color variance of more than 3 delta E color units).

- C. Finish: All fence components shall be subject to a six-stage pretreatment/wash followed by an electrostatic spray application of a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2-4 mils. The color shall be (Black).
- D. Completed panels shall be capable of supporting a 200 lb. load (applied at midspan) without permanent deformation. Panels without rings shall be biasable to a 12.5% change in grade.
- E. Swing gates shall be fabricated using 1-1/4" x 1-7/16" Forerunner rail, 1.75” sq. x .125” gate ends, and 3/4” sq. x .080 pickets. Gates that exceed 6’ in width will have a 1.75” sq. x .125” intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Latches shall be lockable by pad lock supplied by the owner.

2.04 WARRANTY

- A. The ornamental metal fence system shall include a written limited lifetime warranty against defects in materials and workmanship.
- B. The ornamental metal fence system shall include a written limited lifetime warranty on the coating against cracking, chipping, blistering, peeling or corroding. Refer to warranty certificate for complete details and limitations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The metal fence system shall be constructed according to the size and locations shown on the Drawings and as specified herein, or as otherwise required by the Engineer.
- B. The metal fence system shall be erected in accordance with the manufacturer's installation guidelines.

END OF SECTION

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SECTION 02920

LOAMING AND SEEDING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers all labor, materials, and equipment necessary to do all loaming, seeding and related work as indicated on the drawings and as herein specified. All lawns disturbed by the Contractor's operations shall be repaired as herein specified.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Submit information detailing the seed mixes, fertilizers, mulch material and origin of loam shall be submitted to the Engineer for review.
- B. Test results shall be submitted to the Engineer for review.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. LOAM:

1. Loam shall be a natural, fertile, friable soil, typical of productive soils in the vicinity, obtained from naturally well-drained areas, neither excessively acid nor alkaline, and containing no substances harmful to grass growth. Loam shall not be delivered to the site in frozen or muddy condition and shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter.
2. The loam shall contain not less than 4 percent nor more than 20 percent organic matter as determined by the loss of weight by ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F.

B. LIME:

Lime shall be standard commercial ground limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide), and 50 percent of the material must pass through a No. 100 mesh sieve with 98 percent passing a No. 2 mesh sieve.

C. FERTILIZER:

Fertilizer shall be commercial fertilizer, 10-10-10 fertilizer mixture containing at least 40 percent of organic nitrogen. It shall be delivered to the site in the original sealed containers, each showing the manufacturer's guaranteed analysis. Fertilizer shall be stored so that when used it will be dry and free flowing. No fertilizer shall be used which has not been marketed in accordance with State and Federal Laws, relating to fertilizers.

D. MULCH:

1. Materials to be used in mulching shall conform to the following requirements:
2. Straw Mulch - Straw Mulch shall consist of stalks or stems of grain after threshing.
3. Wood Fibre Mulch - Wood Fibre Mulch shall consist of wood fibre produced from clean, whole uncooked wood, formed into resilient bundles having a high degree of internal friction and shall be dry when delivered to the project.

E. SEED:

1. Seed shall be of an approved mixture, the previous year's crop, clean, high in germinating value, a perennial variety, and low in weed seed. Seed shall be obtained from a reliable seed company and shall be accompanied by certificates relative to mixture purity and germinating value.
2. Grass seed for lawn areas shall conform to the following requirements:

	Proportion by Weight	Germination Purity	Purity Minimum
Chewing's Fescue	30%	70%	97%
Kentucky 31 Fescue	30%	90%	98%
Kentucky Blue Grass	20%	80%	85%
Domestic Rye Grass	20%	90%	98%

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. After approval of rough grading, loam shall be placed on areas affected by the Contractor's operations. Loam shall be at least 6-inches compacted thickness.
- B. Lime shall be applied to bring the pH to 6.5 or, without a soil test, at the rate of 2-3 tons of lime per acre.

- C. Fertilizer shall be applied according to the soil test, or without a soil test, at the rate of 1000 pounds per acre.
- D. Loam shall be worked a minimum of 3-inches deep, thoroughly incorporating the lime and fertilizer into the soil. The loam shall then be raked until the surface is finely pulverized and smooth and compacted with rollers, weighing not over 100 pounds per linear foot of tread, to an even surface conforming to the prescribed lines and grades. Minimum depth shall be 6-inches after completion.

3.02 SEEDING:

- A. Seeding shall be done when weather conditions are approved as suitable, in the periods between April 1 and May 30 or August 15 to October 1, unless otherwise approved.
- B. If there is a delay in seeding, during which weeds grow or soil is washed out, the Contractor shall remove the weeds or replace the soil before sowing the seed, without additional compensation. Immediately before seeding is begun the soil shall be lightly raked.
- C. Seed shall be sown at the approved rate, on a calm day by machine.
- D. One half the seed shall be sown in one direction and the other half at right angles. Seed shall be raked lightly into the soil to a depth of 1/4-inch and rolled with a roller weighing not more than 100 pounds per linear foot of tread.
- E. The surface shall be kept moist by a fine spray until the grass shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than 3 sq. ft., the Contractor shall reseed, roll, and water as necessary to obtain proper germination.
- F. The Contractor shall water, weed, cut and otherwise maintain and protect seeded areas as necessary to produce a dense, healthy growth of perennial lawn grass.
- G. If there is insufficient time in the planting season to complete the fertilizing and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor or as required by the Engineer. In that event, a temporary cover crop shall be sown. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized and the permanent seed crop shall be sown as specified.

3.03 PLACING MULCH:

- A. Straw Mulch shall be loosely spread to a uniform depth over all areas designated on the plans, at the rate of 4-1/2 tons per acre, or as otherwise required.
- B. Straw Mulch may be applied by mechanical apparatus, if in the judgment of the Engineer the apparatus spreads the mulch uniformly and forms a suitable mat to control slope erosion. The apparatus shall be capable of spreading at least 80 percent of the hay or

straw in lengths of 6-inches or more, otherwise it shall be spread by hand without additional compensation.

- C. Wood Fibre Mulch shall be uniformly spread over certain selected seeded areas at the minimum rate of 1,400 pounds per acre unless otherwise required. It shall be placed by spraying from an approved spraying machine having pressure sufficient to cover the entire area in one operation.

3.04 SEEDING AND MULCHING BY SPRAY MACHINE:

- A. The application of lime, fertilizer, grass seed and mulch may be accomplished in one operation by the use of an approved spraying machine. The materials shall be mixed with water in the machine and kept in an agitated state in order that the materials may be uniformly suspended in the water. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, grass seed and mulch shall be equal to the specified quantities.
- B. A certified statement shall be furnished, prior to start of work, to the Engineer by the Contractor as to the number of pounds of limestone, fertilizer, grass seed and mulch per 100 gallons of water.
- C. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above. If the results of the spray operation are unsatisfactory, the Contractor will be required to abandon this method and to apply the lime, fertilizer, grass seed and mulch by other methods.

3.05 INSPECTION AND ACCEPTANCE:

At the beginning of the planting season following that in which the permanent grass crop is sown, the seeded areas will be inspected. Any section not showing dense, vigorous growth at that time shall be promptly reseeded by the Contractor at his own expense. The seeded areas shall be watered, weeded, cut and otherwise maintained by the Contractor until the end of that planting season, when they will be accepted if the sections show dense, vigorous growth.

END OF SECTION

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SECTION 03302
FIELD CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers concrete and all related items necessary to place and finish the concrete work.
- B. Concrete thrust, and anchor blocks, to be provided at all water main bends, tees, plugs and wyes and at other locations required by the Engineer shall be installed in accordance with the details shown on the drawings and as specified in this section.
- C. Concrete encasement for piping with shallow cover and for encasement of telephone, and electrical duct bank when specified shall be installed in accordance with the details shown on the drawings and as specified in this section.

1.02 RELATED WORK (NOT USED)

1.03 REFERENCES:

- A. The following standards form a part of this specification:

American Concrete Institute (ACI)

ACI 304 Recommended Practice for Measuring, Mixing, Transporting, and
Placing Concrete.

ACI 305 Recommended Practice for Hot Weather Concreting

ACI 306 Recommended Practice for Cold Weather Concreting

ACI SP-66 ACI Detailing Manual

ACI 318 Building Code Requirements for Reinforced Concrete

American Society for Testing and Materials (ASTM)

ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C33 Concrete Aggregates

ASTM C94 Ready-Mixed Concrete

ASTM C143 Test for Slump of Portland Cement Concrete

ASTM C150 Portland Cement

ASTM C260 Air Entraining Admixtures for Concrete

ASTM C494 Chemical Admixtures for Concrete

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

Statement of materials constituting the design of mixes for each size aggregate as required by ASTM C94 shall be submitted to the Engineer within one week following award of the Contract.

PART 2 - PRODUCTS

2.01 CONCRETE:

- A. All concrete, reinforced or non-reinforced shall have a 28 day compressive strength of 3000 psi unless otherwise noted on the design drawings. A minimum of 5.5 sacks of cement per cubic yard and a maximum water cement ratio of 6.9 gallons per sack shall be used.
- B. Concrete shall conform to ASTM C94. The Contractor shall be responsible for the design of the concrete mixtures. Slump shall be a maximum of 4-inches and a minimum of 2-inches, determined in accordance with ASTM C143.
- C. Admixtures shall be as specified in subsection 2.05. No additional admixtures shall be used unless approved by the Engineer.
- D. No additional water except for the amount indicated by the design mix shall be added to the concrete without the prior permission of the Engineer.

2.02 REINFORCING:

Reinforcing as shown on the plans or as required by the Engineer, shall conform to ACI 318 and ASTM A615 and shall be detailed in accordance with ACI SP-66. All Steel reinforcing bars shall be grade 60.

2.03 CEMENT:

The cement shall be an approved brand of American manufactured Portland Cement, Type II conforming to the applicable requirements of ASTM C150.

2.04 AGGREGATES

- A. Except as otherwise noted, aggregate shall conform to the requirements of ASTM C33.
- B. Maximum size aggregate shall be 3/4-inch.

2.05 ADMIXTURES:

- A. All concrete (unless otherwise directed) shall contain an air entraining agent. Air entrained concrete shall have air content by volume of 4 to 8 percent for 3/4-inch aggregate.
- B. Air entraining agent shall be in accordance with ASTM C260 and shall be Darex AEA, as manufactured by W.R. Grace & Company; Placewel (an entraining Type), as manufactured by Johns Manville; Sika AER as manufactured by Sika Chemical Company; or an approved equal product.
- C. Water reducing agent shall be WRDA, as manufactured by W.R. Grace & Company; Placewel (non-air entraining Type), as manufactured by Johns Manville; Sika Plastiment as manufactured by Sika Chemical Company; or an approved equal product.
- D. Water reducing agent-retarder shall be "Daratar" as manufactured by W.R. Grace & Company; Sika Plastiment as manufactured by Sika Chemical Company; or an approved equal product.

2.06 WATER:

- A. Water for concrete shall be potable, free of deleterious amounts of oil, acid, alkali, organic matter and other deleterious substances.

2.07 CONCRETE FORMS

- A. Forms for exterior and interior surfaces which will be exposed to view after the work is completed, whether such surfaces are painted or unpainted, shall be new plywood stock, steel, tempered masonite, or other materials which will provide smooth concrete surfaces without subsequent surface plastering. Plastic or plastic-faced forms shall not be used, except with the prior approval of the Engineer.
- B. Form ties shall be cone type or equal, with waterstop, which leaves no metal closer than 2-inches to finished face of concrete.
- C. Form release agent shall be a non-staining, non-yellowing, non-toxic liquid free from kerosene and resins of the type recommended by the manufacturer of the forming system being used such as EZ strip by L&M Construction Chemicals, Omaha, NB and "Magic Kote" by Symons Corp., Des Plaines, IL or approved equal.

- D. Where steel adjacent to vertical faces of forms cannot be otherwise secured, mortar doughnuts shall be used to prevent steel from lying too close to the finish vertical faces of the concrete

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Before placing concrete, forms and the space to be occupied by the concrete shall be thoroughly cleaned, and reinforcing steel and embedded metal shall be free from dirt, oil, mill scale, loose rust, paint or the material which would tend to reduce the bond.
- B. Earth, concrete, masonry, or other water permeable material against which concrete is to be placed shall be thoroughly saturated with water immediately before concrete is placed.
- C. No concrete shall be placed until the consolidation of the ground and the arrangement and details of forms and reinforcing have been inspected and approved by the Engineer.

3.02 THRUST AND ANCHOR BLOCKS:

- A. Minimum bearing areas for thrust blocks and dimensions of anchor blocks shall be as shown on the drawings.
- B. Concrete for thrust and anchor blocks shall be placed against undisturbed earth, and wooden side forms shall be used to provide satisfactory lines and dimensions. Felt roofing paper shall be placed to protect joints. No concrete shall be placed so as to cover joints, bolts or nuts, or to interfere with the removal of the joints.

3.03 FILL CONCRETE:

- A. Fill concrete shall be placed in those locations as indicated on the design drawings. Fill concrete shall consist of materials as previously specified, with a minimum 28-day compressive strength of 3000 psi.
- B. Before fill concrete is placed, the following procedures shall be used to prepare surfaces; all dirt, scum and laitance shall be removed by chipping and washing. The clean, roughened base surface shall be saturated with water, but shall have no free water on the surface. A coat of 1:2 cement-sand grout, approximately 1/8-inch thick, shall be well scrubbed into the thoroughly dampened concrete base. The concrete fill shall be placed immediately, before grout has dried or set.
- C. Fill concrete shall be brought to lines and grades as shown on the design drawings.

3.04 CONCRETE PLACING DURING COLD WEATHER:

- A. Concrete shall not be placed on frozen ground, and no frozen material or material containing ice shall be used. Materials for concrete shall be heated when temperature is below 40°F, or is expected to fall to below 40°F, within 73 hours, and the concrete after placing shall be protected by covering, heat, or both.
- B. All details of Contractor's handling and protecting of concrete during freezing weather shall be subject to the approval of the Engineer. All procedures shall be in accordance with provisions of ACI 306.

3.05 CONCRETE PLACING DURING HOT WEATHER:

- A. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing, shall be sprinkled with cold water. The Contractor shall make every effort to minimize delays, which will result in excessive mixing of the concrete after arrival on the job.
- B. During periods of excessively hot weather (90°F or above), ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels in accordance with the provisions of ACI 305. Any concrete with a temperature above 90°F, when ready for placement, will not be acceptable, and will be rejected.

3.06 FIELD QUALITY CONTROL

- A. Concrete inspection and testing shall be performed by the Engineer or by an inspection laboratory, designated by the Engineer, engaged and paid for by the Owner. Testing equipment shall be supplied by the laboratory, and the preparation of samples and all testing shall be performed by the laboratory personnel. Full assistance and cooperation, concrete for samples, and such auxiliary personnel and equipment as needed shall be provided by the Contractor.
- B. At least 4 standard compression test cylinders shall be made and tested and 1 slump test from each day's placement of concrete. A minimum of four compression test cylinders shall be made and tested for each 100 cubic yards of each type and design strength of concrete placed. One cylinder shall be tested at 7 days, and two at 28 days. The fourth cylinder from each set shall be kept until the 28 day test report on the second and third cylinders in the same set has been received. If the average compressive strength of the two 28 day cylinders do not achieve the required level, the Engineer may elect to test the fourth cylinder immediately or test it after 56 days. If job experience indicates additional cylinder tests or other tests are required for proper control or determination of concrete quality, such tests shall be made.

- C. The Engineer shall have the right to reject concrete represented by low strength tests. Rejected concrete shall be promptly removed and replaced with concrete conforming to the specification. The decision of the Engineer as to whether substandard concrete is to be accepted or rejected shall be final.

END OF SECTION

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SECTION 03931

REPAIR OF EXISTING CONCRETE STRUCTURES

PART 1 GENERAL

1.01 WORK INCLUDED:

Furnish all labor, materials, equipment and incidentals required to repair deteriorated areas of existing concrete structures including the sealing of existing joints as required by the Engineer in the field and as specified herein.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING

- A. Prior to shipment, and in accordance with Section 01330, the Contractor shall submit to the Engineer for review, the following: manufacturer's technical literature for epoxy bonding agent, adhesive anchor system, repair mortar, polyurethane chemical grout, and strip and seal system. The Contractor shall include manufacturer's installation and or application instructions in the submittal.
- B. A complete, easily readable functional description of the proposed product.
- C. Upon completion of installation, the results of the field and acceptance tests as specified under this section of the specification shall be submitted to the Engineer.
- D. Furnish written certification from the manufacturer's representative of the proper installation and use of each product.

1.04 REFERENCES:

- A. The following standards form a part of this specification and indicate the minimum standards required:

American Society for Testing and Materials (ASTM)

ASTM C881 -Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

ASTM C882 -Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE:

- A. Do not begin repair work until authorized by the Engineer to do so.
- B. When removing deteriorated concrete erect barriers or other protective devices to prevent damage to the structures beyond the limits of new work, protect personnel, control dust and prevent damage by falling or flying debris.
- C. Unless otherwise indicated or specified, saw cut the limits of all concrete repairs.
- D. Furnish a notarized certificate stating that the materials to be provided meet the requirements of this Section and have the manufacturer's current printed literature on the specified product.

1.06 MANUFACTURER'S QUALIFICATIONS:

- A. Consideration shall be given only to well-established and reliable manufacturers who are regularly engaged in such work and thoroughly experienced in the design and manufacture of said systems. The manufacturer shall certify a minimum of ten (10) years of experience in the manufacture and use of the products specified under this section as evidence of meeting the experience requirement.
- B. The system described herein and shown on the drawings establishes a standard of required type, function and quality to be met by any proposed substitute or "or-equal" systems. All "or-equal" systems shall meet the exact system configuration and operational function as shown on the drawings and specified herein. No "or-equal" system shall be considered by the Engineer unless written request for approval has been submitted for and approved by the Engineer in writing. The burden of proof of merit for the proposed "or-equal" systems is upon the Contractor and the proposed equipment manufacturer. The Engineer's decision of approval or disapproval of a proposed item shall be final. If the Engineer approves any "or-equal" item, the Contractor shall indemnify, hold harmless and defend both the Owner and the Engineer from any claims associated with the "or-equal" systems. Approval of "or-equal" systems does not relieve the Contractor of any requirements specified herein, called for by the Engineer or shown on the drawings.

1.07 DELIVERY, STORAGE AND HANDLING:

Deliver products in original, unopened containers clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions. Storage and condition of products shall be as recommended by the manufacturer.

1.08 WARRANTY:

- A. The manufacturer shall warranty, in writing, that the products supplied under this Section fully meet the criteria specified herein, and shall further warranty that the products are free from all defects in materials and workmanship.
- B. The manufacturer's warranties from defects shall contain a provision that the manufacturer shall repair or replace any defects, to the satisfaction of and at no additional cost to the Owner, for a period of twelve (12) months from the date of Substantial Completion.

PART 2 – Products

2.01 PATCHING MATERIALS:

- A. Materials shall comply with this Section and any Federal, State or local VOC limitations.
- B. Epoxy Bonding Agent

Provide a two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bond plastic concrete to hardened concrete where indicated on the Drawings or directed by the Engineer. The Epoxy bonding agent shall comply with the requirements of ASTM C881, Type 11, Grade 2. Epoxy bonding agent shall be Sikadur 32, Hi-Mod by Sika Corporation, Lyndhurst, NJ; Epoxy Adhesive CR631 by Sto Concrete Restoration Division, Amherst, MA; Euco 452MV by Euclid Chemical Co., Cleveland, OH, or equal.

C. Repair Mortar

- 1. Repair mortar shall be a two-component, polymer-modified, cementitious, fast-setting, trowel-grade, non-sag, structural repair mortar suitable for use on horizontal, vertical and overhead surfaces, on grade, above, and below grade on concrete and mortar.
- 2. Material
 - a. The polymer modified cementitious system shall consist of a factory pre-proportioned two-component system whose components conform to the following requirements:
 - 3. Component A shall be a liquid polymer emulsion of an acrylic copolymer base and additives. This acrylic copolymer shall have the following properties:
 - i. Minimum film forming temperature approximately 68 degrees F

- ii. Tea- Strength approximately 990 to 1,420 psi
 - iii. Elongation at break 500 to 900 percent
 - iv. Particle Size Range Less than 0.1 micron
- 4. Component B shall be a blend of selected Portland cements, specially graded aggregates, organic accelerator and admixtures for controlling setting time, water reducers for workability and a corrosion inhibitor.
 - 5. The component ratio A:B shall be 1:7.2 by weight for horizontal repairs and 1:5.2 by weight for vertical and overhead repairs. The system shall not contain chlorides, nitrates, added gypsum, added lime, or high alumina cements. The system shall be non-combustible, either before or after cure.
- a. Typical Properties of Mixed Components
 - 1. Application Time (Working Time) 5 minutes after combining components
 - 2. Finishing Time – 20 to 60 minutes after combining components
 - 3. Color – Concrete Gray
 - b. Typical Properties of Cured Material
 - 1. Splitting Tensile Strength (ASTM C496) -750 psi minimum at 28 days
 - 2. Bond Strength.(ASTM C882) -2,200 psi minimum at 28 days
 - 3. Thermal Compatibility (ASTM C884) -passes test
 - 4. Compressive Strength (ASTM C109) -1 day, 3,000 psi minimum 7 days, 5,500 psi minimum 28 days, 7,000 psi minimum
 - 5. Flexural Strength (ASTM C293) -28 days, 2,000 psi minimum
 - 6. This system shall not produce a vapor barrier.
 - 7. This system shall be thoroughly compatible with concrete.
 - 8. For horizontal repairs greater than 1-inch in thickness 3/8-inch coarse aggregate may be added. Do not use limestone aggregate.
 - c. Approved manufacturers include:
 - 1. Repair mortar for horizontal surfaces shall be SikaTop 122 Plus by Sika Corporation, Lyndhurst, NJ or equal.
 - 2. Repair mortar for vertical and overhead surfaces shall be SikaTop 123 Plus by Sika Corporation, Lyndhurst, NJ or equal.

2.02 BACKER RODS:

- A. Open Cell Backer Rod -Extruded, open cell polyurethane foam. Diameter shall be not less than 200 percent of the joint width dimension.

- B. Closed Cell Backer Rod -Extruded, nonstaining, resilient closed cell polyethylene foam, compatible with sealant. Diameter shall be not less than 25 percent greater than the joint width. Sealant shall not adhere to backer rod.

2.03 POLYURETHANE CHEMICAL GROUT:

A. General

- a. The grouting compound shall be a single component, expanding, moisture reactive polyurethane grout that is designed to seal cracks and open joints in concrete. The cured chemical grout shall form a compressed closed cell urethane foam that shall completely fill the crack or joint.
- b. An accelerator may be used if recommended by the approved polyurethane chemical grout manufacturer.
- c. Injection packers shall be required for application of polyurethane chemical grout in existing concrete.

B. Material

a. Properties of cured material

- 1. Tensile Strength (ASTM D 1623): 15.5 psi minimum at 1 day.
Elongation at Break - 25 percent.
- 2. Shear Strength (ASTM C 573): 11.70 psi minimum at 1 day.
- 3. Shrinkage (ASTM D2156) 0 percent
- 4. Water Absorption (ASTM D2842): 0.09 lb/square ft
- 5. Density (ASTM D1622): 1.64 lb/cubic ft

C. Approved manufacturers include:

Sika Corporation, Lyndhurst, NJ – SilcaFix HH-LV, or equal.

PART 3 – EXECUTION

3.01 GENERAL:

- A. Repair deteriorated areas of concrete and seal existing joints and cracks as required by the Engineer and as specified herein.
- B. All commercial products shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations and as specified herein.

- C. Where concrete is repaired in the vicinity of an expansion joint or control joint, preserve the isolation between components on either side of the joint.

3.02 CONCRETE REMOVAL:

- A. When removing deteriorated concrete, saw cut the limits of removal. Remove concrete such that existing concrete and reinforcing to be left in place and existing equipment in place are not damaged.
- B. Remove fractured, loose, deteriorated and unsound concrete by bush hammering, chipping, high pressure water blast or other appropriate means. Remove all dirt, oil, grease and all other bond inhibiting materials from surface. Exposed reinforcing steel, reinforcing to be incorporated into repair mortar, and corroded reinforcing steel shall be treated as specified herein. Saturate existing concrete surfaces with water. Restore area to original limits or as shown using repair mortar. Comply with manufacturer's recommendations for concrete removal, surface preparation, mixing, application, finishing, and curing.
- C. Repair or replace concrete specified to be left in place which is damaged during concrete modifications as required by the Engineer at no additional cost to the Owner.

3.03 CONNECTION SURFACE PREPARATION FOR NEW CONCRETE:

- A. Prepare connection surfaces as specified below for concrete areas requiring patching or repairs as indicated on the Drawings, specified herein, or as required by the Engineer.
- B. Remove all loose and deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means such as sandblasting, chipping or wire brushing. Uniformly roughen the concrete surface to approximately 1/4 in. amplitude with pointed chipping tools. Thoroughly clean surface of loose or weakened material and dust by dry mechanical means such as sandblasting and air blasting. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into the parent concrete.
- C. If reinforcing steel is exposed, clean it by dry mechanical means to remove all loose material, contaminants and rust as approved by the Engineer. If half of the diameter of the reinforcing steel or more is exposed, chip out a minimum of 1-in of concrete behind the steel. Do not damage reinforcing to be incorporated in new concrete while removing existing concrete.
- D. Prepare concrete surfaces in accordance with the following as indicated, specified or as required by the Engineer.

- a. Method A – After the existing concrete surface at connection has been roughened and cleaned, thoroughly saturate with water and maintain saturation for a period of at least 12 hours. Brush on a 1/16-in. layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as indicated.
- b. Method B – After the existing concrete surface has been roughened and cleaned, apply epoxy-bonding agent at connection surface. The field preparation and application of the epoxy-bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture as indicated within time constraints recommended by the manufacturer to ensure bond.

3.04 POLYURETHANE CHEMICAL GROUT:

- A. Apply polyurethane chemical grout to leaking cracks, joints, and voids in existing concrete.
- B. Clean concrete surfaces as required by the manufacturer of the polyurethane chemical grout.
- C. The polyurethane chemical grout shall be installed through drilled-in injection ports installed as recommended by the polyurethane chemical grout manufacturer. Installation and curing of polyurethane chemical grout shall be in accordance with manufacturer's requirements.
- D. Remove all excess material from the interior face of walls, floors, etc. and the exterior face of walls to the satisfaction of the Engineer.
- E. Remove all injection ports and seal with grout. The repair area shall be flush with the surrounding concrete surface.
- F. At completion of repairs, the Contractor, Engineer, and installers of the materials used on the repairs shall inspect the work. Any leaky joints, cracks, or voids shall be repaired in accordance with the manufacturer's instructions at no additional cost to the Owner. At the completion of the repairs, the Contractor, Engineer, and installers of the materials shall again inspect the repaired problem areas.

END OF SECTION

SECTION 11000

EQUIPMENT - GENERAL

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. Furnish, install and test all equipment specified in this Contract and as shown on the Drawings.

1.02 RELATED WORK (NOT USED):

1.03 QUALITY ASSURANCE:

- A. Provide only equipment of proven reliability manufactured by reputable manufacturers.
- B. Acceptable manufacturers are listed in each equipment item section in this Division. Substitute or "or-equal" equipment will be allowed only when indicated.
- C. Certificates, patents, licenses or other required legalities, when applicable, are specified in each Section of this Division.
- D. Manufacturer's names listed in "Acceptable Manufacturers" section of each specification are intended to indicate the type and quality of materials desired. Where the words "or equivalent" or "or equal" are indicated other manufacturers of equal quality that comply fully with the specifications are allowed.
- E. The Specifications and Drawings direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the equipment complete in all details and ready for operation for the intended purpose.
- F. These Specifications are intended to provide standard equipment of a recognized manufacturer meeting all the requirements of the Specifications. Due to differences in such prefabricated equipment of various manufacturers, submit complete shop drawings, cuts, specifications, etc. to the Engineer to review for compliance with the Contract Documents prior to ordering any equipment. If the equipment differs materially from the dimensions given on the Drawings, submit complete drawings showing elevations, dimensions etc. for the installation. If Engineer's acceptance is obtained for alternate equipment, make any needed changes in the structures, piping

or electrical systems necessary to accommodate the equipment at no additional cost to the Owner.

G. Workmanship shall be first class in all respects.

1.04 SUBMITTALS:

- A. Provide shop drawings and samples as specified in the General Conditions and Section 01330 of the Contract Documents. Equipment Systems Manufacturers shall integrate all required shop drawings into a common package.
- B. Catalog Data: Submit manufacturer's literature and illustrations for all equipment to be installed, including dimensions, construction details, shop painting details, and materials by generic name.
- C. Installation Instructions: Submit complete sets of manufacturer's instructions for each equipment item, including equipment storage requirements.
- D. Operating Data: Complete operating manuals.
- E. Maintenance Data:
 - 1. Maintenance instructions.
 - 2. Parts list.
 - 3. List of special tools (where applicable).
- F. Certificates: Submit manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements. Submit equipment performance testing results as required by these specifications. Should the proposed equipment not comply with all the specification requirements, all deviations from the specification requirements shall be listed.
- G. Submit all requirements for interface with controls and/or equipment furnished in Divisions 13 and 16. Submit wiring diagrams as required to accurately depict all such interface requirements to ensure proper operations of each system or item of equipment.
- H. Submittals are further specified in this Division.
- I. Guarantees/Warranties as specified below.
- J. Attention is directed to the fact that the Drawings are based upon a particular piece of equipment.
 - 1. If the equipment to be provided requires an arrangement differing from that indicated on the Drawings, the Contractor shall prepare and submit for review, detailed mechanical drawings showing all necessary changes. Such changes shall be at no additional cost to the Owner.

K. Contractor shall provide a letter, from each individual equipment manufacturer certifying that the equipment manufacturer or supplier has:

1. Reviewed the Contract Documents, the intended installation by the Contractor, and the intended functional and operational conditions;
2. Determined all conditions to be acceptable; and
3. Found no conditions that would cause the warranty to be void or the equipment to function improperly.
4. The submittals will not be reviewed without the inclusion of these noted certifications.

1.05 GUARANTEE/WARRANTIES:

- A. The Contractor shall obtain a warranty from the manufacturer in the name of the Owner. Submit the equipment manufacturer's warranty to the Engineer for review.
- B. Equipment that is supplied by a system supplier and is intended to function as a complete and integrated system shall be warranted by the system supplier as set forth in this specification section.
- C. The manufacturer's warranty must guarantee the equipment to be free of defects for a period of one year from the date of substantial completion as defined in the General Conditions, unless otherwise stated in the equipment item specification section.
- D. All required warranties that run longer than the Contractor's one-year warranty period shall be issued to the Owner after the Contractor's one-year warranty period has expired. The Contractor will be required to handle warranty problems during the one-year warranty period following substantial completion.
- E. Any part of mechanical equipment that shows undue or excessive wear, or that fails due to normal operational conditions within the first year of operation after the date of Substantial Completion, shall be considered as evidence of defective material or defective workmanship, and it shall be replaced with equipment or parts to meet the specified requirements at no cost to the Owner.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Coat all machined surfaces subject to corrosion with an easily removable rust preventive compound prior to shipment.
- B. Ship fabricated assemblies in the largest sections permitted by carrier regulations, properly labeled for field erection.

- C. Deliver equipment in manufacturer's original, unopened and undamaged packages, unless mounted on equipment assembly.
- D. Contractor shall perform all maintenance, as required by equipment manufacturer during storage.
- E. Should damage occur, immediately make all repairs and replacements necessary to the satisfaction of the Engineer at no costs to the Owner.
- F. Store in a manner to protect items with epoxy shop coatings from exposure to UV light that can cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with coating manufacturer's recommendations. This includes protection from UV light after installation while awaiting covering or filling of tanks, or prior to field painting for items scheduled to be topcoated.

PART 2 - PRODUCTS

2.01 GENERAL DESIGN OF EQUIPMENT:

- A. All parts and components of mechanical equipment shall be designed for satisfactory service under continuous duty without undue wear, under the specified operating conditions, for a period of not less than one year.
- B. All parts of mechanical equipment shall be amply proportioned for all stresses that may occur during operations, and for any additional stresses that may occur during fabrication and erection. Iron castings shall be tough, close-grained gray iron casting, Class 30, in accordance with ASTM A48, latest revision. Structural steel shall conform to ASTM A36.
- C. Mechanical equipment, including drives and electrical motors, unless otherwise noted, shall be supplied and installed in accordance with the Williams-Steiger Occupational Safety and Health Act of 1970 and subsequent amendments. The Contractor's attention is drawn to the requirements for equipment guards. The noise level of equipment, drives and motors, unless otherwise noted, shall not exceed 50 dBA measured 10 feet from the closest residence under free field conditions.
- D. All equipment and machinery furnished under this Contract shall be the latest improved design suitable for the service specified. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum wear, vibration and noise when properly installed.
- E. Provide certified bearing life calculations on all equipment bearings.
- F. Ample room for erecting, repairing, inspecting and adjusting of all equipment and machinery shall be provided. The design, construction and installation of all

equipment and machinery shall conform to and comply with the latest safety codes and regulations.

- G. All equipment of identical size, type and service shall be the product of the same manufacturer.
- H. All equipment selected shall suit the general arrangement of the space in which it is to be installed.
- I. Unless otherwise specified, electrical SCR controller units shall be furnished with the driven equipment, mounted and factory aligned, where applicable. Wiring of motors and controls shall be in accordance with the requirements of Division 16 and other applicable portions of the Specifications. Electrical variable frequency drives shall be furnished under this specification and installed by the electrical contractor, unless otherwise noted as specified in Division 16.
- J. Suitable provisions shall be made for easy access for service and replacement parts.

2.02 BOLTS, ANCHOR BOLTS AND NUTS:

- A. All necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves shall be furnished by the Contractor in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.
- B. All anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated or specified.
- C. Expansion bolts shall have malleable iron and lead composition elements of the required number of units and size.
- D. Unless otherwise specified, stud, tap, and machine bolts shall be of the best quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).
- E. Bolts, anchor bolts, nuts, washers, and lock washers specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, latest revision or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, latest revision as is appropriate.
- F. Bolts, anchor bolts, nuts, washers, and lock washers specified to be stainless steel shall be Type 316 stainless steel.

- G. Anchor bolts and expansion bolts shall be set accurately. If anchor bolts are set before the concrete has been placed, they shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4-inches by 4-inches by 3/8-inch or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. If anchor or expansion bolts are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by the Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.
- H. All bolts shall be suitable size for the intended purpose, with direct input from the equipment or product manufacturer. In no case shall anchor bolt size be less than 3/8-inch diameter.
- I. Stainless steel hardware is required in all submerged applications, and all corrosive atmospheres, including but not limited to the wet well and valve vault areas.

2.03 FOUNDATIONS, INSTALLATION AND GROUTING:

- A. The Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by him, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.
- B. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.
- C. In setting pumps, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 in. for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-shrink grout.
- D. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
- E. Where such procedure is impracticable, the method of placing grout shall be as permitted by the Engineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner, if necessary, given a burlap-rubbed finish, and painted with at least two coats of an acceptable paint.

2.04 ELECTRIC MOTORS:

- A. Unless otherwise specified or permitted by the Engineer, all electric motors furnished and installed by the Contractor shall conform to the requirements hereinafter set forth.

1. Ratings of Motors

- a. Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit.
- b. When the horsepower rating is specified for a motor, the motor furnished shall meet the requirements of the output specified. When the horsepower rating is not specified, the motor shall have sufficient capacity to operate the driven equipment as given in the Detailed Specifications.
- c. All electric motors shall have either NEMA or FM approval ratings.
- d. Motor shall have a service factor of 1.15, unless otherwise specified. Motors intended for use on a variable frequency drive shall be rated for inverter duty.

2. Type of Motors

- a. All motors shall be of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.
- b. Motors shall be manufactured by General Electric Co., Reliance, Toshiba, Siemens, or be an equivalent product, that meets all the requirements herein.
- c. All motors shall have Class F insulation with temperature rise in accordance with NEMA Standards for Motors and Generators and based on a maximum ambient temperature of 40 deg. C.
- d. Explosion-proof motors shall comply with all requirements of Class I, Division 1, Group D, hazardous locations as defined by the National Electrical Code and with all other safety codes pertaining thereto. Explosion proof motors shall be rated explosion proof for continuous in air duty.
- e. All motors shall be premium efficiency type, unless specifically excluded under the Energy Independence and Security Act of 2007 (EISA). The minimum guaranteed efficiency shall be printed on the motor nameplate. The efficiency values (full-load for NEMA Premium efficiency motors) shall be the highest available for the type and size of

motor, and meet or exceed the values in the following table for motors with 200 horsepower and less:

Enclosed Motors			
Nominal Efficiency (%)			
HP	2 Pole	4 Pole	6 Pole
1	77.0	85.5	82.5
1.5	84.0	86.5	87.5
2	85.5	86.5	88.5
3	86.5	89.5	89.5
5	88.5	89.5	89.5
7.5	89.5	91.7	91.0
10	90.2	91.7	91.0
15	91.0	92.4	91.7
20	91.0	93.0	97.7
25	91.7	93.6	93.0
30	91.7	93.6	92.0
40	92.4	94.1	94.1
50	93.0	94.5	94.1
60	93.6	95.0	94.5
75	93.6	95.4	94.5
100	94.1	95.4	95.0
125	95.0	95.4	95.0
150	95.0	95.8	95.8
200	95.4	96.2	95.8

3. General Design of Motors

- a. Motors shall comply with the latest NEMA Standards for Motors and Generators, unless otherwise specified.
- b. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.
- c. Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.
- d. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment. Bearings for totally enclosed and explosion-proof motors shall be of the ball type.
- e. Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.
- f. Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision shall be made for access for testing.

4. Wound-Rotor Induction Motors

- NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY
- a. Wound-rotor motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detailed Specifications.
 - b. Motors shall be of the wound-rotor, induction type suitable for speed control by rotor resistance.
 - c. The collector rings shall be constructed of hard composition metal of sufficient conductivity and ample contact surface. The rings shall be mounted accurately and securely on the shaft by means of acceptable insulating construction. The leads to the collector rings shall be fastened to and insulated from the shaft in a suitable manner.
 - d. The collector rings and brushes for the wound-rotor induction motors shall be suitable for operation in an atmosphere containing moisture.
 - e. The brushes shall be of the electrographite type, or other suitable type, of sufficient hardness and conductivity and shall have ample contact surfaces. Brush holders shall be provided with adjustable, spring-tension devices. Brushes shall be connected to the holders with tinned, flexible, copper-wire pigtails so arranged that no appreciable current shall be carried through the sliding contacts or springs. Brushes shall operate without noise or chattering. Rings and brushes shall be located on top of the motor, and shall be easily accessible for inspection and maintenance.
5. Synchronous Motors
- a. Synchronous motors shall comply in all respects with the latest NEMA Standards for Motors and Generators, and AN Standard C50 for Rotating Electrical Machinery.
 - b. Synchronous motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detail Specifications.
 - c. The temperature rise (based on a cooling temperature not exceeding 40 deg. C. and an altitude not exceeding 3,300 ft.) in the various parts of the motors, when operating continuously at rated voltage, frequency, and power factor, shall conform to the applicable requirements of the above-mentioned NEMA Standards.
 - d. Synchronous motors shall be manufactured by General Electric Co., or be an equivalent product.
6. Single-Phase Motors with Auxiliary Devices
- a. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each

combination unit shall be mounted upon a single base and shall be provided with a single conduit box.

7. Motor Terminal Boxes and Leads

- a. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections and with flexible leads of sufficient length to extend for a distance of not less than 4-inches beyond the face of the box. The size of cable terminals and conduit terminal box holes shall be as permitted by the Engineer. An acceptable type of solderless lug shall be furnished. Totally enclosed and explosion-proof motors shall have cast-iron terminal boxes.

8. Special Motors

- a. Hoists and other devices complying with special safety codes shall be furnished complete with their control equipment and with all accessories and safety devices for code-approved, safe, and efficient operation.

2.05 DRIVE COUPLINGS:

- A. Couplings shall be all metal, flexible, designed for both angular and parallel misalignment, provided with a guard, and provided with a means for lubrication.
- B. Close-coupled connections shall have machined shouldered joints for motor and pump motor support.
- C. Acceptable Manufacturers:
 - 1. H.S. Watson, Co. Toledo, Ohio
 - a) Watson Spicer Shafts
 - 2. Mechanics Universal Joint Division of Borg-Warner Corporation, Rockford, Illinois
 - a) Flexible Shafts
 - 3. Or equivalent
- D. Drive couplings for mixers which differ from the above referenced all metal type, which are standard integral parts of a mixer manufacturer's assembly may be permitted, with review and approval of the Engineer.

2.06 BELT DRIVES:

- A. V-belt drives shall be provided with front removable guards (refer to Section 2.12), not requiring disturbing of the sheaves.

- B. Capable of upsize and downsize sheaving.
- C. Design shall be based upon minimum 1.5 service factor, unless specified elsewhere.

2.07 MECHANICAL-TYPE VARIABLE-SPEED DRIVE UNITS (When Applicable):

- A. Type as specified in equipment specification sections and as shown on the Drawings.
- B. The variable-speed transmission shall be a self-contained drive which shall consist of a totally enclosed constant-speed motor, a housing on which the motor is mounted and which encloses an adjustable, heavy duty V-belt drive between two variable-pitch pulleys and the output shaft.

2.08 SCR CONTROLLERS:

- A. Each SCR controller shall be a completely solid state assembly consisting of an electronic switching amplifier, silicon controlled full wave rectifier and associated circuitry.
- B. Bridge and gate trigger circuitry shall employ printed circuit boards.
- C. Any required power transformers shall be supplied as appropriate.
- D. The SCR units shall be heavy-duty type suitable for handling the full current rating of the motors and brief acceleration current.
- E. The assembly shall be mounted on a heat sink but insulated therefrom.
- F. Power supply to the SCR controllers shall be 115 volts, single phase, 60 Hz.
- G. Each unit shall be factory wired and tested with all leads brought out to terminal strips to facilitate connections to the motors and local control stations.
- H. Each SCR unit shall include the following features:
 - 1. Full wave rectification.
 - 2. Power cube containing all power semi-conductors in a single component.
 - 3. Armature contactor with auxiliary normally open and normally closed contacts.
 - 4. Circuit breaker to provide overload protection.
 - 5. Surge suppressers to protect semi-conductors from line surges and transients.
 - 6. Adjustable current limit.

7. Adjustable IR compensation.
8. Voltage level and current capacities shall meet the requirements of the connected equipment (i.e. 90V DC output for 90V DC motors).

2.09 GEAR REDUCTION UNITS:

- A. Gears of gear reduction units shall be made of highest quality alloys treated for hardness and severe service. All gear reduction units on equipment shall be selected for Class II or more severe service as classified by the American Gear Manufacturers Association.
- B. Unless otherwise specified, the complete reduction unit shall be fully enclosed in a heavy cast-iron or fabricated steel housing with gears running in oil. All bearings shall be of the anti-friction type.
- C. The actual and rated horsepower, torque, overhang capacity, or bearing capacity of each reduction unit shall be not less than the horsepower rating of the drive motor, nor less than that which will be encountered under full load or under the most severe loading conditions of the equipment. The Engineer may reject any gear reduction unit that does not meet the above requirements. The manufacturer of gear reduction units shall be long established with a good reputation.
- D. Unless otherwise specified, all gear reduction units shall be helical or spiral bevel helical combinations. The planetary gear units and worm gear type units may be used only where specified. Class of service shall be Class II or heavier, as determined by the manufacturer or as required by the Engineer.
- E. The equipment manufacturer shall furnish the Engineer with complete engineering information, catalog data, design features, loading capacities, and mechanical efficiency ratings for every gear reduction unit incorporated in the work.

2.10 LUBRICATION FITTINGS:

- A. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, or without creating falling hazards by unusual elevations. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible.
- B. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type.
- C. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.

- D. Oil drains shall be piped to a location outside the equipment frame for ease of draining. Provide ball valve for positive shutoff. Pipe shall be type-L copper or galvanized steel.

2.11 SPECIAL TOOLS:

- A. For each type of equipment furnished by him, the Contractor shall provide a complete set of all special tools (including grease guns or other lubricating devices) that may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.
- B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.
- C. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Owner.

2.12 EQUIPMENT DRIVE GUARDS:

- A. All equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal guards enclosing the drive mechanism. Guards shall be removable with quick open latches.
- B. Guards shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members, unless otherwise specified.
- C. Guards shall be secured in position by steel braces or straps that will permit easy removal for servicing the equipment.
- D. The guards shall conform in all respects to all applicable safety codes and regulations.

2.13 PROTECTION AGAINST ELECTROLYSIS:

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis.
- B. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.14 NAMEPLATES:

- A. Each piece of equipment shall be provided with a substantial nameplate of noncorrodible metal, securely fastened in place and clearly and permanently

inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.

- B. Provide a plastic engraved nameplate to be affixed to the equipment frame indicating the equipment name. Nameplate shall be black plastic with a white background.

2.16 ELECTRICAL CONTROLS:

- A. Additional controls for various items of equipment are specified under Division 13 and/or Division 16, as indicated on the Drawings, and as specified. Due to potential differences in electrical requirements for equipment of various manufacturers, the Contractor shall coordinate the electrical requirements of the equipment supplied with the work specified in Division 13 and/or Division 16.
- B. Provide auxiliary contacts as required for remote status and alarm conditions. Contractor to coordinate for each piece of equipment. Refer to the Electrical and Instrumentation Drawings.

2.17 GAGES:

A. General:

1. Gage assemblies shall be complete with 1/2-inch brass pipe and fittings, 1/2-inch ball valve with bronze body, stainless steel ball, Teflon seats and spring-closing handle and a tee with a brass test cock with female outlet end all arranged to allow field checking with a 4½-inch test gage.
2. All gages shall be equipped with snubbers. If single snubber does not correct pulsing, provide additional snubbers in series.
3. All gages shall meet requirements as outlined hereinafter.
4. All gauges provided are to be from the same manufacturer.

B. Process Liquid Applications:

1. Gages shall be furnished for the suction and discharge nozzle of each pump and where called for on the Drawings or within other Specification Sections.
2. Gages shall be round black case, 4½-inches diameter, 1/2-inch NPT bottom male threaded connections, stainless steel rack and pinion movement, black micro-adjusted rezeroing pointers, rack and pinion movement, black micro-adjusted rezeroing pointers, and black figures with white plastic dials and a threaded ring. Gages shall have an accuracy of 1/2 percent of scale range.
3. Gages shall be bracket supported.

4. Gages shall be filled with glycerin and shall be furnished complete with factory-mounted protective diaphragm attachment and snubber which will allow cleaning of the lower diaphragm assembly without breaking the seal or refilling and shall not require recalibration of the gage. The diaphragm shall be stainless steel with a stainless steel seal and shall be fitted with a bleed screw on the lower side. The diaphragm shall be rated for gauge operating pressure range. Other diaphragm materials will be considered for acceptance on a case-by-case basis when dictated by chemical compatibility. Provide a locking plate or lock-wire to prevent turning of the assembly.
 5. Suction gages shall be compound type having a range of 15 feet to 0 to +30 feet.
 6. Discharge gage shall be selected at the nearest standard range to read in feet of water that provides a top limit above the pump shutoff head at the operating conditions or pump relief valve setting.
- C. Water for Disinfection System:
- D. Gages shall be manufactured by:
1. Ametec U.S. Gage Division
 2. Ashcroft
 3. Terice
 4. or equal.
- E. Contractor shall provide a gage schedule listing all gages, functions, locations, scales, etc., as part of the shop drawing submittal package.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Carefully inspect receiving structures and anchor supports for defects in workmanship prior to equipment arrival.
- B. Carefully inspect all equipment for:
1. Damage in shipping.
 2. Defects in workmanship and materials.
 3. Tightness of all nuts and bolts.
- C. Inspection shall include, but not be limited to, the following as applicable:
1. Soundness (without cracked or damaged parts).

2. Correctness of setting, alignment, and relative arrangement of various parts.
3. Adequacy and correctness of packing, sealing and lubricants.
4. Completeness in all details, as specified.

D. Field Quality Control

1. As part of the equipment cost, the Contractor shall provide the services of the manufacturer's service representative to assist the Contractor with equipment adjustment, start-up, and necessary testing to prove that the equipment is in proper and satisfactory operating condition.
2. On completion of his work, the manufacturer's service representative shall provide written certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void, as outlined in the attached equipment certification form.
3. As part of the start up services, the manufacturer's services representative shall provide the Owner's personnel with training in the proper operation and maintenance of all associated equipment. The equipment training certification form shall be used for this purpose.
4. When the work is substantially complete the Contractor will be required to demonstrate, to the satisfaction of the Engineer, the ability of all equipment to operate as intended without defect including binding, vibration, jamming, overheating, etc.
5. All equipment found defective by the Engineer shall be replaced by the Contractor at no expense to the Owner.

3.02 PREPARATION:

- A. Provide all required adhesives, sealants, insulation, lubricants, waterproofing, fireproofing or other protection specified in each Section of this Division.

3.03 INSTALLATION:

- A. Contractor shall install equipment in accordance with manufacturer's requirement.
- B. Do not install equipment until all defects or inadequacies in receiving structure have been corrected to meet Specifications.
- C. Erect and lubricate equipment in strict accordance with the manufacturer's instruction. Installation shall include all oil and grease required for proper operation.

- D. All equipment mechanisms shall withstand all stresses that may occur during fabrication, erection, and intermittent or continuous operation.
- E. Contractor to furnish and install supports as indicated on the Drawings, and as required by the equipment manufacturer.
- F. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, and other foreign matter and touch up factory finish to the satisfaction of the Engineer.

3.04 STARTUP AND TESTING:

- A. Test and adjust all equipment in accordance with the general requirements of Division 1 and Division 11.
- B. Contractor shall provide necessary water or other materials needed for testing.
- C. Demonstrate the equipment's ability to operate without overloading jamming, excessive vibration, etc. during normal operation conditions.

3.05 EXISTING EQUIPMENT RELOCATION:

- A. Equipment to be removed from site shall be relocated to GNHWPCA warehouse at 293 East Street, New Haven, CT. Equipment includes generator, automatic transfer switch pump control panel, Scada panel, floats, and dry pit pumps.

END OF SECTION

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SECTION 11304

SUBMERSIBLE WASTEWATER PUMPING EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the submersible wastewater pumping equipment to be furnished and installed where indicated on the drawings. Each pump shall be complete with all equipment specified herein. All components, except as otherwise noted, shall be provided by one supplier and shall be installed by the Contractor.

RELATED WORK (NOT USED)

1.02 SYSTEM DESCRIPTION:

- A. Each pump shall be furnished with motor, removal system, and all associated equipment and accessories required to make a complete system.
- B. Control of pumps shall be automatic using a programmable controller motor starter relay based on the wet well level height. All pumps shall operate automatically with provision for manual override.
- C. Equipment and accessories not specifically described herein shall be the manufacturer's standard catalog products unless otherwise approved by the Engineer.
- D. Pump monitoring signals shall be compatible with Control Systems of CT Inc. pump control panel or pump supplier shall provide switch for installation into pump panel. Contractor to coordinate.

1.03 QUALITY ASSURANCE:

- A. All equipment shall conform to the following criteria:
 - 1. Equipment shall be manufacturer's standard products presently in commercial production.
 - 2. Conform to Hydraulic Institute Standards.
 - 3. All the equipment specified under this Section shall be furnished by a single supplier and shall be products of manufacturers regularly engaged in the production of said equipment. The supplier shall have the sole responsibility for proper functioning of the complete pump packages.

4. Any reference to a specific manufacturer or model number is for the purpose of establishing a quality or parameter for specification writing and is not to be considered proprietary. In all cases any source or device that has the quality and operating capabilities specified may be acceptable.
5. Conform to requirements for materials, installation and equipment approvals of state, local, Underwriter's Laboratories, Inc., or other applicable codes, whether or not called for on the drawings or in the specifications.
6. Workmanship shall be first class in all respects.
7. Base the use of unspecified materials on their continuous and successful employment under similar conditions, as called for in this section.

B. Manufacturer's Qualifications

1. Quality Assurance System

Manufacturer shall have Quality Assurance System in place which complies with NQA-1, ISO 9001:2000, ANSI and MIL-Q-9858A. Upon request from the Engineer, the manufacturer shall submit to an audit to verify compliance with the referenced standards.

2. Consideration shall be given only to the equipment of well-established and reliable manufacturers who are regularly engaged in such work and thoroughly experienced in the design and manufacture of said equipment. The manufacturer shall certify a minimum of ten (10) successful operating installations in the State of Connecticut and a minimum of five (5) years of experience in the United States using similar size equipment as specified herein as evidence of meeting the experience requirement.
3. The system described herein and shown on the drawings establishes a standard of required type, function and quality to be met by any proposed substitute or "or-equal" systems. All "or-equal" systems shall meet the exact system configuration and operational function as shown on the drawings and specified herein. No "or-equal" system shall be considered by the Engineer unless written request for approval has been submitted for and approved by the Engineer in writing. The burden of proof of merit for the proposed "or-equal" systems is upon the Contractor and the proposed equipment manufacturer. The Engineer's decision of approval or disapproval of a proposed item shall be final. If the Engineer approves any "or-equal" item, the Contractor shall indemnify, hold harmless and defend both the Owner and the Engineer from any claims associated with the "or-equal" systems. Approval of "or-equal" systems does not relieve the Contractor of any requirements specified herein, called for by the Engineer or shown on the drawings.
4. The pumps shall undergo factory testing and all curves certified. This testing shall confirm the pumps meet the capacity and head requirements at the pump speeds

specified based on water. The testing and tolerances shall be as specified by the Hydraulic Institute Standards.

5. All spare parts shall be available for same day shipment and next day delivery. The manufacturer shall maintain a fully equipped shop facility to perform all operations including welding, fabrication, assembly and testing. All materials shall be designed to withstand the stresses encountered in fabrication, erection and operation. All equipment shall be of corrosion resistant materials or shall be suitably protected by the supplier with corrosion resistant industrial coatings approved by the Engineer.

6. Submersible wastewater pumping equipment shall be as manufactured by:

- a. Sulzer-ABS Pumps, Meriden, CT
- b. HOMA Pump Technology, Inc, Ansonia, CT

C. Factory Tests

The pumps and motors shall be given an operational test prior to shipment in accordance with the standards of the Hydraulic Institute, test grade "1U" criteria. Certified pump performance curves shall be submitted to the Engineer for approval. The data on the certified curves shall include the motor and pump nameplate information, serial numbers, performance curve showing five (5) points of operation including shut off head, pump speed, input horsepower, watts, volts, amperes and efficiency. Recordings of the test shall substantiate the correct performance of the equipment at the design head, capacity, speed and horsepower as herein specified.

D. Field acceptance tests shall be performed as specified in Part 3 Execution.

1.04 REFERENCES

A. The following standards form a part of this specification:

American National Standard Institute (ANSI)

ANSI A21.10 Standard for Gray-Iron and Ductile Iron Fittings, 3-in. through 38-in., for Water and Other Liquids.

ANSI A21.11 Standard for Rubber-Gasket Joints for Ductile Cast-Iron and Gray-Iron Pressure Pipe and Fittings.

ANSI A21.15 Standard for Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges.

ANSI A21.51 Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

American Society for Testing and Materials (ASTM)

ASTM A48 Specifications for Gray-Iron Castings.

ASTM A53 Specifications for Pipe, Steel, Black and Hot-dipped, Zinc Coated, Welded and Seamless.

ASTM D429 Rubber Property - Adhesion to Rigid Substrates

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

National Electric Code (NEC)

NEC Code National Electrical Code.

National Electrical Manufacturers Association (NEMA)

NEMA Standard as Specified.

American Water Works Association (AWWA)

AWWA C509 Standard for Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewer Systems

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Prior to fabrication, the Contractor shall submit to the Engineer for review, six copies of each of the following: complete shop drawings, including manufacturer's data sheets, showing illustrated cuts of the item(s) with scale details, sizes, dimensions, capacities, performance characteristics, wiring diagrams, controls, and other pertinent information, complete operating and maintenance instructions, and parts lists. A secondary submittal shall include the actual performance of the units under factory testing.
- B. A complete, easily readable functional description of the proposed equipment.
- C. Refer to Section 01330 for submittal information. In addition, the submittals shall also include the following:
 - 1. General arrangement drawings.
 - 2. Certified shop and erection drawings showing all important details of construction, dimensions, moment, rotational and torsion loads, anchor bolt locations, and field connections.
 - 3. Descriptive literature, bulletins, and catalogs of the equipment.
 - 4. Detailed data on the pumps, motors, control panels and appurtenances.
 - 5. Certified performance test reports.
 - 6. Long term storage, installation, operation, and start-up procedures including lubrication requirements.
 - 7. Total weight of the equipment including the weight of the single largest item.

8. O&M manuals as described herein.
 9. Complete list of deviations from the drawings and specifications.
 10. Letter from manufacturer, certifying that proposed equipment is approved for use as shown on the drawings and specified herein.
 11. A certified installation list and start-up date for the manufacturers' equipment currently operating in United States installations.
- D. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.
- E. Upon completion of the installation of each unit, the results of the field and acceptance tests as specified under this section of the specification shall be submitted to the Engineer.
- F. Furnish written certification from the manufacturer's representative of the proper installation and operation of each component.
- 1.06 OPERATIONS AND MAINTENANCE MANUALS (four sets):
- A. The manufacturer shall be responsible for supplying written instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the equipment and all associated equipment supplied by the manufacturer. Said instructions shall assume that the operator is familiar with equipment, motors, piping, and valves, but that he has not previously operated and/or maintained the exact equipment supplied.
- B. These instructions shall be prepared as a systems manual applicable solely to the equipment supplied by the manufacturer to these specifications, and shall include those devices and equipment supplied by him. However, items of equipment for which the manufacturer has made mounting or other provisions, but which he has not supplied, may be excluded from these instructions.
- C. Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these specifications. Instruction manuals applicable to many different configurations and pumps, and which require the operator to selectively read portions of the instructions shall not be acceptable.
- D. Submit operations and maintenance manuals for the equipment, within 30 days of shop drawing approval.
- E. Manuals shall include but are not limited to the following:
1. Complete operations and maintenance information for the specific equipment.
 2. Name, address, and telephone number of the nearest competent service representative who can furnish parts and technical service.
 3. Complete parts list including the manufacturer's reference and ordering numbers, including any required maintenance items or tools.

4. Descriptive literature, including illustrations, covering the operational features of the equipment, specific for the particular installation, with all inapplicable information omitted or marked out.
5. Unit weight, moment, rotational and torsion loads.
6. Operating, maintenance and trouble shooting information.
7. Complete connection, interconnecting and assembly diagrams.
8. Approved Shop Drawings.
9. Recommended Spare Parts List.

F. Manuals shall also include the following:

1. Instructions for all adjustments, which must be performed at initial startup of the equipment, adjustments which must be performed after the replacement of control system components, and adjustments which must be performed in the course of preventive maintenance as specified by the manufacturer.
2. Instructions for the adjustment, calibration, and testing of selected electronic components or assemblies, normally considered replaceable by the manufacturer, whose performance is not ascertainable by visual inspection.
3. Service instructions for major components not manufactured by the manufacturer but which are supplied by him in accordance with these specifications. Incorporation of literature produced by the actual component manufacturer will be acceptable.
4. Electrical schematic diagram of the equipment packages as supplied, prepared in accordance with all applicable standards. Schematics shall show, to the extent of authorized repair, motor branch, control, and alarm system circuits, and interconnections among these circuits. Wire numbers shall be shown on the schematic. Schematic diagrams for electronic equipment, the detail parts of which are normally repairable by the operator, need not be included, and shall not be substituted for an overall schematic diagram. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall schematic diagram.

G. The manuals shall be reviewed by the Engineer for completeness; those that are deemed inadequate shall be returned for correction.

H. Operation and maintenance instructions which are limited to a collection of component manufacturer literature without overall package instructions will not be acceptable.

I. Refer to SECTION 01760 – Operations and Maintenance Manuals for additional information.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. The equipment, materials and spare parts shall be shipped complete and ready for installation except where partial disassembly is required by transportation regulations, is recommended by the manufacturer, or for protection of components.
- B. All necessary location drawings and templates required to install the equipment in concrete, masonry, etc., shall be furnished and delivered to the site by the manufacturer of the equipment furnished under this Section, for installation under other Sections of the specifications. Delivery of these items shall be as required by the overall construction schedule.
- C. Deliver to Site. The Contractor shall deliver and unload the equipment and properly store and maintain the equipment as required until installation.
- D. Units temporarily stored shall have covered and taped ends for protection. Equipment damaged or bent during storage, shipment or unloading shall be replaced at no additional cost to the Owner.
- E. The manufacturer shall properly store and support equipment. Protect all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed.
- F. Store motors in buildings or trailers, which have a concrete or wooden floor, a roof and fully closed walls on all sides. Protect the equipment from being contaminated by dust, dirt, vibration, ultra violet radiation and moisture.
- G. Provide suitable temporary leads for motor space heaters, if space heaters are deemed necessary.
- H. Spare parts shall be packed in containers bearing labels clearly designating contents and pieces of equipment for which intended. The containers shall be suitable for long-term storage by the Owner. Spare parts shall be delivered to the site at the same time as the basic equipment and turned over to the Owner after completion of work.
- I. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations and shall be properly match-marked for ease of field erection.
- J. The manufacturer shall recommend and confirm all storage arrangements.

1.08 WARRANTY STATEMENT:

The manufacturer's warranties from defects shall contain a provision that the manufacturer shall repair or replace any defects, to the satisfaction of and at no additional cost to the Owner, for a period of twenty four (24) months, from the date of project Substantial Completion or thirty six (36) months, from the date of shipment (whichever is greater). The warranty information shall be provided in writing from the manufacturer

in the submittal and shall be revised upon Substantial Completion to incorporate the date of the project Substantial Completion.

PART 2 - PRODUCTS

2.01 PUMPS:

- A. Pumps shall be submersible type, single stage, centrifugal pumps, as indicated on the Drawings and specified herein. Each pump shall be capable of pumping continuously at the conditions indicated.
- B. Pump Casings shall be made of high tensile close-grained cast iron, ASTM 48 Class 30.
- C. Each pump shall be arranged to automatically clamp the pump discharge to the discharge connection when lowered along guides.
- D. Discharge connection shall be cast iron, rigidly bolted to floor with stainless steel cinch anchors; machined to receive yoke and face of the pump discharge; discharge connection also shall hold the lower ends of the guides.
- E. Shaft seals shall consist of two mechanical seals mounted in tandem, with an oil chamber between the seals. The rotating faces of the seals shall be silicon carbide or tungsten carbide and the stationary faces shall be silicon carbide or tungsten carbide.
- F. Submersible motor windings shall be open type with moisture resistant Class H insulation designed for Class 1, Division 1, Group C and D installations (explosive). Winding housing shall be filled with oil for cooling windings and seals and lubricating bearings.
- G. Each motor shall be protected from excessive temperature by a built-in automatic overload protection. The heat sensor thermostats embedded in the motor windings shall open when the temperature in motor rises to over 220°F and automatically reset when the temperature drops to safe limit. The overload shall be connected in series with the starter coil so that the starter is tripped if the overload opens. The motor starter shall be equipped with overload relays so all normal overloads are protected by external heater block.
- H. Motors shall be of sufficient horsepower for operation anywhere on the pump head-capacity curve without overloading, with a 1.15 service factor based on the nameplate rating.
- I. Motor ball bearings shall be designed for minimum B-10 life of 50,000 hours for all operating points.
- J. Power and Control Cables: Each pump shall be furnished with sufficient flexible power and separate control cables (coordinated with the electrical and control wiring termination points) to reach from the pump to the electrical enclosure indicated. A minimum of 50 feet of cable shall be provided. Cable leads shall be epoxy sealed at the motor connection.
- K. Design each pump shaft with ample provision to compensate for pump thrust and for overhung load on impeller. Shafts shall be stainless steel.

- L. Provide moisture sensing probes in the air filled seal chamber and temperature sensing probes in the motor windings. Associated alarms and lockouts shall also be provided.
- M. A 316 stainless steel-welded lifting chain shall be provided for each pump. Ropes and lift-out cables shall not be accepted. Lifting eyes shall be provided every four feet on the chain. A stainless steel hook shall be mounted inside the wetwell or process tank to hang the chain on when it is not in use.

2.02 PUMP IMPELLERS:

- A. The impeller shall be of the semi-open, non-clogging and non-ragging, single vane design. The bottom plate shall be designed with an inlet incorporating strategically placed cutting grooves and an outward spiral V-shaped groove on the side facing the impeller, to shred and force fibrous, stringy solids outward from the impeller and through the pump discharge. The bottom plate shall be self-cleaning design and shall clean fibrous, stringy solids from the leading edge of the impeller. The impeller and bottom plate shall be cast iron ASTM A-48, Class 35B. The impeller shall be dynamically balanced to ISO 1940 Grade 6.3.
- B. Provide one spare impeller and set of wearing rings per pump.

2.03 PUMPS AND MOTORS SCHEDULE:

- A. The following submersible pumps shall be furnished and installed under this section:

Submersible Pump	Flow (gpm)	Total Dynamic Head (ft)	Pumps online	Max Motor HP	Max Motor Speed (RPM)	Minimum Wire to Water Efficiency	Discharge Size (in)
Sulzer-ABS	260	22	1	25	3,600	42%	4"

* The contractor shall field verify all pipe lengths and heads based on actual field conditions

- B. Adequate tolerances in the listed capacity, head and efficiency values have been included. No deviation below the listed parameters will be permitted.

C. SERVICE CONDITIONS:

Pumps P-1 through P-2 are submersible wastewater pumps. Pumps P-1 through P-2 are interchangeable and configured in a standard duplex configuration. The pumps shall alternate from primary, to backup as specified. Pump P-1 or P-2 shall work to transfer wastewater from the influent pumping station wetwell to the force main. The first point shown is the normal working point and the second point shown is the maximum pumping capacity.

2.04 MATERIALS:

- A. Iron Castings, Shapes and Bars: ASTM A48 of suitable class for intended purpose.
- B. Other Materials: Applicable ASTM specifications unless otherwise specified.

2.05 LIFT-OUT SYSTEMS:

- A. The slide rail assembly system shall be double rail self-sealing with a simple up and down motion required to remove and reinstall pumps in the basin.
- B. The slide rail system shall be adjustable so that perfect vertical alignment can be obtained.
- C. A pump slide rail assembly shall be supplied for each pump by the pump manufacturer and shall consist of Type 304 stainless steel upper guide rail brackets and pump guide rail assemblies of AISI Type 304 stainless steel structural tee sections. The stationary and movable parts of the discharge coupling assemblies shall be epoxy coated cast iron. The upper guide rail brackets shall be affixed to the concrete structure and shall be positioned over the upper end of the stainless steel guide rails while the discharge base elbow positions the lower end of the guide rails.
- D. Each stainless steel rail shall support the pump at a distance of approximately four inches from the concrete floor to provide unrestricted flow of material into the pump. Each cast iron movable fitting, when in position, shall be held against the stationary fitting by the construction of the stainless steel rail, aligning the movable fitting to the base elbow for proper sealing of the two surfaces under pressure.
- E. Each pump shall be fitted with a 316 stainless-steel lifting chain for pump installation and removal. The chain shall have a minimum breaking strength of 2,000 pounds, or a minimum safety factor of 2.5 whichever is greater.
- F. Intermediate supports shall be provided for the discharge piping and for the pump slide rail brackets as indicated on the Drawings. Supports shall be fabricated of Type 304 stainless steel with Type 316 stainless steel anchor bolts and fasteners.
- G. All fastening hardware, including anchor bolts, shall be AISI Type 316 stainless steel.
- H. Pump slide rail assemblies shall be manufactured by the same manufacturer as the submersible wastewater pumps. Lift-out systems comprised of guide wires shall not be acceptable.

2.06 ALUMINUM ACCESS HATCHES:

- A. Aluminum access hatches shall be sized so that the pumping units may be removed and replaced, as shown on the drawings. Installation shall be in accordance with manufacturer's instructions. Manufacturer shall guarantee against defects in material or workmanship for a period of five years.

2.07 PAINTING AND SURFACE PREPARATION:

- A. The components of the pumps shall be thoroughly cleaned to remove mill scale, dirt, rust, grease, and other foreign matter. Motors, casings, receivers and other items customarily finished at the shop shall be given coats of paint filler and enamel or other approved treatment customary with the manufacturer.
- B. Pumping units and appurtenances shall receive factory finish paint in accordance with the manufacture's standard paint for wastewater applications. Paint shall be suitable for submergence in typical municipal wastewater with temperatures as low as 4 degrees Celsius. Submit descriptive information and catalog cuts of the surface preparation and paint with the shop drawings. Frame mounting systems and appurtenances shall receive surface preparation and shop prime and finish paint per the manufacturer's recommendations. Finish paint to be applied in the field shall be provided by the manufacturer and applied by the Contractor.
- C. Stainless steel surfaces shall not be painted.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation of the pump packages and related appurtenances shall be performed in accordance with all written instructions furnished by the manufacturer.
- B. After installation, Contractor shall clean all surfaces damaged in shipment or installation and shall touch up in the field with the same materials as original coatings.

3.02 MANUFACTURER'S REPRESENTATIVE SERVICES:

- A. Manufacturer shall provide the necessary on-site services for each submersible wastewater pumping unit that is provided hereunder to include:
 - 1. Observation of installation
 - 2. Certification of proper installation
 - 3. Alignment and adjustment as necessary
 - 4. Startup and testing
 - 5. Certify for use and start of warranty
- B. The services of a factory-trained manufacturer's representative shall be provided as specified herein.
- C. Services to be provided:

The service representative shall be responsible for complete component inspection on site after delivery and shall assist in the correct assembly of the components for a minimum period of one (1) eight-hour day. (Note: It is anticipated that all units will be installed, tested, and made operational at the same time, requiring a minimum of one (1) and potential as many as two (2) separate site visits by the manufacturer's representative for installation).

1. For inspection and check out of erected equipment – One (1) eight - hour day.
2. For start-up services and supervision – One (1) eight - hour day.
3. For complete instruction of the operating personnel – One (1) eight - hour day.

- D. The minimum period of time herein specified does not relieve the manufacturer from providing sufficient time to satisfactorily complete the required service functions.
- E. The manufacturer's representative shall certify in writing that each submersible wastewater pumping unit has been properly installed.
- F. The Owner reserves the right to videotape the instruction of the operating personnel for future use in training.
- G. The submersible wastewater pumping units shall be assembled and installed in strict accordance with the manufacturer's recommendations and as approved by the Engineer.

3.03 FIELD ACCEPTANCE TESTS:

- A. After installation of the equipment and after completion of the services of the manufacturer's representative the Contractor shall operate each unit to demonstrate its ability to pump without excessive vibration, motor overloading, or overheating. Each pump shall be operated for a sufficient period of time to permit thorough observation of all pump components.
- B. Start-up and testing shall be conducted in accordance with Section 01751, STARTUP AND TESTING FOR SEWER PUMP STATIONS.
- C. Notify Engineer in writing at least three days in advance of the tests. If testing cannot be conducted because of scheduling, unavailable service personnel, etc., the Engineer's fees for a second visit shall be paid by the Contractor.
- D. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.
- E. All final adjustments necessary to place the equipment in satisfactory working order shall be made prior to the tests.
- F. If sufficient sewage is not available for the test, the Contractor shall provide water for testing. All labor and materials necessary for the test shall be furnished by the Contractor.

- G. After installation, all piping shall be tested for tightness in an approved manner. Should leaks be found, faulty joints shall be repaired, even to the extent of disassembling and remaking the joint, and all defective pipe and fittings shall be removed and replaced in a manner satisfactory to the Engineer.

3.04 SPARE PARTS:

- A. Provide a list of all spare and replacement parts and locations where they are available and can be purchased.
- B. At a minimum the submersible wastewater pumping manufacturer shall provide the following spare parts:
- a. One complete set of any and all special tools required.
 - b. One (1) complete set of gaskets required for the pump, for each pump.
 - c. One (1) complete set of wearing rings for the impeller and pump casing, for each pump.
 - d. One impeller key, washer and lock screw.
 - e. Two (2) impellers.
 - f. Two (2) self-cleaning bottom plates.
 - g. One (1) mechanical seal repair kit.
- C. The submersible wastewater pumping manufacturer shall also provide all other spare parts as recommended and as itemized in the operations and maintenance manual, for each submersible wastewater pump unit installed and ancillary system component installed.

END OF SECTION

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SECTION 13421

INSTRUMENTATION AND CONTROL

PART 1 - GENERAL

PART 1 – GENERAL

1.01 WORK INCLUDED

The work covered under this section of the specifications includes the furnishing and installing of all instrumentation and control hereinafter specified to perform the intended function. Control panel shall be produced by an Underwriters Laboratories, Inc. (UL) 508 listed shop to manufacture UL 508A control panels and shall present their certification documentation with submittal drawings. The work covered under this section of the specifications includes the furnishing and installation requirements of all instrumentation and control hereinafter specified to perform the intended function. The pump station control panel shall contain the main circuit breaker, automatic transfer switch (where required), surge protection devices, motor starters, feeder circuit breakers, motor controllers, control power transformer, space for future telemetry equipment, and necessary controls. The **Contractor** shall be responsible for coordinating all work with the Owner and Project Engineer.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Prior to purchase, fabrication, and delivery to the site, the Contractor shall furnish to the Engineer details, shop drawings, catalog data sheets and other such descriptive drawings and materials as may be required to fully describe the equipment proposed and its conformance with the specification.
- B. Submittals shall be in accordance with the requirements of Section 01330 of the Construction Documents.
- C. Shop Drawings shall be thoroughly checked by the Contractor for compliance with the Contract Documents. Verify that all equipment and materials proposed to be furnished will fit into available space and maintain specified clearances/clearances required by code, and that all equipment is compatible with the system operation. Provide complete equipment panel layout drawings, equipment catalog cuts, schematic wiring diagrams, point to point wiring diagrams for all systems.
- D. Shop Drawings at a minimum shall consist of:
 - 1. Project name and location
 - 2. Contractor's name and contact information

3. Instrumentation System Supplier name and contact information
 4. Index Sheet - Listing the equipment being submitted using equipment designations, tag identification, and/or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/type and catalog number.
 5. Specification Section reference and check sheets.
 6. Manufacturer's scale or dimensioned drawings along with standard catalog number.
 7. Drawings of panel layouts including interior and exterior components keyed to a bill of materials.
 8. Single-line and schematic diagrams of all required instrument piping and electrical work. Provide Schematic for each motor/drive system.
- E. All material shall be contained in one submission; partial submissions shall not be accepted and shall be returned as rejected.
- F. Submissions shall be in the form of individual binders, of the quantity indicated in the General Conditions. Each equipment type shall be separated by index tabs with typewritten titles.
- G. Provide samples of instruments, devices, graphics, etc., within ten (10) days upon receipt of request from the Engineer.
- H. Maintain properly documented and witnessed test and checkout reports, as noted in this section, and submit these to the Engineer. Test reports should indicate each control panel component tested and checked, with initials or signature, and listing of any problems encountered.
- I. Upon completion of the work and before request for final payment, deliver to the Engineer six (6) bound sets of full and complete directions pertaining to the operation and maintenance of all equipment and systems installed under this Contract. These directions shall be typewritten on 8-1/2" x 11" sheets neatly bound with index tabs, and shall be accompanied by plans, diagrams, etc., of the work installed, parts lists, etc., necessary for the guidance of the Owner in operating, altering or repairing the installation. Operational descriptions should include custom functional descriptions of the controller programming, list of hard-coded timers and setpoints, list of user-settable timers, control setpoints, alarm setpoints, and description of enable/disable functions. The descriptions should describe how to operate in automatic and manual, where applicable.
- J. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc.
- 1.04 QUALITY ASSURANCE:
- A. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to the approval of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's approval. The discontinuance of production of

any material or product after approval has been granted shall not relieve the Contractor from furnishing an Engineer approved alternate of comparable quality and design without additional cost.

- B. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use for at least three years.
- C. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. Provide, for a period of twelve (12) months from the date of final acceptance of the work, all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects.
- D. Instrumentation and Controls Supplier:
1. The Contractor's attention is directed to the fact that the instrumentation and controls are an integrated system and as such, shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacture, and be responsible to the Contractor for satisfactory operation of the entire system. Substitutions on functions specified will not be acceptable.
 2. The exception shall be where instrumentation and control packages are furnished by respective equipment manufacturers as specified in Division 11, 15, and 16. All necessary provisions will be made to ensure a proper interface between the main process instrumentation and control packages specified within this section and those provided under other Divisions.
 - a. Acceptable Instrumentation System Supplier shall be Control Systems of CT, Inc. The Owner has standardized on instrumentation systems by Control Systems of CT, Inc., as such there is no approved equal system integrator for the Owner.
- E. The Pumping Station Manufacturer's attention is directed to the fact that the instrumentation is an integrated system and as such shall be furnished by one supplier, who will provide all of the equipment and appurtenances, regardless of manufacture, and accept responsibility for satisfactory operation of that system.
- F. The Pumping Station Manufacturer shall coordinate the work of the system supplier for the installation, interconnection, testing and calibration of the instruments, and the scheduling of the supplier's personnel. The instrument supplier shall be responsible for assuring himself that this equipment properly meets the functional intent of the specifications and comprises a complete and functional system meeting the approval of the Engineer. Substitutions on functions specified shall not be acceptable.

- G. No form of energy shall be turned on to any part of the instrumentation system prior to receipt by the Engineer of a certified statement of approval of the installation from the Pumping Station Manufacturer containing his supplier's authorization for turning on energy to the system.

PART 2 – PRODUCTS

2.01 SINGLE SOURCE SYSTEM SUPPLIER

- A. All instrumentation and control systems equipment shall be furnished by a Single Source System Supplier. The System Supplier shall provide and be responsible for the proper operation of all Process Instrumentation and Controls and Control Panels. The Single Source System Supplier shall perform in house submittal drawings and assembly of products. Subcontracting submittal drawings and equipment assembly will not be permitted.
- B. Substitutions of functions or equipment specified will not be acceptable.
- C. The entire system shall be warranted for one (1) year from date of substantial completion.
- D. The Contractor shall assign full responsibility for the function operation of all new instrumentation and control systems to a Single Source System Supplier. This System Supplier shall be responsible for all coordination necessary in order to select, to furnish, to supervise installation and connections, to calibrate, and to place into operation all instrumentation and controls along with all other equipment and accessories as specified herein.
- E. The System Supplier shall be one of established favorable reputation who has designed and produced similar systems and components for a period of at least ten (10) years.
- F. It shall be required of the Single Source System Supplier to execute and submit a guarantee to assume full responsibility as defined in paragraph 'E' above. It is the duty of the Contractor to include this guarantee with his Bidding Documents.
- G. Only the guarantee of the base bid System Supplier and alternate System Supplier (if used) whose name the Contractor has inserted in his Bidding Documents is required. Only one Alternate System Supplier may be listed on bid documents. Failure by a System Supplier to provide a written guarantee with his proposal shall be deemed by the Contractor as "NO BID" and that System Supplier will not be acceptable. The written guarantee shall be on the named System Supplier's letterhead and shall be signed by a responsible representative who will be primarily involved in the fulfillment of this guarantee. The written guarantee shall be stated as follows:

“... (Name of Single Source System Supplier)...guarantees that the proposal offered

provides for complete compliance with all requirements of this section of the project specifications without exceptions to these specifications.

Full responsibility will be placed upon... (Name of Single Source System Supplier)...for all coordination necessary to select, to furnish, to supervise installation and connections, to calibrate, and to place into operation Process Instrumentation and Controls, Control Panels, and all other equipment and accessories needed to provide a complete operating system to comply with requirements of this section of the project specifications.

... (Name of Single Source System Supplier)... guarantees to provide all submittal drawings, instruction manuals, and qualified personnel for specified field services and training, all as defined within this section of the project specifications.”

Guarantee on system function and equipment shall be one (1) year from date of substantial completion or partial acceptance.

2.02 INSTRUCTION MANUALS

Prior to 65% of the value of job completion, System Supplier shall furnish two (2) copies to the Engineer and one (1) copy to the Owner of all descriptive matter and complete system operation instruction manuals in separate indexed binders coordinated with the equipment that is furnished and installed for approval. System Supplier shall incorporate Engineer's comments and resubmit for approval within thirty (30) days of receipt of Engineer's comments. Once final approval is obtained, System Supplier shall furnish two (2) copies to the Owner and two (2) to the Engineer.

PART 3 – EXECUTION

3.01 ENGINEERING SUPERVISION

- A. The services of a qualified representative of the selected Single Source System Supplier shall be provided to inspect the completed installation, suggest all adjustments necessary to place the system in proper operation, and instruct operating personnel in the care and operation of the equipment furnished. A minimum of one (1) day and one (1) trip start-up service and training operating personnel shall be included. The services shall be furnished by the **Contractor** as a part of the work included under this section of the specifications.
- B. The System Supplier shall show satisfactory evidence that he maintains, a fully equipped factory organization capable of furnishing adequate service for the equipment furnished, included replacement parts. Suppliers employing outside organizations for “ON CALL” service shall not be considered.

3.02 GENERAL INSTALLATION

- A. Installation of instrumentation and controls shall be in strict compliance with the manufacturer's instruction. The locations of these items as shown on the Contract Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. It is the duty of the **Contractor** to obtain, in the field, all relevant information required for proper placement of instrumentation and controls. In the case of interference with other work, proceed as instructed by the Engineer and provide all materials and labor required to prevent construction delays.
- B. Execution of the installation shall be in full accordance with codes and local rulings. The **Contractor** shall be responsible for any expenses that are a result of work performed contrary to said codes and regulations.
- C. The System Supplier shall coordinate with the **Contractor** the installation, the location of process equipment, and connections of process equipment to related equipment panels, subject to the Engineer's approval. The equipment being furnished with electrical controls or instrumentation must be submitted to the System Supplier for approval and coordination with all other control and instrumentation on this project. This engineer will not approve any equipment submittal until this coordination has been accomplished.

3.03 DELIVERY AND HANDLING

After delivery to the jobsite, the **Contractor** shall store the control panel off of the ground in a dry location until such time as it is mounted and supplied with electrical service. The contractor shall also insure that the pump power and control cords, as well as control floats, are protected from submergence until they are properly installed and sealed.

3.04 MAIN FREE STANDING STABLE SS STEEL CABINET

- A. FREE STANDING ENCLOSURE: The free standing cabinet will be factory assemble and test before shipping to the **Contractor** for field installation, the enclosure will include:
1. Utility Meter base
 2. Main Circuit breaker /Disconnect
 3. Pump Control Panel
 4. Lighting panel
 5. Generator Automatic Transfer Switch
 6. Generator battery charger if required
 7. Heaters, lighting receptacle and thermostats
 8. Transformer if required
 9. Surge protection device
 10. SCADA Panel
 11. Intrusion alarm
 12. Flowmeter transmitter
 13. Pressure Indicator
 14. Intrinsically Safe Barrier
 15. Wet well pump connection junction box on exterior

- 16. Pump lockout/tagout point of disconnect
- 17. Pump heat/seal equipment termination point

- B. FREE STANDING ENCLOSURE: Free standing 304 Stainless Steel double-door, double sided enclosures free standing shall be securely fastened to concrete base with wedge anchors, sleeve anchors, drop-in anchors or equivalent. All mounting hardware shall be stainless steel. Zinc plated material shall not be accepted. Anchor embedment shall be a minimum of three inches (3"). Control panel(s) shall be accurately leveled following the manufacturer's instructions. The leveling shall be checked in the presence of the Project Engineer and shall be to then engineer's satisfaction. Control panel installation shall be the responsibility of the Contractor.

HOFFMAN – NEMA 4X
(QTY OF 2), back to back
MODEL # A90727224SSFSDN4
Size to be finalized at submittal stage

- C. FREE STANDING ENCLOSURE HEATING (2 each side)
HOFFMAN
(QTY OF 4)
MODEL # DAH4001B
- D. FREE STANDING ENCLOSURE LIGHTING (2 each side)
LITHONIA
(QTY OF 4)
MODEL # DMWL2440606 MAGNUM DMVOLTGZ10

3.05 PUMP CONTROL PANEL GENERAL REQUIREMENTS

- A. Control panel enclosures shall be constructed of a minimum 14-gauge painted steel. Seams shall be continuously welded and ground smooth. Door shall be removable by pulling a steel continuous hinge pin. Large, double-door enclosures shall come complete with twelve-inch (12") painted white steel floor stands welded to the enclosure. Enclosure(s) shall be rated NEMA 12/13 and be manufactured by Hoffman, Stahlin or approved equal.
- B. All power and control wires shall be stranded copper type MTW. All wiring shall be in covered plastic wireway.
- C. All points necessary for external connection in the control panel whether power or control shall be wired to a terminal strip located at the top or bottom of the enclosure as directed by the engineer. The terminal strip shall be permanently marked with the same designation as the wire connected to it.
- D. All power and control wires shall be marked at both ends using self-adhering wire markers. No two wires having different functions within the control panel shall have

the same markings.

- E. All circuit breakers, starters, and other control devices mounted within the controller panel shall be labeled for identification both within the panel and on the wiring schematic with corresponding designations.
- F. Control power shall be 120 Volts and shall be protected by the correctly sized circuit breaker. If required, provide a properly sized control power transformer with primary over current protection.
- G. Each starter shall be provided with overload protection in all three phases and each individual starter shall have phase failure protection.
- H. All selector switches, indicators, and pilot lights shall be identified with an engraved Bakelite nameplate. All selector switches, pilot lights, and control devices shall be visible and operable from the Controller exterior door or an interior deadfront panel when required. The deadfront panel shall be constructed of anodized aluminum and shall have a continuous aluminum hinge. An anodized aluminum deadfront shall be utilized when the Controller environment is not conducive to exposed controls or as specified on drawings.
- I. All approval drawings shall be prepared per Joint Industrial Conference (J.I.C.) standards for engineer's review prior to any fabrication of control equipment. The Controller shall be produced by an Underwriters Laboratories, Inc. (U.L.) 508 listed shop. Proof of label availability shall be submitted with approval drawings.
- J. The Controller manufacturer shall provide a written warranty with approval drawings covering all Control materials and parts furnished for a period ending one (1) year after final acceptance of the project. This warranty shall cover all material replacement, all labor, and all travel expenses.
- K. The Controller manufacturer shall show satisfactory evidence that he maintains a fully equipped factory organization capable of furnishing adequate service for the equipment furnished, including replacement parts within a 100-mile radius of the job site. Suppliers employing outside organizations for "ON CALL" service shall not be considered.
- L. Controller manufacturer shall have a service department capable to respond in emergency condition 24/7 and 365 day a year.
- M. Under no circumstances will a PLC type control panel be considered equal or acceptable.
- N. The quality-establishing brand for the control panels shall be that manufactured by Control Systems, Inc. of Jackson, Mississippi.
- O. SPARE PARTS: The System Supplier shall maintain an inventory at his facility of at

least one part of each type furnished on this project. These parts shall be available for delivery to the owner in a maximum of eight (8) hours.

Provide with this specific project:

DC101F Controller	Qty of 1
MPCT6 Controller	Qty of 1
MM101 Controller	Qty of 1
SPLT Transducer	Qty of 1

- P. CONTROL STRATEGY: Pumps shall operate on a lead/lag basis as controlled by the duplex control module (DC1-2). In the automatic mode, the duplex pump controller shall receive stop and start commands based upon the level in the station wet well as sensed by the submersible pressure/level transmitter (LT-1). A back-up float system shall be utilized in the event of submersible pressure transmitter failure. Pump(s) shall not be allowed to operate on high temperature and shall automatically switch to the other pump. Pump(s) shall alternate on pump failure and seal failure when a failure condition is detected and the pumps are in the automatic mode. The failed pump shall become the lag pump on future cycles until the failure condition is corrected. Pumps shall automatically alternate and exercise uniformly. Each motor shall be able to be selected for Lead operation or fully automatic alternation on each call-for cycle. All electronic controls shall be bypassed (including delays) when the Man-Off-Auto switches are in the Manual or Off positions to allow motor control even in the event of a circuit failure. Provide variable delays for Power-On, Pump Failure and Improper Sequence Pump Off delays. Level inputs shall be optically isolated and intrinsic safe. Field adjustable motor failure delays shall be provided in the range of five (5) seconds to eight (8) minutes. Upon motor failure, the remaining functional motor shall be made Lead until the failure is corrected and manually reset. The failed motor shall only be called to operate at the lag pump operating level. Individual, adjustable power-on delays shall also be supplied which delay pump start during initial startup or after a power failure. In the event that both motors are called for at the same time, there shall be a minimum of five (5) seconds between motor starts and stops. Motor failure, seal failure and high level alarms will flash the associated red pilot lights. All setpoints shall be approved by the Project Engineer.

3.06 THREE PHASE DUPLEX PUMP STATION CONTROL PANEL

- A. ELECTRIC SERVICE: The panel shall be designed for onsite 480 volt, 3 phase, 4 wire, 60 Hertz power. The **Contractor** shall verify the site voltage with the servicing power company. If site voltage differs that that indicated it shall be the responsibility of the **Contractor** to make appropriate changes in his bid. The **Contractor** shall verify what type of transformer bank is being supplied and the transformer connections (open-delta, open-wye, delta, wye, high-leg delta, etc.). This information shall be given to the pump supplier and control panel supplier. New Control Panel shall be NEMA 12/13 rated, painted steel. Panel to be Arc Flash Compliant.

1. Woodbridge Sewer Pumping Station - 25 HP, 480v, 3 Phase, Duplex
-
- B. NORMAL MAIN BREAKER: Provide a properly sized Normal Main Breaker, as shown on the drawings. The Actual Normal Main Breaker size may differ from that indicated on the drawings dependant of the actual motor horsepower being furnished. The actual horsepower may differ from that indicated on drawings. In addition, provide a through the door mounted operator (DMO) on the interior deadfront. The operator shall prevent the deadfront from being opened while the breaker is in the "ON" position.
 - C. POWER DISTRIBUTION BLOCKS: Provide properly sized Power Distribution Block(s) (PDB), as required for the control panel. Power distribution blocks shall be UL Listed and rated for the voltage and ampere rating as required; manufactured by Marathon, Square D, or approved equal. Provide necessary lugs for service entrance neutral.
 - D. SERVICE ENTRANCE SURGE PROTECTION DEVICE: Provide a service entrance rated Type 2, AC power distribution Surge Protection Device (SPD-1), per Component Specifications, designed to protect all types of loads fed from the distribution panels, branch panels and/or individual equipment panels. Units shall be UL listed and shall bear a UL label. Surge Protection Device shall be rated for 120kA per phase and 60kA per mode. Unit shall be internally fused and have a 15-year replacement warranty.
 - E. PHASE MONITOR: PM-1 - Provide a service entrance Power Monitor (PM), per Component Specifications. Power monitor shall constantly monitor the three-phase voltages to detect harmful power line conditions, caused by single-phasing, low voltage, phase reversal, and voltage unbalance. When a harmful condition is detected, no three-phase motors shall be allowed to operate. Phase monitor shall be protected by 1-Amp, 480-Volt fuses on the primary side.
 - F. PUMPS NO. 1 & NO. 2: Provide a properly sized combination circuit breaker with lock out tag out provisions on each pump circuit breaker and Solid State rated motor starters for type and size required by the servicing power company and for the motor horsepower being furnished. The actual horsepower may differ than that indicated on drawing. In addition, provide the following additional equipment and controls.
 1. The pumps shall be controlled by a Duplex Pump Controller (DC1-2), per Component Specifications. The controller shall be capable of operating with float switches or a level controller with dry contact outputs for All-Stop, Lead Start and Lag Start during normal operation. In the automatic mode, the Duplex Pump Controller shall receive stop and start commands from the Level Meter/Controller, as described below, based upon the level in the station wetwell as sensed by a submersible transducer. Back-up float switches shall be utilized in the event of a submersible pressure level transmitter failure and activate the common alarm light. The Duplex Pump

Controller shall be a standard, catalogued product of a water and wastewater automation equipment manufacturer regularly engaged in the design and manufacture of such equipment for a period of at least fifteen (15) years. The duplex controller shall perform all control functions as specified in Component Specifications section and shall be UL recognized. The duplex pump controller shall have the following indicators and controls for each pump:

- a. Manual-Off-Automatic selector switch for Pump No.1
 - b. Manual-Off-Automatic selector switch for Pump No.2
 - c. Pump 1 / Pump 2 – Lead / Lag Selector Switch
 - d. Green “Pump 1 Running” pilot light
 - e. Green “Pump 2 Running” pilot light
 - f. Red “Pump 1 Failure” pilot light
 - g. Red “Pump 2 Failure” pilot light
 - h. Red “High Water” pilot light
 - i. Red “Low Water” pilot light
2. The float switch shall be a direct acting switch and contain a single pole non-mercury switch, which actuates when the longitudinal axis of the float is horizontal and deactuates when the liquid level falls 1” below the actuation elevation. The float shall have a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed non-mercury switch and the entire assembly shall be encapsulated to form a completely watertight and impact resistance unit. Float shall include a bracket for support pipe mounting. Provide the following float switches and control points:
- a. High Level Alarm – All Start
 - b. All Stop
- Backup float switches shall be set at one foot (1’) above normal level inputs from the level meter/controller. Float switches shall be set at levels per Project Engineer’s direction.
3. Provide input indicator and test module with improper input sequence indicator and controls (FT1-2), per Component Specifications, to interface with the float inputs. Controller shall be UL Recognized for use in industrial control panels. Device shall have the following indicators and controls.
- a. Four (5) LED indicators: One for each of the following Stop, Lead Start, Lag Start, High Level and Improper Sequence.
 - b. Four (4) “Test” pushbuttons to test each pump level control input.
 - c. One (1) “Reset” pushbutton.
4. Provide a Motor Monitor for each motor furnished (MM-1 and MM-2) and properly sized Current Transformers (CT), all per Component Specifications.

The Motor Monitor shall provide a positive run signal to the duplex pump controller, monitor proper motor running conditions, indicate motor running time, and indicate motor full load running amperes. A TRUE motor failure shall be generated from the motor monitor(s) and duplex pump controller. In addition, motor monitor shall come complete with either high or low amperes set point for the motor. In the event of low amperes, the motor shall be failed and not be allowed to operate until the failure is acknowledged. Contractor to supply motor monitoring equipment to pump control panel fabricator.

- G. DUPLEX ALARM TELEMETRY OPTION: Provide an Alarm Telemetry system for the Duplex Controller (DCAT), which provides auxiliary normally open relay contact outputs for the following duplex controller alarms: auxiliary alarm, improper sequence, Motor 1 Failure, Motor 2 Failure, Motor 1 Seal Failure, Motor 2 Seal Failure, and High Level. Provide the following features

1. The control circuitry shall be solid-state and contain an integral power supply with proper surge and over-current protection.
2. Provide an individual Normally Open, Dry-Contact output for each alarm that has a contact rating of 5 Amps @ 120 VAC, resistive.
3. Provide individual LED indicators for each output relay to show when each relay is energized.

- H. WETWELL LEVEL METER/CONTROLLER - MPCT-6 - Provide a Level Meter/Controller, (LMC1-2), per Component Specifications, to interface with wetwell submersible transducer. All control setpoints shall be field adjustable throughout the complete signal range from the front of the meter/controller. Setpoints shall be displayed on a digital readout at any time via pushbutton. The setpoints shall be field adjustable to operate on rising above or falling below the desired setpoint. The Level Meter/Controller shall be a standard, catalogued product of a water and wastewater automation equipment manufacturer regularly engaged in the design and manufacture of such equipment for a period of at least fifteen (15) years. The Level Meter/Controller shall receive an analog signal from the wet pit submersible pressure level transmitter. Back-up float switches shall be utilized in the event of a submersible pressure level transmitter failure and activate the common alarm light. The Level Meter/Controller shall provide OFF-ON set point controls for the Duplex Pump Controller (DC1-2).

1. High Level Alarm (Rising Level)
2. Lag Pump Start (Rising Level)
3. Lead Pump Start (Rising Level)
4. Pump(s) Stop (Falling Level)
5. Low Level Alarm (Falling Level)
6. Provide one (1) spare setpoint for future use.

In addition, provide a signal failure relay option with two relays, to energize when the transducer signal goes above 20mA or falls below 4mA. The relays can energize on both high/low conditions or one can energize on high failure (signal above 20mA)

and the other on low failure (signal loss). This failure alarm shall also energize a front panel flashing LED alarm indicator.

- I. ANALOG SIGNAL LINE FILTER: SP101 - Provide an analog signal Line Filter (LF-SPLT), per Component Specifications, for the level/meter controller. Line filter shall protect associated equipment from transient voltage surges and induced voltages.

- J. SCADA EQUIPMENT: Shall be provided by the system owner and factory installed before shipping to the contractor the telemetry system is manufactured by NIC Systems, Inc. Rocky Hill, CT and mounted on the back-plate of the Main Pump Station Cabinet, and be provided with the new pump controls with the necessary integration points for the transmission of the following:

1. Pump 1 Running
2. Pump 2 Running
3. Power Failure
4. Pump 1 Failure
5. Pump 2 Failure
6. Loss of control power
7. Wetwell High Level Alarm
8. Wetwell Low Level Alarm
9. Transducer Failure Alarm
10. Intrusion Alarm
11. Generator Running
12. Generator Failure
13. Generator Fuel Tank Low Level
14. Generator Fuel Tank Leak
15. Valve Vault High Level
16. ATS in Normal Position
17. ATS in Emergency Position
18. Analog 4-20ma Wetwell level input
19. Analog 4-20ma discharge pressure
20. Flow meter

- K. LIGHTING PANEL: Provide 20 circuit breaker panelboard with the following circuit breakers as on the drawing.

1. 20 Amp, 1 pole for control power
2. 20 Amp, 1 pole for cabinet lighting
3. 20 Amp, 1 pole for telemetry equipment
4. 20 Amp, 1 pole for generator block heater
5. 20 Amp, 1 pole for cabinet heat
6. 20 Amp, 1 pole for generator field receptacle
7. 20 Amp, 1 pole for cabinet receptacle
8. 20 Amp, 1 pole for valve vault
9. (12) 20 Amp, 1 pole for Spare

- L. AUTOMATIC TRANSFER SWITCH: The Automatic transfer switch shall be provided by the **Contractor** and shall be factory installed by the Main Pump Control Cabinet manufacturer for connection to all integration points and connections to the new SCADA equipment and the main power wiring of the 480v, 3 Phase power scheme, See Generator Specification Section.
- M. UTILITY POWER SERVICE MAIN CIRCUIT BREAKER: Provide and install a main circuit breaker as required by the utility service provider, in the location as required by the design.
- N. UTILITY MAIN POWER SERVICE METER: Provide and install as required by the utility service provider, in the location as required by the design.
- O. CONTROL POWER SURGE PROTECTOR: Provide a single phase, in-line (series) 120 volt, single-phase, 20A continuous power Surge Protection Device (SPD-2), per Component Specifications, designed to protect all of the loads fed from the control power circuit. Device shall have protection modes and protection status indication of each mode when power is present (L-N, L-G, N-G).

3.07 FIELD INSTRUMENTS AND CONTROLS

- A. GROUNDING: All electrical control panels shall be properly grounded per Division 16. The **Contractor** shall provide verified test reports of ground resistance.
 - 1. Certification that the materials and installation are in accordance with the drawings and specifications.
 - 2. Certification by the **Contractor** that the complete installation has been properly installed and tested.
- B. CONDUITS: ALL conduits entering each control panel shall be properly sealed, per plans, to ensure corrosive gasses; water/moisture does not enter into control panel. It is the responsibility of the **Contractor** to provide and install adequate conduit seals. It is recommended that re-enterable sealant compounds are used; equal to 3M Scotchcast 2112C or Alesko Epoxy Sealing Putty.
- C. SUBMERSIBLE PRESSURE/LEVEL TRANSMITTERS:

DWYER – SERIES – PBLT2
MODEL # PBLT2-15-100PU

Provide (2) units as part of the project, one unit as spare

Provide a solid-state direct submersible level sensor and transducer designed as pressure sensor for continuous, hydrostatic level measurement in open containers/basins. Transmitter shall have a high resistance to overload and aggressive media with a ceramic diaphragm and enclosed in 316L stainless steel housing. The range of the transmitter

shall be as required for the desired application with excitation voltage of 10 – 35V DC. Instrument cable shall be commercially available shielded instrument cable with a minimum of forty-foot (40') cable length. The transmitter shall be capable of being supported by its own cable. The electronics shall be completely potted and provide an analog output to drive a level meter controller. The output shall be 4 - 20mA. Pressure overload rating shall be at least 20 times the adjusted span. The transmitter shall be mounted near the bottom of the vessel with support bracket and be cable connected. Transmitter shall have approvals by: ATEX, FM, and CSA.

- D. SUBMERSIBLE PRESSURE/LEVEL TRANSMITTER INSTALLATION: The submersible pressure/level transmitter shall be field installed by the **Contractor**, per project engineer's direction. Transmitter shall be suspended six-inches (6") above the bottom of the wetwell. The **Contractor** shall provide and install 6" PVC (length as required for wetwell) with ½" holes drilled thru pipe every six-inches (6") throughout the entire length of pipe. PVC pipe shall be connected or anchored to the wetwell if possible. Existing wetwell(s) may not allow for PVC pipe installation.

Note:

GNHWPCA requires a SS cable to be mounted to the PLT for use to pull the unit without damage to the cable of the unit, and be connected at surface of the wetwell with a SS hanger bracket.

- E. PRESSURE TRANSMITTER FIELD SIGNAL INDICATOR DEVICE- The Pressure Transmitter signal indicator device shall integrate with (F) below and shall be factory installed by the Main Pump Control Cabinet manufacturer for connection to the integration points and connections to the new SCADA equipment.

ROSEMOUNT – SERIES 754
0-60psi
MODEL #754AM4NAB

- F. PRESSURE TRANSMITTER DEVICE - The Pressure Transmitter device shall be field installed by the **Contractor**, per project engineer's direction and the transmitter shall transmit a signal to the Main Pump Control Cabinet for connection to the Pressure Transmitter field signal indicator device provided with the new pump controls with the necessary integration points for the transmission connections to the new SCADA equipment.

ROSEMOUNT – SERIES 2088
0-60 psi
MODEL # 2088G2S22A1M4Q4Q4S1

Note:

There are piping requirements to the forcemain by the engineer, see detail drawing for installation, piping and fittings are not provided with the device.

- G. PRESSURE GAUGE ASSEMBLIES:

1. Each pump assembly shall be provided with a complete pressure gauge assembly on both the inlet and discharge of the unit, regardless of whether they are shown on the drawings or not. Pressure gauge assemblies shall be provided as shown on the Contract Drawings.
2. Gauges shall incorporate minimum 4-inch dials with 304 stainless steel case and crimped ring with vent plug, acrylic window, glycerin filled, ½-inch NPT 316 stainless steel connection lower mount and bourdon tube, ASME B40.1 Grade 1A +/- 1.0% accuracy full scale, white dial with black print, black pointer, 0 to 60 PSI range (oil filled) for pump discharge gauges, and 0-30 inches vacuum/0-30 psi pressure combination gauges for the pump suction gauges. Gauges shall be as manufactured by Wika, model 40-213.53-2L or equivalent.
3. Gauges shall be mounted to diaphragm seal, with silicone fill between instrument and seal. All gauge assemblies shall be pressure tested and calibrated. Seals shall be Zavoda W516-03SS diaphragm seal, clean out design, ¼-inch NPT plated steel instrument housing, ½-inch NPT 316 stainless steel process housing, 316 stainless steel welded diaphragm element, ¼-inch NPT flushing connection, silicone fill.

H. FLOWMETER DEVICE WITH REMOTE TRANSMITTER: The flowmeter device shall be field installed by the Contractor, per project engineer's direction and the transmitter shall be mounted on the back plate of the Main Pump Control Cabinet, and provided with the new pump controls with the necessary integration points for the transmission connections to the new SCADA equipment.

ROSEMOUNT – SERIES 8750W
 4" flanged
 MODEL # 8750WFMW1A1NP8A060CA1M4G1R10

I. AUXILIARY BACKUP FLOAT SWITCHES: Provide a backup float control system to operate the pumps in the event of a Submersible Pressure/Level Transmitter failure for each pump station. If the high-level float is engaged, all pumps shall operate @ 100% until the stop float is engaged. In addition, provide Low Level Stop float. Backup float switches shall be set at one foot (1') above normal level inputs from the programmable logic controller. Programmable logic controller shall ramp the pump(s) up to full speed while operating on backup float control system. Ramp time shall be field set at project start-up. Normal operating levels shall be set per Project Engineers direction. The float switch shall be a direct acting switch and contain a single pole non-mercury switch, which actuates when the longitudinal axis of the float is horizontal and deactuates when the liquid level falls 1" below the actuation elevation. The float shall have a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed non-mercury switch and the entire assembly shall be encapsulated to form a completely watertight and impact resistance unit. Float shall include a bracket for support pipe mounting.

Note:

GNHWPCA requires a SS chain with anchor weight for use with these floats to pull

the unit without damage to the cable of the unit, and be connected at surface of the wetwell with a SS hanger bracket.

- J. JUNCTION BOX AND ANALOG SIGNAL LINE FILTER (Where Required): Provide and install a properly sized NEMA 4 rated junction box, suited for outdoor/wet locations, complete with an analog signal Line Filter (LF), per Component Specifications, for the wetwell pressure/level transmitter. Junction shall have a 1/8" drain/breather hole installed in the bottom of the enclosure. Line filter shall protect associated equipment from transient voltage surges and induced voltages. Junction box shall be field installed by the **Contractor** in close proximity of the submersible pressure level transmitter. The **Contractor** shall be responsible for properly sealing the conduits entering junction box.
- 3.08 SERVICE ENTRANCE SURGE PROTECTION DEVICE: The Surge Protection Device shall be mounted in the control panel(s) adjacent to the Main Breaker. The SPD is connected to the main bus in the panel with conductors of size and of no greater length than indicated in the Surge Protection Device manufacturer's installation instructions. SPD shall be a Type 2 device ideal for distribution panels, branch panels and critical loads.
- A. SPD shall provide transient voltage surge suppression and electrical high frequency noise filtering. Unit is designed for parallel connection to the main bus. SPD unit uses selenium cells and metal oxide varistors to achieve its performance. Products using gas tubes, spark gaps, silicon avalanche diodes or other components, which under failed conditions would cause system failure, are not acceptable.
- B. Manufacturer qualifications: The product of a manufacturer engaged in the commercial design and manufacture of the type of product described herein for a minimum five (5) years.
- C. Standards: Product complies with the requirements of the following:
1. CUL
 2. CE Compliant
 3. UL 1449 3rd Edition
 4. UL 1283 Listed
 5. NEMA LS1 Compliance
- D. Operating Voltage: 120/208 volts, 1-phase, 3-wire + ground
480 volts, 3-phase, 4-wire + ground
- E. Maximum Continuous Operating Voltage (MCOV): greater than 115 percent of nominal voltage for all products. All suppression filter systems comply with NEMA LS 1.
- F. Frequency: Operating frequency range of 47 – 64 Hertz.
- G. Protection Modes: all phases – phase to ground; all phases – phase to neutral; all phases – phase to phase; and neutral to ground.

H. Rated Single Pulse Surge Current Capacity: at rated voltage, no less than:

120,000 A Line to Line
60,000 A Line to Neutral
60,000 A Line to Ground
60,000 A Neutral to Ground

I. Tested Single Pulse Surge Current Capacity: Filter system is designed to withstand a single pulse surge current up to 150 percent of the design rating and tested at an independent test laboratory. In the absence of testing facilities capable of such testing, testing of individual components or sub-assemblies within a mode is accepted by ANSI C62.41-1991; the testing includes a Category C1 surge test followed by a second Category C1 test. The test results demonstrate the unit does not degrade by more than 10 percent from the initial test.

J. Clamping Voltage: Suppression filter system clamping voltages are in compliance NEMA LS1-1992.

K. High Frequency Filter: EMI-RFI noise rejection or attenuation values comply with test and evaluation procedures of NEMA LS1-1992.

L. Overcurrent Protection: Unit includes coordinated UL 489 or UL 198 listed or recognized overcurrent protection devices; if fuses are used unit incorporates non-encapsulated, field replaceable fuses.

M. Documentation: Provide product data including equipment manual, electrical and mechanical drawings indicated dimensions weights, mounting provisions, connection details and layout diagram, certified tests of UL1449 Listing/Clamp Voltages and NEMA LS1 compliance, certified single pulse surge current capacity testing, and minimum repetitive surge current capacity testing.

N. Status Indicators: Unit has long-life, solid state, externally visible status indicators that monitor the on-line status of each phase of the unit.

O. Warranty: 15-years Unlimited Free Replacement for service entrance Surge Protection Device.

P. Service entrance Surge Protection Device system shall be equal to Surge Suppression Inc. model SSMA121S1 or SSMA123S1 for service entrance.

TAG
SPD-1

SERVICE
Service Entrance Surge Protection Device

3.09 PHASE FAILURE/UNBALANCE/UNDER VOLTAGE/REVERSAL RELAY: Phase monitor shall be designed to protect 3-phase motors regardless of size and for use with 200 – 240 or 425 – 485 VAC, 50 to 60 Hz motors to prevent damage. The unit shall constantly

monitors the three phase voltages to detect harmful power line conditions, caused by single phasing, low voltage, phase reversal and voltage unbalance. When a harmful condition is detected, an output relay is deactivated after a trip delay. The output relay shall reactivate after power line conditions return to an acceptable level for the specified Restart Delay. The trip delay shall prevent nuisance tripping due to rapidly fluctuating power line conditions. Phase monitor shall have the following features and functions.

- A. Under Voltage:
Trip: -15% of setting for 230V (-10% for 480V)
Reset: -12% of setting for 230V (-8% for 480V)
- B. Over Voltage:
Trip: -15% of setting for 230V (-10% for 480V)
Reset: -12% of setting for 230V (-8% for 480V)
- C. Phase Unbalance:
Trip: 7% with 5 second trip delay
15% with 1 second trip delay
Reset: 6%
- D. Trip Delay: 5 seconds (delay is reduced to 1 second if Phase Unbalance is 15% or greater)
- E. Reset Delay: 2 seconds standard (5-60 seconds optional)
- F. Voltage Range: 200V to 240V or 425V to 525V
- G. Output Rating: 10A resistive @ 480V AC
6A resistive @ 480V AC
- H. Operating Temp: -40°C to +50°C, -38°F to +122°F
- I. Storage Temp: -45°C to +85°C, -47°F to +185°F
- J. Enclosure: Lexan, surface mount
- K. UL and cUL listed

TAG

PM

SERVICE

Electrical System Power Monitor

- 3.10 CONTROL POWER SURGE PROTECTION DEVICE (SPD): The surge protection device shall be mounted in the control panel in series with the control power circuit. Provide a single-phase, in-line series AC power line surge protector with the following features:

- A. Rated voltage shall be 120 VAC @ 60Hz.
- B. Current rating shall be 20 Amps @ 40°C.
- C. The protection circuitry shall automatically reset after the transient has passed.
- D. Protection modes shall be: Line to Neutral, Line to Ground, and Neutral to Ground.
- E. Provide three (3) Green LED indicators to indicate protection status of each mode when power is present (L-N, L-G, N-G).
- F. Varistors with integral thermally activated elements shall be used to open in the event of overheating due to the abnormal overvoltage, limited current conditions outlined in UL1449. The lower inductance of the varistors shall result in improved clamping performance to fast overvoltage transients.
- G. Metal Oxide Varistors (MOV) shall have cured, flame retardant epoxy polymer coating meeting UL94V-0 requirements.

- H. Electromagnetic Interference (EMI) filtration shall be incorporated into the unit to dampen unwanted signals from the protected side of the unit.
- I. Operating temperature shall be -40 to +70°C.
- J. Screw terminals shall be provided for all wiring.
- K. Maximum continuous operating VAC shall be 115% of rated line voltage.

TAG
SPD-2

SERVICE
Control Power Surge Protection Device

3.11 DUPLEX PUMP CONTROLLER: DC101-F - Provide a Duplex Pump Controller including the following features.

- A. OPERATORS AND FRONT PANEL INDICATORS (for each pump)
 - 1. Manual-Off-Automatic selector switch
 - 2. Green "Pump Running" pilot light
 - 3. Red "Pump Failure" pilot light
 - 4. Red "Pump Seal Failure" pilot light (if required)
- B. A Pump NO. 1 LEAD – ALTERNATE – Pump NO. 2 LEAD sequence selector switch to select either pump as lead pump or to select that the pumps alternate as lead pump on each call for cycle.
- C. Signal inputs for stop, lead pump start, lag pump start, and high/low alarm. The sensors shall be optically isolated and operate on 24V DC with a maximum current of 16mA for intrinsic safety.
- D. Pilot light indicators for each signal input described above, as well as, Pump No. 1 and No. 2 running inputs.
- E. The controller shall operate a pump based upon various combinations of signal inputs. Normal operation shall operate pumps in the following automatic sequence:

With no signal inputs activated and both pumps off, a stop input activation shall not cause a pump to operate. With a stop input activated and a lead start input activated, the controller shall start a single pump that pump shall operate until the lead start and stop inputs are deactivated. With both the stop and lead start inputs activated and one pump operating, a lag start input being activated shall operate the second pump. Both pumps shall operate until the lag start, lead start, and stop inputs are deactivated.

In the event an input device(s) fails to activate the controller shall operate as follows:

With a stop input device failure, the controller shall operate a single pump based upon the status of the lead start input and a field adjustable short cycle delay. The short cycle delay shall keep the pump operating after the start input deactivates for the delay time setting. If the stop input device fails to activate, the controller shall

operate one pump as described above with the lag start input starting the second pump. Both pumps shall operate until both start inputs are deactivated and the individual pump short cycle delays have expired. In the event both the stop and lead start inputs fail to operate, the controller shall operate both pumps based upon the status of the lag start input and the individual pump short cycle delay timers. Both pumps shall operate until the lag start input is deactivated and the individual pump short cycle delays have expired. If all input devices fail except the high/low alarm input, the controller shall operate both pumps based upon the status of the high/low alarm input and the individual pump short cycle delay timers. Both pumps shall operate until the high/low alarm input is deactivated and the individual pump short cycle delays have expired.

- F. A field adjustable failure time delay for each pump, in the range of 5 seconds to 62 minutes, to start the lag pump at the lead pump start point if the lead pump fails or if the lead pump selector switch is placed in the off position. If a pump fails, the remaining functional pump shall remain the lead pump on future cycles. The failed pump shall only be called to operate at the lag pump operating point. Normal pump alternation shall resume when the failure condition is corrected and the pump has been reset.
- G. Individual field adjustable time controls to delay starting each pump in the automatic mode after power failure or during initial startup.
- H. Pump failure, pump seal failure, and high/low alarm red pilot lights shall flash when activated. Provide field selectable controls to allow the seal failure indicator to burn steady when activated.
- I. Manual override inputs for each pump, which can be used to manually override the duplex controls, pump outputs when the controls are in the Automatic mode. Inputs shall be provided to start or stop each pump from a remote location.
- J. Provide a selectable improper sequence alarm to activate the common alarm in the event the control inputs are activated in the wrong order. The proper order shall be Stop, Lead Start, and Lag Start. The High water alarm shall not be included in the improper sequence test. Provide a selectable Lag Stop Level control to allow the lag pump to stop based upon the status of the lead start level input.
- K. Provide automatic pump alternation on pump failure and seal failure when a failure condition is detected and the pumps are in the automatic mode. The failed pump shall be made the lag pump on future cycles until the failure condition is corrected. Pump failure shall require manual reset to clear the failure condition and the seal failure condition shall clear when the failure condition clears. Provide field selectable controls to allow the seal failure condition to not automatically alternate the pumps.

TAG
DC1-2

SERVICE
Pump No. 1 and No. 2 Duplex Controller

3.12 DUPLEX ALARM TELEMETRY OPTION: DCAT - Provide an Alarm Telemetry system for the Duplex Controller, which provides auxiliary normally open relay contact outputs for the following duplex controller alarms: auxiliary alarm, improper sequence, Motor 1 Failure, Motor 2 Failure, Motor 1 Seal Failure, Motor 2 Seal Failure and High Level. Provide the following features for the DCAT system.

- A. The control circuitry shall be solid-state and contain an integral power supply with proper surge and over-current protection.
- B. Provide an individual Normally Open, Dry-Contact output for each alarm that has a contact rating of 5 Amps @ 120 VAC, resistive.
- C. Provide individual LED indicators for each output relay to show when each relay is energized.

TAG
DCAT

SERVICE
Duplex Alarm Telemetry System

3.13 FLOAT TEST: FT101 - Provide input indicator and test module with improper input sequence indicator and controls. The following controls and equipment shall be supplied.

- A. Four deadfront panel mounted input pilot light indicators: One for each of the following level control points Stop, Lead Start, Lag Start and High Level alarm.
- B. Four deadfront panel mounted pushbuttons to test each pump level control input.
- C. Automatic input sequence monitoring, such that if the inputs do not occur in proper order (stop, lead start and lag start); a red pilot light indicator shall be activated.
- D. If stop input fails, followed by lead input activation, lead pump shall operate and continue until lead pump input is removed and a field adjustable time delay has expired.
- E. If stop input fails, followed by lead and lag input activation, both motors shall operate and continue until their respective input is removed and an individual field adjustable time delay for each pump has expired.
- F. If stop, lead and lag inputs fail, followed by high level input activation, both motors shall operate and continue until the high level input is removed and a field adjustable time delay for each pump has expired.
- G. Improper sequence activation shall also activate the common external alarm controls.
- H. Improper sequence alarm shall require reset button activation to remove the alarm light.

TAG
FT1-2

SERVICE
Float Indication and Test Module

3.14 MOTOR MONITOR: MM101 - Provide an electronic solid state Motor Monitor powered by 120 volt AC that will accept a zero (0) to five (5) amp input signal condition the signal to perform ON/OFF or OPEN/CLOSE discrete dry type setpoint contact conditions based on the input signal value. The Motor Monitor shall have the following features.

- A. Provide an LCD readout meter providing field adjustable scales of 0-25.0, 0-50.0, 0-100.0, 0-250, 0-500 and 0-1000 to accurately indicate the motor full load current using the 0-5 amp input signal.
- B. The Monitor shall be capable of displaying motor total running time up to 99,999.9 hours and be provided with reset capability from the rear of the monitor. The display shall include a non-volatile EEPROM memory backup that does not require battery backup during power failure.
- C. Provide two (2) separate field adjustable setpoints, each with discrete, isolated sealed SPDT relay output contacts. The setting of each setpoint shall be adjustable throughout the complete signal range from the front of the Monitor. Each set point shall be provided with a field adjustable "ON" and "OFF" time delay, adjustable from zero (0) to fifteen (15) seconds. The actual setting of each setpoint shall be able to be displayed on the LCD readout at any time. An LED indicator shall be provided for each setpoint and shall operate as follows:
 - 1. Setpoint No. 1. When setpoint is timing, the indicator shall burn amber. After timing period and current is at or above setpoint, indicator shall burn green.
 - 2. Setpoint No. 2. When set point is timing, the indicator shall burn amber. After set timing period and current is at or above setpoint, indicator shall burn red.

TAG
MM-1
MM-2

SERVICE
Pump No. 1 Motor Monitor
Pump No. 2 Motor Monitor

3.15 CURRENT TRANSFORMER: Current transformers insulation class shall be 0.6 KV BIL, 10 KV Full Wave. They shall be manufactured to meet the requirements of UL1244 and have a minimum accuracy of 60Hz of 2%. Current transformers shall be provided with brass stud terminals and mounting bracket.

3.16 FLOAT SWITCHES: The float switch shall be a direct acting switch and contain a single pole non-mercury switch, which actuates when the longitudinal axis of the float is horizontal and de-actuates when the liquid level falls 1" below the actuation elevation. The float shall have a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed non-

mercury switch and the entire assembly shall be encapsulated to form a completely watertight and impact resistance unit. Float shall include a bracket for support pipe mounting.

TAG
F

SERVICE
Wetwell Float Switches

- 3.17 CONTROL RELAYS: Provide a SnapTrack channel mounted relay board with LED status indicator and individual quick-connect terminals. The SnapTrack can be optionally snapped to a DIN rail. The indicator LED shall turn on when the relay is energized. The terminals shall be of the fixed screw cage clamp type, rated for at least 10 amps at 250 Volts. Tubular screw clamp types will not be accepted. The relay shall be rated for 10 amps. Surge suppression shall be provided on the coil side of the relay. The board shall include built-in transient protection across the coil. DC powered versions shall include a built-in diode across the coil to protect external devices from coil surges. The relay and connectors shall be UL approved.

TAG
CR

SERVICE
Misc. Control Relay

- 3.18 SUBMERSIBLE PRESSURE/LEVEL TRANSMITTER: DWYER PBLT-2 Series, Provide a solid-state direct submersible level sensor and transducer designed as pressure sensor for continuous, hydrostatic level measurement in open containers/basins. Transmitter shall have a high resistance to overload and aggressive media with a ceramic diaphragm and enclosed in 316L stainless steel housing. The range of the transmitter shall be as required for the desired application with excitation voltage of 10 - 35V DC. Instrument cable shall be commercially available shielded instrument cable with a minimum of forty-foot (40') cable length. The transmitter shall be capable of being supported by its own cable. The electronics shall be completely potted and provide an analog output to drive a level meter controller. The output shall be 4-20mA. The operating temperature shall be -20 to +70°C (-4 to +158°F) and the accuracy shall be $\pm 0.2\%$ full scale. Pressure overload rating shall be 40 times the adjusted span. Long term drift shall be $\pm 0.1\%$ full scale per year. The transmitter shall be mounted near the bottom of the vessel with support bracket and be cable connected. Transmitter shall have approvals by: ATEX, FM, and CSA.

TAG
LT-1

SERVICE
Wet Pit Level Transmitter

SCALE
0- 35 feet

- 3.19 LEVEL METER/CONTROLLER: MPCT-6 - Provide an electronic, solid-state, proportional Level Meter/Controller that will accept a four (4) to twenty (20) mA or a one (1) to five (5) volt DC signal. In addition, condition the signal to provide a valid basis for control and then perform ON/OFF or OPEN/CLOSE discrete dry type set point contact conditions based on the input value of the analog input signal. The Level Meter/Controller shall have the following features.

- A. Provided with a 3.5 digit LED (or LCD if required) readout meter in feet of water. The display shall be capable of being calibrated from the front of the unit and have a maximum display of 1999, with a decimal point that is user selectable.

- B. The display zero indication shall be able to be offset anywhere within the range of the meter, with a minimum range of 60 counts.
- C. Provide six (6) separate setpoints each with discrete, isolated sealed SPDT relay output contacts.
- D. Provide excitation voltage to drive a transducer/transmitter and condition its output signal to provide a continuous display of level.
- E. The setpoints shall be field adjustable to operate on rising above or falling below the setpoint.
- F. An LED indicator shall be provided for each setpoint to indicate when it is activated.
- G. The actual setting of each setpoint shall be able to be displayed on the digital readout at any time.
- H. The setting of each setpoint shall be adjustable throughout the complete signal range from the front of the meter/controller.
- I. Provide a means of manually ramping the meter/controller, up and down, throughout its complete signal range, to test the operation of the setpoints.
- J. The meter/controller shall come complete with a four (4) to twenty (20) mA, or a one (1) to five (5) volt DC output signal for additional monitoring and control devices.
- K. Provide a signal failure relay option with two relays, to energize when the input signal goes above 20 mA or below 4 mA. The relays can energize on both high/low conditions or one can energize on high failure and the other on low failure. In addition, either relay may be set to 'flash' on and off during the failure condition. This failure alarm shall also energize a front panel flashing LED alarm indicator.

TAG

LMC1-2

SERVICE

Wet Pit Level Meter/Controller

- 3.20 ANALOG SIGNAL LINE FILTER: Provide a analog signal line filter with a fast-acting design to protect data and communications equipment from transient voltage surges and induced voltages. The filter shall be a low-impedance, two-stage hybrid design with a first stage consisting of a heavy-duty energy handling gas discharge tube having a breakdown voltage rating between 200 and 350 volts. Impulse breakdown at 100 volts per microsecond shall equal 600 volts. A filter capacitor shall be connected across the lines, rated a 1kv. The second stage shall consist of two current limiting resistors, a fast-acting solid-state transient voltage surge absorber from each line to ground to protect each line up to a maximum continuous voltage of 30V AC or 38V DC with a 50-nanosecond response time. In addition, a separate bi-directional transient voltage surge absorber rated at 1500W @ 33V DC, which is connected across the two lines, for maximum protection. Integral wiring terminal blocks shall be included for both line and equipment sides of the filter. The filter shall be mountable directly on the panel backplate or be able to use track mounting if required.

TAG

LF-SPLT

SERVICE

Analog Signal Line Filter

--- END OF SECTION ---

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

SECTION 15110

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish and install valves and appurtenances as indicated on the drawings and in the specifications and as herein specified, including all labor, material, equipment and incidentals required.

1.02 RELATED WORK (NOT USED)

1.03 QUALITY ASSURANCE:

- A. Insofar as possible, valves shall be the product of one manufacturer who has had long experience in the design of valves and whose products have proven reliable in service in similar installations over a reasonable period of years. The valves shall be designed so that parts subjected to wear may be easily replaced and shall be constructed of wear-resistant materials.

1.04 REFERENCES:

- A. The following standards form a part of this specification, as referenced:

American National Standards Institute (ANSI)

ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 125.

ANSI B16.10 Standard Face-to-Face and End-to-End Dimensions of Ferrous Valves.

American Water Works Associations (AWWA)

AWWA C500 Gate Valves for Ordinary Water Works Service.

Federal Specifications (FS)

FS	WW-V-54C	Amendment 1, Type I or II, Class A for Valve Gate, Bronze (125, 150 and 200 lb., Screwed, Flanged Solder - End, for Land Use).
FS	WW-V-51D	Valve, Bronze, Angle, Check and Globe 125, 150 and 200 Pound Screwed, Flanged or Solder-End (For Land Use)
FS	WW-V-35C	Valve, Ball
FS	TT-V-51F	Varnish, Asphalt

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Submit to the Engineer for review, six (6) sets of complete shop drawings plus operating and maintenance instructions for each item furnished.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All hand wheels, operating nuts and key stops shall be turned counterclockwise to open the valves. Handwheels shall be of ample size and shall have an arrow and the word "open" cast thereon to indicate the direction of opening.
- B. Valves to be buried shall be designed for buried service and shall be provided with gate boxes and tee handle operating wrenches in the number and lengths necessary to permit operation of all valves by operator of average height, working in normal standing positions. At least two (2) of each type, size and length of wrench shall be provided, unless otherwise stated below. Operating nuts for use with tee handle operating wrenches shall be 2-inches square, and conform to the appropriate AWWA Standard.
- C. Where indicated on the drawings or necessary due to location, size, or inaccessibility, geared or chain wheel operators shall be furnished with the valves. Such operators shall be designed to have adequate strength for use with the valves with which they are supplied.
- D. As indicated on the drawings, certain valves or gates require floorstands and/or bench-stands.
- E. Unless otherwise specified in the specifications or on the drawings, all flanged valves shall conform to ASA Specification B16.1 and ANSI Specification B16.10.
- F. It shall be the Contractor's responsibility to make the valve or gate manufacturer aware of the type of service to which the valve or gate will be subjected and the nature of the

materials (i.e. sewage, sludge, chemicals, etc.) which it will handle, and to make sure that all materials used in the manufacture of the valve or gate are suitable for the use intended.

- G. All anchor bolts and embedded items for complete installation or mounting, holding down or supporting of equipment to be furnished under this section, including necessary location drawings and templates required to install the items in concrete, masonry, etc., shall be furnished and delivered to the site by the manufacturer of the equipment furnished under this section, for installation under other sections of these specifications. Delivery of the items shall be as required by the overall construction schedule.
- H. These specifications direct attention to certain features but do not purport to cover all details entering into the design of the equipment. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness, and to be especially adapted for the work done.

2.02 AIR CUSHIONED SWING CHECK VALVES:

- A. Unless otherwise specified, all check valves 3-inches and larger shall be 175 lb. W.O.G., flanged, iron body, air cushioned swing type, check valves with bolted covers and equipped with levers and counter-weights. The valve body shall be cast iron per AWWA C508 having integral (not wafer) flanges. The seat shall be centrifugally cast with an O-ring seal and shall be locked in place with stainless steel lock screws and be field replaceable without the use of special tools. The shaft shall be single and continuous stainless steel, extending both sides of the body with a lever and weight, using an air cushion cylinder side mounted.
- B. The air cushion cylinder shall be constructed of corrosion-resistant material and the piston shall be totally enclosed within the cylinder and not open at one end. The cushion cylinder assembly shall be externally attached to either or both sides of the valve body and shall permit adjustability to cushion the closure of the valve. Cushioning shall be air trapped in the cushion cylinder which shall be fitted with a one way adjustable control check valve to cushion disc contact to the seat at the shut-off point. The bottom cylinder head shall be swivel mounted and not rigid to follow the change of force angles as the lever raises or lowers to open or close the check valve.
- C. The check valve shall prevent backflow of the media on normal pump shut-off or power failure, and shall be water tight. The disc shall be cast iron utilizing a double clevis connected to a ductile iron disc arm.
- D. The valve component materials of construction and ASTM certifications shall be as follows:

<u>Component</u>	<u>Materials of Construction</u>	<u>ASTM Specification</u>
Body, Cover, Disc	Cast Iron	ASTM A126 GR.B
Disc Arm	Ductile Iron	ASTM A536
Seat	Stainless Steel	ASTM A276
Disc seat	Buna-N or Metal	To suit
Cylinder	Corrosion-Resistant Material	Commercial

- E. Check valves shall be manufactured by M & H Valve and Fittings Co., Anniston, AL; Clow Valve Co., Bensenville, IL; or DeZurik, Inc. Sartell, MN.

2.03 PLUG VALVES:

- A. Plug valves shall be of the non-lubricated rectangular port, eccentric type with neoprene faced plugs and shall be furnished with flanged joint ends. Flanged valves shall be faced and drilled to ANSI B 16.1 Class 125. Valve bodies and plugs shall be made of ASTM A 126, Class B cast-iron. All exposed nuts, bolts, springs, washers, etc., shall be zinc plated. Resilient plug facings shall be neoprene suitable for use with sewage. Valves shall be furnished with corrosion resistant seats, which comply with AWWA Standard C507 and with AWWA Standard C504. Valve shaft seals shall comply with AWWA Standard C507, and with AWWA C504 and shall be replaceable without valve or gear disassembly.
- B. Valves shall provide drip-tight shut-off up to the full pressure rating.
- C. All valves shall be hydrostatically pressure tested at 175 psi by the manufacturer.
- D. All valves shall be 100% full port design.
- E. All valves shall be provided with gear actuators and either handwheels or chainwheels, depending upon the mounting height. All valves mounted at six (6) feet or higher above the floor shall be provided with gear actuators and chainwheels. All gear actuators shall be provided with an indicator plate, which shall indicate valve position throughout the operating range. An adjustable stop shall be provided to provide field adjustment of closure.
- F. Where indicated on the Contract Drawings or requested by the Engineer, plug valves shall be furnished with bevel gear nut actuators for use with a hand-held electric driver specified elsewhere.
- G. Where indicated on the Contract Drawings or requested by the Engineer, plug valves shall include a valve stem extension constructed of painted steel. Valve stem extensions shall be of the length required as indicated on the Contract Drawings. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the

installing contractor. Valve stem extensions shall be suitable for use with the valve actuators specified herein.

- H. Plug valves shall be as manufactured by DeZurik Water Controls, Sartell, MN; Clow Valve Company, Oskaloosa, IA, Kennedy Valve, Elmira, NY, or approved equal.
- I. Plug valves in horizontal pipelines shall be installed with shaft in horizontal position so that with valve in open position the plug is located in the upper part of the valve body. The valves shall be oriented so that with valve in closed position; the plug is at the upstream end of the valve.

2.04 HANGERS AND SUPPORTS

- A. The Contractor shall furnish and install all supporting devices necessary or required to support all valves and appurtenances in a safe, firm and substantial manner at the locations indicated or as required in a manner to prevent the loads of valves and appurtenances from being carried on pumps, pipes or other equipment.
- B. Install hangers and supporting devices necessary or required to hold all valves and appurtenances in a safe, firm and substantial manner at the positions indicated or as required and in a manner to prevent the loads of valves and appurtenances from being carried on pumps or other equipment.
- C. All valves shall be furnished with a stainless-steel saddle support for installation. The flange of the saddle support shall have a drilling conforming to ANSI B16.1 Class 125/ANSI B16.5 Class 150 standards. The saddle support shall be inserted into the valve sleeve during installation. The sleeve shall be fastened to the valve body with the flange of the saddle support.

2.05 SHOP PAINTING:

- A. Before exposure to the weather and after thorough cleaning to remove all rust, dirt, grease and other foreign matter, the valves, floor stands, and appurtenances shall be painted in the shop as specified below.
- B. Ferrous surfaces which will be submerged shall be cleaned by sandblasting to remove all foreign matter.
- C. Interior surfaces of all valves, the exterior surfaces of buried or submerged valves and gates, and miscellaneous piping appurtenances shall be given a shop finish of an asphalt varnish conforming to Federal Specification TT-V-51c, for Varnish, Asphalt.
- D. After thorough cleaning, exterior surfaces of various parts of valves and miscellaneous piping appurtenances exposed within the building shall be given one shop coat of an

approved rust-inhibitive primer compatible with the field coats and applied in accordance with the instructions of the paint manufacturer.

- E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

PART 3 - EXECUTION

3.01 INSTALLATION:

All valves shall be carefully erected and supported in their respective positions free from all distortion and strain. Care shall be taken to prevent damage or injury to the valves or appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

3.02 FIELD PAINTING:

Field painting of valves shall be in accordance with Section 09900, PAINTING.

END OF SECTION

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Specifications\Div 15\15110 - Process Valves for Sewer.docx

SECTION 15140

PROCESS PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers furnishing, laying, jointing, and testing of process pipe within the pump station, including fittings, special castings and appurtenant work, as indicated on the drawings and as specified.

1.02 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured.
- B. The Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.03 REFERENCES:

The following standards form a part of this specification and indicate the minimum standards required:

American National Standards Institute (ANSI)

ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

ANSI A21.10 Ductile-Iron and Gray-Iron Fittings, 3-inches through 48-inches, for Water and Other Liquids

ANSI A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

ANSI A21.15 Flanged Ductile-Iron Pipe with Threaded Flanges

ANSI A21.50 Thickness Design of Ductile-Iron Pipe

ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal or Sand-Lined Molds for Water or Other Liquids

ANSI A21.53 Ductile-Iron Compact Fittings, 3 inch Through 16 inch., for Water and Other Liquids.

American Water Works Association (AWWA)

AWWA C606 Standard for Grooved and Shouldered Joints

AWWA C651 Standard for Disinfecting Water Mains

American Society for Testing and Materials (ASTM)

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless

ASTM A307 Low-Carbon Steel, Externally and Internally Threaded Standard Fasteners

1.04 SUBMITTALS:

- A. Submit shop drawings and product data as specified in the General Conditions and Section 01330 of the Contract Documents.
- B. Pipe support design calculations stamped and approved by a Professional Engineer registered in the state of Connecticut.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE:

- A. All ductile iron pipe shall be designed in accordance with ANSI A21.50 and shall be manufactured in accordance with ANSI A21.51.
- B. Pipe for use with sleeve type couplings shall be as specified above except that the ends shall be plain (without bells or heads). The ends shall be cast or machined at right angles to the axis.
- C. Pipe for use with grooved type couplings shall have ends grooved in accordance with AWWA C606.
- D. Pipe thickness class, unless otherwise indicated:
 - 1. Minimum thickness class shall be Class 53 for use with threaded flanges.
 - 2. For grooved couplings, minimum thickness class shall be Class 53 for pipe smaller than 18-inches and Class 56 for pipe 18-inches and larger.
- E. Machined surfaces shall be cleaned and coated with a suitable rust-preventative coating at the shop immediately after being machined.
- F. The inside of pipe and fittings shall be given a cement lining and bituminous seal coat in accordance with ANSI A21.4. The thickness of lining shall be double that specified in the

above referenced specification.

- G. The outside of pipe and fittings within structures shall not be coated with the bituminous coating, but shall be thoroughly cleaned as recommended by the coating manufacturer and given one shop coat of 69-1211 H.B. Epoxoline II primer made by Tnemec Company, Inc.; Multiprime made by Pittsburgh Plate Glass Co., Pittsburgh, PA; Recoatable Epoxy Primer B67H5/R5 made by Sherwin-Williams Company; or an approved equal product.

2.02 JOINTS:

- A. Flanged joints shall conform to ANSI A21.15 except that special drilling or tapping shall be provided as necessary to ensure correct alignment and bolting.
- B. Flanged pipe shall use long-hub flanges which shall be screwed tight at the foundry by machine before they are faced and drilled.

2.03 FITTINGS:

- A. Fittings shall conform to the requirements of ANSI A21.10 and shall be of a pressure classification at least equal to that of the pipe with which they are used.
- B. Flanged fittings shall be faced and drilled in accordance with ANSI A21.10 except that special drilling or tapping shall be provided as necessary to ensure correct alignment and bolting.
- C. Provide ductile-iron grooved end fittings conforming to ANSI A21.10 for center-to-face dimensions.
 - 1. End preparation for grooved-ends conforming to AWWA C606 for flexible or rigid joints as required by type of joint.
 - 2. Minimum wall thickness of grooved fittings 12-inch and smaller conforming to ANSI A21.53.
 - 3. Minimum wall thickness of grooved fittings larger than 12-inch conforming to ANSI A21.10.
- D. Fittings shall be provided with standard bosses where so indicated.

2.04 SLEEVE TYPE COUPLINGS:

- A. To ensure correct fitting of pipe and couplings, all flexible couplings and accessories shall be furnished by the supplier of the pipe and shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.
- B. Flexible couplings shall be Style 38 by Dresser Mfg. Div., Bradford, PA; Style 441 Smith-Blair, Inc., San Francisco, CA; R.H. Baker & Co., Inc., Huntington Park, CA; Clow

Corporation, Rochester, NY; or approved equal products.

- C. All couplings shall be furnished with the pipe stop removed.
- D. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

2.06 WALL PENETRATIONS:

A. NON-RESTRAINED:

Where non-restrained wall penetrations are called for on the drawings, mechanical seals shall fill the space between the process pipe and the pipe sleeve to create a water tight seal. Mechanical seal shall be Link-Seal by Thunderline Corporation, Wayne, Michigan; Sure Seal by International Piping Systems, Inc., Saugus, Massachusetts; OMNI*SLEEVE, by OMNI*SLEEVE of Cream Ridge, NJ; or approved equal.

2.07 FILLING RINGS:

The Contractor shall provide suitable filling rings where the layout of the flanged piping is such as to necessitate their use. In materials, workmanship, facing and drilling, such rings shall conform to the 125-lb. ANSI Standard. Filling rings shall be of suitable length with nonparallel faces and corresponding drilling if necessary, to ensure correct assembly of the adjoining piping or equipment.

2.08 GASKETS, BOLTS, AND NUTS:

- A. For flanged joints, gaskets shall be a minimum of 1/8-inch thick full face gaskets.
- B. Gaskets shall be of a composition suitable for exposure to the liquid within the pipe.
- C. Flanged joints shall be either made with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges. Bolts and nuts shall, except as otherwise specified or noted on the drawings, be heavy hex Grade B conforming to ASTM A307. Bolt studs and studs shall be of the same quality as machine bolts.

2.09 JOINT RESTRAINT:

- A. Where indicated or necessary to prevent joints or flexible couplings from pulling apart under pressure, suitable socket pipe clamps, tierods, and bridles shall be provided. Bridles and tierods shall be at least 3/4-inch diameter except where they replace flange bolts of smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The socket clamps and tierods or bridles shall be coated with an approved primer paint after assembly, or, if necessary, prior to assembly.

PART 3 - EXECUTION

3.01 HANDLING AND CUTTING PIPE:

- A. Any pipe or fitting which has a damaged lining, scratched or marred machine surface, and/or abrasion of the pipe coating or lining shall be rejected and removed from the job site.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.
- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting ductile iron pipe. Hydraulic squeeze cutters are not acceptable. Travel type cutters or rotary type abrasive saws may be used. All cut ends shall be examined for possible cracks caused by cutting.
- E. The Contractor's attention is directed to the fact that damage to the lining of pipe or fittings will render them unfit for use; he shall use the utmost care in handling and installing lined and coated pipe and fittings to prevent damage. Protective guards shall not be removed until the pipe is to be installed.
- F. Lined and coated pipe and fittings shall be assembled and installed with approved packing or gaskets of the type recommended by the pipe manufacturer for the particular lining used.
- G. Castings to be encased in masonry or concrete shall be accurately set with the bolt holes, if any, carefully aligned. OMNI*SLEEVE shall be installed per manufacturer's instructions.
- H. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign matter.

3.02 INSTALLING PIPE AND FITTINGS:

- A. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
- B. Pipes and fittings shall be subjected to a careful inspection and a hammer test just before being installed.
- C. Before the pieces are assembled, rust-preventive coatings shall be removed from machined surfaces. Pipe ends, sockets, sleeves, housings, and gaskets shall be thoroughly cleaned and

all burrs and other defects shall be carefully smoothed.

- D. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the completed work.
- E. Flanged joints shall be made up tight, care being taken to prevent undue strain upon pump nozzles, valves, and other pieces of equipment.
- F. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to ensure good alignment both horizontally and vertically.
- G. Castings to be encased in masonry shall be accurately set with the bolt holes, if any, carefully aligned.
- H. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.

3.03 ASSEMBLING SLEEVE TYPE COUPLINGS:

- A. Prior to the installation of flexible couplings, the pipe ends shall be cleaned thoroughly for a distance of 8-inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-inches from the end, and the middle ring shall be placed on the already laid pipe and until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.
- B. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.
- C. The correct torque as indicated by a torque wrench shall not exceed 90 foot-pounds.

3.05 PIPING SUPPORT:

- A. The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in a firm, substantial manner at the lines and grades indicated on the drawings or specified. Pipe supports shall be furnished with one shop coat of rust inhibitive primer.
- B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification from the manufacturer stating that such requirements have been complied with.
- C. Piping within buildings shall be adequately supported from floors, walls, ceilings or beams.

Supports from the floor shall be by approved saddle stands, or suitable concrete piers as indicated or approved. Pipe saddles shall be shaped to fit the pipe with which they will be used and shall be capable of screw adjustment. Brick and concrete piers shall conform accurately to the bottom one-third to one-half of the pipe. Piping along walls shall be supported by approved wall brackets with attached pipe rolls or saddles or by wall brackets with adjustable hanger rods. For piping supported from the ceiling, approved rod hangers of a type capable of screw adjustment after erection of the piping and with suitable adjustable concrete inserts or beam clamps shall be used.

3.06 TAPPED CONNECTIONS:

- A. Tapped connections in pipe and fittings shall be made so as to provide a watertight joint and adequate strength against pullout. The maximum size of taps in pipe or fittings without bosses shall not exceed that listed in the appropriate table of the Appendix to the ANSI A21.51, based on 3 full threads for ductile iron.
- B. Where the size of the connection exceeds that given above, a boss shall be provided on the pipe barrel and the tap shall be made in the flat part of the intersection of the run and branch of a tee or cross, or the connection shall be made by means of a tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, all as indicated or approved.
- C. All drilling and tapping of ductile iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate. Drilling and tapping shall be done only by skilled mechanics. Tools used shall be adapted to the work and in good condition so as to produce good, clean-cut threads of the correct size, pitch, and taper.

3.07 PRESSURE AND LEAKAGE TESTS:

- A. Prior to the pressure and leakage tests, the piping shall be thoroughly cleaned of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings.
- B. Except as otherwise required by the Engineer, all pipelines shall be given combined pressure and leakage tests in sections of approved length. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner or Engineer may monitor the tests using their own gages.
- C. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.
- D. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If hydrants and blowoffs are not available at high points for releasing air, the Contractor shall make the necessary taps at such points, including required excavation and backfilling, and shall plug said holes after completion of the test.
- E. The section under test shall be maintained full of water for 24 hours prior to the combined

pressure and leakage test being applied.

- F. The pressure and leakage test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test, corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
- G. Following or during the pressure test, the Contractor shall conduct a leakage test by metering the flow of water into the pipe while maintaining pressure equal to the pressure rating of the pipe. If the average leakage during a two-hour period exceeds a rate of 11.6 gallons per inch of diameter per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test.
- H. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.
- I. If, in the judgment of the Engineer, it is impracticable to exactly follow the foregoing procedure, modifications in the procedure may be made as required and approved. The Contractor will still be responsible for providing a line, which satisfies the above leakage and pressure requirements.

END OF SECTION

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SECTION 15145

PIPING AND EQUIPMENT LAYOUT AND COORDINATION DRAWINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section covers the preparation and implementation of piping and equipment layout and coordination drawings as required for coordination of construction disciplines as specified herein.
- B. The Contractor shall furnish all labor, materials, tools and equipment necessary to prepare piping and equipment layout and coordination drawings for implementation by the construction team. The Contractor shall develop and prepare piping and equipment layout and coordination drawings for each individual construction location/project area/equipment component. The actual quantity of piping and equipment layout and coordination drawings shall be as required.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six (6) sets of plan and profile layout and coordination shop drawings shall be furnished for review.

1.04 REQUIREMENT FOR DETAILED LAYOUT AND COORDINATION DRAWINGS:

- A. The Contractor shall develop and provide detailed scaled equipment, piping and coordination drawings. All equipment, piping and valves shall be laid to scale by the Contractor based on actual field conditions, approved equipment and construction discipline coordination. The Contractor shall submit the scaled layout and coordination drawings for review by the Engineer prior to the purchasing of any equipment, coring penetration or routing piping and or mechanical equipment to confirm there are no conflicts and the proposed mechanical equipment and piping will fit within the allotted space. A copy of the layout shall be maintained and updated in the field by the Contractors site superintendent/foreman.
- B. The Contractor shall not scale distances and dimensions from the drawings. The Contractor shall utilize existing/proposed field dimensions, the approved shop drawings and the equipment and piping layout drawings developed for layout of the proposed work and coordination of the different construction disciplines.
- C. The mechanical, equipment, piping and electrical layouts provided in the contract documents are diagrammatic in nature. The Contractor shall field verify and coordinate all dimensions with the actual equipment supplied, the existing conditions and all Federal,

State and Local code requirements. The work of the various trades shall be coordinated by the Contractor to avoid interference and to secure maximum head room and working space. The Contractor shall pay particular attention to congested spaces inside and outside of structures. The Contractor shall develop "Interference Drawings", defined as drawings embodying the actual approved/purchased equipment, existing and proposed structures as well as the work of the multiple trades (electrical, mechanical, instrumentation, etc.) involved on the project. The "Interference Drawings" shall be developed and provided by the Contractor at no additional cost to the Owner.

- D. All bends in piping which shall be inaccessible after construction (i.e. below concrete slabs) shall have a maximum bend of 45 degrees. The contract shall substitute bends and provide additional bends as necessary for inaccessible piping at no additional cost to the owner.
- E. It is the responsibility of the Contractor to provide a complete and functional system as shown and described in the Contract Documents. The determination of complete and functional system shall be at the sole discretion of the Engineer. Complete and functional systems shall meet the approval of the Engineer based on the actual field conditions. It is not the intent of the Contract Drawings to portray every detail of the required work and or system. The Contractor shall provide the equipment, piping, coordination and system complete so that when assembled and installed they shall operate and perform as shown and described in the Contract Documents.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16010

ELECTRICAL WORK - GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The work covered by this section of the specifications consists of furnishing all labor, equipment, appliances, materials and incidentals in connection with the installation of the complete electrical systems as herein specified and as shown on the drawings.
- B. It is not the intent that the drawings shall show every junction box, conduit, wire, fitting, device, accessory, etc., but the Contractor shall be required to furnish without additional expense all transportation, labor and materials necessary to complete the electrical systems in accordance with the best practice of the trade.
- C. Unless otherwise specified, materials of the same classifications, used for the same purpose shall be the product of the same manufacturer.
- D. The work shall include furnishing and installing the following items:
 - 1. Underground Secondary Services
 - 2. Transformers
 - 3. Grounding System
 - 4. Panelboards
 - 5. Motor Disconnect Devices
 - 6. Raceways
 - 7. Feeder and Branch Circuit Conductors
 - 8. Pull and Junction Boxes
 - 9. Generator and Transfer Switch
 - 10. Hangers and Supports
 - 11. Solderless Lugs and Connectors
 - 12. Conduit and wire for equipment and controls furnished under other divisions of the specifications, when shown on the electrical plans, with the exception of the instrumentation low voltage signal wiring.

E. Electric Service and Metering

The power company serving this project is Eversource.

1. Arrangements shall be made with the power company for obtaining service. All cost for overhead line extensions and work required for these services including metering cost shall be obtained from the power company. The Contractor shall include in his bid and shall pay this money to the power company. All work involving the service and metering shall be as approved by the power company.

F. Interpretation of Drawings

1. The Drawings are diagrammatic only and are not intended to show exact locations of outlets and conduit runs.
2. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.
3. Any work installed contrary to Contract Documents, or without approval by the Engineer, shall be changed or replaced as required by the Engineer and no extra compensation will be allowed the Contractor for making these changes.
4. The locations of equipment and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. The Contractor shall obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, shall proceed as required by the Engineer and shall furnish all labor and materials necessary to complete the work in an approved manner.
5. The number of conductors shown on the Drawings are not necessarily the correct number required. As many conductors as are required in each case shall be installed.
6. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as can be determined in advance of the purchase of equipment. The ratings shown for motor branch circuit protective devices are the maximum ratings permitted. Lower ratings may be used where approved as being proper for the dynamic characteristics of the motor and its connected load.
7. Unless otherwise specified, all conduits, wires, and cables and the support systems for the conduits and cables that are required to make the electrical connections to equipment shall be furnished and installed. All

connections to equipment shall be made as shown, specified, and required and in accordance with the approved shop and setting drawings.

8. The Contractor shall verify, in the field, all measurements necessary for his work and shall assume responsibility for their accuracy.

1.02 LOCAL CONDITIONS:

- A. The Contractor shall provide and place all sleeves for conduits penetrating walls, etc. The Contractor shall locate all necessary slots for his work and these shall be formed before concrete is poured.
- B. All cutting and patching shall be done in a thoroughly workmanlike manner.
- C. Before submitting proposals, the Contractor is expected to inspect the site and survey the conditions to be encountered in the performance of the work. Failure to familiarize himself with the conditions shall not relieve the Contractor's responsibility for full completion of the work in accordance with the provisions of the Contract.

1.03 PERMITS AND INSPECTION:

- A. Permits, fees and notices shall be in accordance with the General Conditions.
- B. All work shall meet or exceed the latest requirements of all national, state, county, municipal and other authorities exercising jurisdiction over electrical construction at this project.
- C. All required permit and inspection certificates shall be obtained, paid for, and given to the Owner at the completion of the work.

1.04 CODES AND STANDARDS:

- A. Unless indicated or specified otherwise, materials and workmanship shall conform with the latest editions of the following codes, standards and specifications.
 1. National Electrical Code (NEC)
 2. National Bureau of Standards Handbook H-30 National Electrical Safety Code
 3. State and Local Codes, and all other authorities having jurisdiction
 4. Underwriter's Laboratories, Inc. (UL)
 5. American National Standards Institute, Inc.
 6. Institute of Electrical and Electronic Engineers (IEEE)

7. National Electrical Manufacturers Association (NEMA)
8. National Board of Fire Underwriters
9. International Municipal Signal Association (IMSA)
10. Insulated Power Cable Engineers Associated Specifications
11. American Society for Testing Materials Specifications

1.05 REVIEW OF MATERIALS:

- A. Material and Equipment Schedules. As soon as practicable and within thirty days after the date of notice to proceed and before commencement of installation of any materials or equipment, the Contractor shall submit to the Engineer six (6) complete Brochures for approval of materials and equipment to be incorporated in the work. The list shall include manufacturer's name, catalog numbers, cuts, diagrams, drawings, and such other descriptive data as may be required. No consideration will be given to a partial submittal from time to time. Approval of materials will be based on manufacturer's published ratings. Any materials and equipment listed that are not in accordance with the specification requirements will be rejected.
- B. Substitutions: Substitution of material or equipment shall be in accordance with the General Conditions.
- C. Shop Drawings. Shop drawings shall be submitted to the Engineer for review in accordance with the Division I. Shop drawings shall be submitted for, but not limited to the following:
 1. Panelboards
 2. Transformers
 3. Wire and Cable
 4. Contactors
 5. Hangers and Supports
 6. Disconnect Switches
 7. Fuses
 8. Circuit Breakers
 9. Raceways
 10. Generator and transfer switch

- D. Submit the following information with all equipment shop drawings.
1. Manufacturer's certified scale drawings, cuts, or catalogs, including installation details and manufacturer's name.
 2. Manufacturer's specifications, including certified performance characteristics and capacity ratings.
 3. Electrical wiring diagrams and controls, where applicable.
 4. Certificate of compliance with Code, where applicable.
- E. Equipment shop drawings and wiring diagrams must be prepared specifically for this installation. Standard factory wiring diagrams with a revision marked in ink for this installation will be accepted.
- F. All control and wiring diagrams shall be complete with the following description:
1. Sequence of operation
 2. Sequence of interlocking
 3. Operation of alarms
 4. Legend
 5. Wiring Numbers
- G. All equipment shop drawings shall be properly identified and indicate the Article number of the specifications or the Drawing number which applies to the submitted item.
- H. Shop drawings for the items listed above shall be submitted for approval in accordance with the preceding paragraphs. The Engineer, however, reserves the right to require submittal of shop drawings on any other material or equipment to be installed under this Section not specifically listed above.

1.06 MINOR DEVIATIONS:

- A. The work as shown on the drawings is diagrammatic and is intended to show the work included and the arrangement of the various systems.
- B. It is not intended that the accompanying plans and specifications cover every detail of the required installation. Furnish and install equipment, materials and labor as shown or specified, as are usually furnished, or as are needed to make a complete and satisfactory operating installation, whether mentioned or not, omitting only those items which are specifically excluded.

- C. Locations and mounting heights of equipment and/or devices as shown are approximately correct. The Engineer reserves the right to relocate any equipment or device prior to actual installation at no extra cost to the Owner.
- D. No deviation from layout shall be made without written approval from the Engineer.

1.07 TEMPORARY LIGHT AND POWER:

- A. The Contractor shall provide temporary light and power and pay all energy charges as described in Division 1.

1.08 ELECTRICAL REFERENCE SYMBOLS:

- A. Symbols shown on the drawings shall approximate location of fixtures, outlet boxes, and conduit runs, and other equipment, unless otherwise detailed. The exact location shall be governed by structural conditions and obstructions. This is not to be construed to permit redesigning systems. All outlets shall be interconnected as shown on the drawings. Locate and install all boxes and equipment where they will be readily accessible.

1.09 PHASE IDENTIFICATION:

- A. The entire system of wiring shall be phased by color code as follows:
 - 1. Wires No. 6 AWG and smaller shall have a continuous colored outer covering.
 - 2. Wires larger than No. 6 AWG shall be identified at all points of termination by gummed tape, plastic tape, etc., applied to the wire.
 - 3. Bus bars in motor control centers and panelboards shall be properly identified by color as herein specified.
 - 4. Code colors for 120/208 volt systems shall be:
 - a. Phase A - Black
 - b. Phase B - Red
 - c. Phase C - Blue
 - 5. Code colors for 277/480 volt systems shall be:
 - a. Phase A - Brown
 - b. Phase B - Orange
 - c. Phase C - Yellow

6. Neutral wires shall be white or grey.
7. Equipment ground wires shall be green.
8. The same colors shall be used for the same phases throughout the entire project.

1.10 PROTECTION AND CLEANING OF EQUIPMENT:

- A. All electrical equipment, upon receipt, shall be adequately stored and protected from damage.
- B. After installation, all electrical equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent entrance of foreign materials.
- C. The interior of boxes and cabinets shall be left clean. Exposed surfaces shall be cleaned and plate surfaces polished.

1.11 OPERATION AND MAINTENANCE MANUALS:

- A. The Contractor shall furnish the Owner with four (4) copies of complete operating and maintenance manuals. Manuals shall include all equipment, maintenance instruction, parts list, warranties, schematic diagrams of control systems, and lubrication charts.
- B. Manuals shall contain only that information which specifically applies to this project, and all unrelated material shall be deleted. During the instruction period, herein specified, this manual shall be used and explained. Each copy of manual shall be clearly indexed and include a directory of all subcontractors and maintenance contractors, indicate the area of their responsibility, and list the name and telephone numbers of the responsible member of each organization. This material shall have a clear plastic protective shield over each sheet of data.
- C. Each manual shall be bound in an expandable plastic covered hard bound binder. Ring type binders will be acceptable. The manual's front cover and side cover shall be stamped "Operation and Maintenance Manual -- Electrical Systems" along with the project title.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS:

- A. A competent Engineer shall be provided by the Contractor to instruct operating personnel in the operation and maintenance of equipment and systems.

1.13 SPARE PARTS DATA:

- A. The Contractor shall furnish a complete list of recommended spare parts and supplies for the equipment furnished with current unit prices and source of supply.

1.14 TESTS:

- A. The Electrical Contractor shall perform all tests at the completion of the work and the results furnished to the Owner and Engineer in writing. Tests shall include, but not be limited to: all systems test free of shorts or grounds, proper neutral connections, ground system resistance, secondary voltages at main distribution panel, power panels and lighting panels, all lighting fixtures with lamps in place for 10 hours.
- B. Upon completion of all work, the Electrical Contractor shall furnish, in duplicate, certificates of inspections from all inspectors and authorities having jurisdiction, notarized letters from the manufacturers stating that authorized Factory Engineers or agents have inspected and tested the installation of their respective systems and found same to be in satisfactory operating condition.
- C. Furnish all labor, material, instruments, supplies and services and bear all costs for the accomplishment of the tests.

1.15 GUARANTEE:

- A. The Contractor shall guarantee equipment and performance of the installation and equipment in accordance with the GENERAL CONDITIONS.
- B. Lamps shall be furnished and installed in each lighting fixture as soon as fixtures are properly hung. Replace all lamps that fail within ninety (90) days after final acceptance at no additional cost. If the Contractor fails to replace lamps during the guarantee period, after a second request the Owner may replace lamps and back-charge Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specification shall be submitted for approval as required by the Engineer.
- B. Materials and equipment used shall be U.L. listed wherever such approved materials and equipment is available.
- C. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. If any apparatus has been damaged, such damage shall be repaired by the Contractor at his cost and

expense. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through such special tests as required by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. All work shall be executed in full accordance with the National Electrical Code and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, this Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- B. Load Balance. Check the load balance on the phases of the various systems and reconnect where necessary as approved by the Engineer to provide equal division of the loads between the phases of the various systems.
- C. Before starting the work, confer with all other trades relative to the location of pipes, ducts, and apparatus or fixtures to be installed by them and select locations for the work which will avoid possible conflicts with the work of other trades involved. All differences or conflicting conditions concerning the work shall be called to the attention of the Engineer for adjustment before starting work. For such work performed or materials installed in violation of the above clause the work shall be readjusted to the complete satisfaction of the Engineer at the sole expense of the Electrical Subcontractor.
- D. A concrete housekeeping pad shall be furnished and installed for all floor-mounted equipment. The pad shall be 4-inches high and sized to extend 4-inches beyond the equipment. The pad shall be poured dead level and the top scored from front to back on 18-inch centers with a parting tool. All edges shall be finished with an edging tool. The Contractor should refer to Division 3, Cast-In-Place Concrete for additional requirements.
- E. Cleanup
 - 1. This Contractor shall cooperate with other workmen and with the General Contractor in the daily removal of debris from the work site.
 - 2. This Contractor shall leave "broom clean" all areas where he has interrupted or completed his work.
 - 3. He shall cooperate with the General Contractor in good housekeeping procedures.
 - 4. At the completion of his work, prior to the final inspection, this Contractor shall clean all devices, plates, fixtures, glassware, switches, cabinets,

exposed conduits, fittings, etc. and shall have the premises in a thoroughly clean condition.

END OF SECTION

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SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Electricity-metering components.
 - 2. Concrete equipment bases.
 - 3. Cutting and patching for electrical construction.
 - 4. Touch-up Paint

1.03 SUBMITTALS:

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.04 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.05 COORDINATION:

- A. Coordinate inserts, sleeves, and openings with general construction work and arrange in structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the structure.
- C. Coordinate electrical service connections to components furnished by utility companies.
 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.01 SUPPORTING DEVICES:

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2-inches o.c. in webs.
- D. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.
 1. Channel Thickness: Selected to suit structural loading.
 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8-inches o.c. in at least one surface.
 1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
 2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
- F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

- G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.02 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING:

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

2.03 CONCRETE BASES:

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: Compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

2.04 TOUCHUP PAINT:

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.01 ELECTRICAL EQUIPMENT INSTALLATION:

- A. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- B. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 ELECTRICAL SUPPORTING DEVICE APPLICATION:

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.03 SUPPORT INSTALLATION:

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- D. Simultaneously install vertical conductor supports with conductors.
- E. Install sleeves for cable and raceway penetrations of concrete walls unless core-drilled holes are used. Install sleeves during erection of concrete structures.

3.04 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT:

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.05 CONCRETE BASES:

- A. Construct concrete bases of dimensions indicated, but not less than 4-inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.06 CUTTING AND PATCHING:

- A. Cut, channel, chase, and drill walls and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

3.07 FIELD QUALITY CONTROL:

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Supporting devices for electrical components.
 - 2. Electricity-metering components.
 - 3. Concrete bases.
 - 4. Cutting and patching for electrical construction.
 - 5. Touchup painting.

3.08 REFINISHING AND TOUCHUP PAINTING:

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.09 CLEANING AND PROTECTION:

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 16055

PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device and protective relay coordination studies. Protective devices shall be set based on results of the study.
- B. Provide a full arc flash analysis per IEEE 1584 and include recommendations, printed warning labels, and submit calculations based upon project specific conditions and all equipment. In addition to IEEE 1584 Standard, evaluate and label all panels, transformers and equipment fed from transformers at or below 125 kVA.
- C. This study shall include all settings including equipment configuration settings, settings and configuration of all relays, fuses and switchgear. This study shall also require the provider to gather and confirm all applicable existing equipment nameplate information and device settings and review shop drawings for applicable information.
- D. This study shall include protective devices upstream of this project feeding the transformer to this building. All operating sequences and scenarios shall be included for both normal and generator sources. Study provider shall contact this utility company to find actual impedance and available fault current.
- E. The first study submission shall be included with the electrical equipment submittal incorporating actual specific project conditions. The first report shall confirm proper withstand rating of all equipment and selectivity for emergency through instantaneous region. The report shall then be revised and resubmitted per comments and reflect final approved equipment and recommended settings for each device.
- F. Final report shall be signed and sealed by a licensed engineer in the state of the project.

1.03 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.

- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital and hard copy form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.
4. Relay settings and configuration tables and calculations for actual submitted relays from shop drawings.
5. Arc fault labels and stickers.

1.04 INFORMATIONAL SUBMITTALS

- A. Protective Relays: Provide calculation backup for protective relays and configuration settings.
- B. Qualification Data: For coordination-study specialists.
- C. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.05 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide SKM Systems Analysis, Inc. or approved equal.

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Project protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
 - 1. Coordination study to be submitted with and incorporate pre-approved, relevant equipment submittals. Protective devices specific to this project must be used in this study prior to their approval. Provide multiple submissions to have a complete report coordinated with, and submitted to, final approval electrical equipment shop drawings.
 - 2. Provide analysis for each and every relay for each and every sequence of operation scenario.
 - 3. Also provide recommendations for frequency, power, voltage and time settings including calculations. Provide interconnect relay settings coordinated with utility company where any onsite power is generated.

3.02 POWER SYSTEM DATA

- A. Gather (gather means to actively garner required information through direct contact with utility company, owner, contractor, suppliers, etc., and include actual site investigation and confirm and find information) and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance, available fault, and required settings of utility service.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

- a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - h. Each malfunction and digital and standalone relay including settings and relay configurations.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.
 - k. Each relay parameter, including but not limited to voltage, frequency, current and power.

3.03 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following below. Coordinate with utility company distribution engineer to obtain available fault level on the primary side of transformer/feeders serving the building.
- 1. Distribution panelboard.

2. Branch circuit panelboard.
 3. Low-voltage transformer.
 4. Transfer switch
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 242 and medium-voltage IEEE standards.
1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 2. Low-Voltage Circuit Breakers: IEEE 101.1 and IEEE C37.20.1.
 3. Low-Voltage Fuses: IEEE C37.46.
 4. Circuit Breakers: IEEE C37.15.
- E. Study Report:
1. Show calculated I_{VR} rates and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399. The study shall be performed using the actual available 3-phase bolted short-circuit current on the secondary of the utility transformer. This value will be obtained by the contractor from the utility company.
 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 242 recommendations for fault currents and time intervals.
- C. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- D. Include all relays and all functions for each relay in the study including relay software, settings and configurations.
- E. Coordinate with contractor and manufacturers exact CT and PT ratios, polarity and configurations.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.

- b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- 3. Include tables and calculations for all relay functions including relay software settings and configurations.
- G. Completed data sheets for setting of protective and control devices.

3.05 ARC FLASH STUDY

- A. Provide a complete arc flash study per IEEE 1584 Standards, including all printed labels and calculations.
- B. Provide time for follow-up and submission of revised settings per comments and final shop drawing coordination.

END OF SECTION

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SECTION 16060
GROUNDING AND BONDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.03 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Product Data: For the following:
 - 1. Ground rods.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.04 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erco Inc.
 - b. Chance/Hubbell.
 - c. Copperweld Corp.
 - d. Kearney/Cooper Power Systems.
 - e. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - f. Raco, Inc.; Division of Hubbell.
 - g. Superior Grounding Systems, Inc.
 - h. Thomas & Betts, Electrical.

2.02 GROUNDING CONDUCTORS:

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
1. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.
 3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.
- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.03 CONNECTOR PRODUCTS:

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.04 GROUNDING ELECTRODES:

- A. Ground Rods: Copper-clad steel.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Grounding Bus: Install in electrical cabinet.
 - 1. Use insulated spacer; space 1-inch from wall and support from wall 6-inches above finished floor, unless otherwise indicated.
- F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24-inches below grade or bury 12-inches above duct bank when installed as part of the duct bank.

3.02 EQUIPMENT GROUNDING CONDUCTORS:

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.

- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.03 INSTALLATION:

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
1. Drive ground rods until tops are 2-inches below finished floor or final grade, unless otherwise indicated.
 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.04 CONNECTIONS:

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.05 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING:

- A. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.

3.06 FIELD QUALITY CONTROL:

- A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

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SECTION 16070

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Fire stopping relating to electrical work.
7. Fire stopping accessories.
8. Equipment bases and supports.

B. Related Sections:

1. Section 03301 - Cast-in-Place Concrete: Product requirements for concrete for placement by this section.
2. Section 16070 - Hangers and Supports.

1.02 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 Fire stops.
 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 5. UL - Fire Resistance Directory.

1.03 DEFINITIONS:

- A. Fire stopping (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.

1.04 SYSTEM DESCRIPTION:

- A. Fire stopping Materials: ASTM E119, ASTM E814 to achieve fire ratings of adjacent construction in accordance with UL Design Numbers noted on the Architectural Drawings.
- B. Surface Burning: ASTM E84 with maximum flame spread / smoke developed rating of 25/450.
- C. Fire stop interruptions to fire rated assemblies, materials, and components.

1.05 PERFORMANCE REQUIREMENTS:

- A. Fire stopping: Conform to applicable code and UL requirements for fire resistance ratings and surface burning characteristics.
- B. Fire stopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06 SUBMITTALS:

- A. Section 01330 - Submittal Procedures: Requirements for submittals.

- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 2. Fire stopping: Submit data on product characteristics, performance and limitation criteria.
- D. Fire stopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- F. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
 2. Fire stopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.
- 1.07 QUALITY ASSURANCE:
- A. Through Penetration Fire stopping of Fire Rated Assemblies: ASTM E814 with 0.10-inch water gage (24.9 Pa) 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.

- B. Through Penetration Fire stopping 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: 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 (24.9 Pa) 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.
- F. Perform Work in accordance with the latest adopted version of the State of New Hampshire Building and Fire Safety Codes.
- G. Maintain one copy of each document on site.

1.08 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 three years experience, approved by manufacturer.

1.09 PRE-INSTALLATION MEETINGS:

- A. Section 01300 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 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.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.01 CONDUIT SUPPORTS:

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company.
 - 3. O-Z Gedney Co.
 - 4. Thomas and Betts
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.02 FORMED STEEL CHANNEL:

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.

3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.

B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2-inches (38 mm) on center.

2.03 SPRING STEEL CLIPS:

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.

B. Product Description: Mounting hole and screw closure.

2.04 SLEEVES:

- A. Sleeves for conduit, raceway, cable tray, busway, or cable through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for conduit, raceway, cable tray, busway, or cable through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for conduit, raceway, cable tray, busway, or cable through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.05 MECHANICAL SLEEVE SEALS:

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. PSI Link-Seal.

- 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.

2.06 FIRESTOPPING:

A. Manufacturers:

1. Dow Corning Corp.
2. Hilti Corp.
3. 3M fire Protection Products.

- 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 Fire stopping Elastomeric Fire stopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Fire stopping Compounds: Single component foam compound.
3. Formulated Fire stopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Fire stopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Fire stopping 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 Fire stopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Fire stop Pillows: Formed mineral fiber pillows.

- C. Color: Dark gray.

2.07 FIRESTOPPING ACCESSORIES:

- A. Primer: Type recommended by fire stopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
- 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.
 - 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 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

3.01 EXAMINATION:

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive fire stopping.

3.02 PREPARATION:

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of fire stopping material.
- B. Remove incompatible materials affecting bond.
- C. Install 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.

3.03 INSTALLATION - HANGERS AND SUPPORTS:

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide expansion anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps 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 reset 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 (100 mm).
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 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 (25 mm) off wall.

3.04 INSTALLATION – FIRESTOPPING:

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring fire stopping.
- B. Apply primer where recommended by manufacturer for type of fire stopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply fire stopping 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. Remove dam material after fire stopping material has cured.
- F. Fire Rated Surfaces:
 1. Seal opening at floor, wall, 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 conduit penetrates fire rated surface, install fire stopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, 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 fire stopping 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.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS:

- A. Provide housekeeping pads of concrete, minimum 3-1/2-inches thick and extending 6-inches beyond supported equipment. Refer to Section 03300.
- 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.

3.06 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 fire stopping insulation and

caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.07 FIELD QUALITY CONTROL:

A. Inspect installed fire stopping for compliance with specifications and submitted schedule.

3.08 CLEANING:

A. Clean adjacent surfaces of fire stopping materials.

3.09 PROTECTION OF FINISHED WORK:

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.03 SUBMITTALS:

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate color, lettering style, and graphic features of identification products.

1.04 QUALITY ASSURANCE:

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.01 RACEWAY AND CABLE LABELS:

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1- to 2-inches wide.
- E. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
1. Not less than 6-inches wide by 4 mils thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.
 4. Printed legend indicating type of underground line.
- F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- G. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch-thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- H. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- I. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002-inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.
- J. Brass or Aluminum Tags: 2- by 2- by 0.05-inch metal tags with stamped legend, punched for fastener.

2.02 NAMEPLATES AND SIGNS:

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16-inch thick for signs up to 20 sq. in. and 1/8-inch thick for larger sizes.
1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.
- 2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS:
- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16- inch.
 2. Tensile Strength: 50 lb. minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: According to color-coding.
- B. Paint: Formulated for the type of surface and intended use.
1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
 3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
 4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Install painted identification according to manufacturer's written instructions and as follows:
1. Clean surfaces of dust, loose material, and oily films before painting.
 2. Prime surfaces using type of primer specified for surface.
 3. Apply one intermediate and one finish coat of enamel.
- F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
1. Bands: Pre-tensioned, wraparound plastic sleeves, colored adhesive tape; or a combination of both. Make each color band 2-inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
 3. Apply the following colors to the systems listed below:
 - a. Security System: Blue and yellow.
 - b. Mechanical and Electrical Supervisory System: Green and blue.
 - c. Telecommunication System: Green and yellow.
- G. Caution Labels for Indoor Boxes and Enclosures for Power: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- H. Circuit Identification Labels on Boxes: Install labels externally.
1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 2. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- I. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6- to 8-inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16-inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

L. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch high label; where two lines of text are required, use labels 2-inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Standby system boxes and enclosures.
3. Disconnect switches.
4. Enclosed circuit breakers.
5. Power transfer equipment.
6. Contactors.
7. Remote-controlled switches.
8. Control devices.
9. Transformers.
10. Power-generating units.

END OF SECTION

SECTION 16130
RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.

1.03 DEFINITIONS:

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

1.04 SUBMITTALS:

- A. Product Data: For surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

- C. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for selecting seismic restraints.
 - 2. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- D. Coordination Drawings: cabinet layout plans drawn to scale and coordinating penetrations. Show the following:
 - 1. Method of attaching hangers to structure.

1.05 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.06 COORDINATION:

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 METAL CONDUIT AND TUBING:

- A. Available Manufacturers:
 - 1. AFC Cable Systems, Inc.

2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. O-Z Gedney; Unit of General Signal.
7. Wheatland Tube Co.
8. Or equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

F. Plastic-Coated IMC and Fittings: NEMA RN 1.

G. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw or compression type.

H. FMC: Aluminum.

I. LFMC: Flexible steel conduit with PVC jacket.

J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.03 NONMETALLIC CONDUIT AND TUBING:

A. Available Manufacturers:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Electri-Flex Co.
6. RACO; Division of Hubbell, Inc.
7. Spiraldut, Inc./AFC Cable Systems, Inc.
8. Thomas & Betts Corporation.
9. Or equal.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

2.04 BOXES, ENCLOSURES, AND CABINETS:

A. Available Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Thomas & Betts Corporation.
9. Or equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic finished inside with radio-frequency-resistant paint.

2.05 Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.06 FACTORY FINISHES:

- A. Finish: For raceway, enclosures, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION:

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A. Outdoors:

1. Exposed: Rigid steel.
2. Concealed: Rigid steel.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 4X.

B. Indoors:

1. Exposed: Rigid steel.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
3. Damp or Wet Locations: Rigid steel conduit.
4. Boxes and Enclosures: NEMA 250, Type 4X.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass-through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits embedded in or in contact with concrete.

3.02 INSTALLATION:

- A. Keep raceways at least 6-inches away from heat generating equipment.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.

- E. Protect stub-ups from damage where conduits rise through concrete slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.
- H. Tighten set screws of threadless fittings with suitable tools.
- I. Terminations:
1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 1- inches of slack at each end of pull wire.
- K. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- M. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6-inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

- N. Flexible Connections: Use maximum of 72-inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- O. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- P. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.03 PROTECTION:

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.04 CLEANING:

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 16131

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SUMMARY:

- A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.
- B. Related Sections:
 - 1. Section 16060 - Grounding and Bonding.
 - 2. Section 16130 - Raceway and Boxes.

1.02 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.

1.03 SUBMITTALS:

- A. Section 01330 – Submittals: 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.

1.04 QUALIFICATIONS:

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.05 EXTRA MATERIALS:

- A. Furnish two of each key.

PART 2 PRODUCTS

2.01 HINGED COVER ENCLOSURES:

- A. Manufacturers:
 - 1. Hoffman
 - 2. Carlon Electrical Products.
 - 3. Hubbell Wiring Devices.
 - 4. Or Equal.
- B. Construction: NEMA 250, Type 4X stainless steel enclosure.
- C. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
- D. Furnish interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard enamel.

2.02 CABINETS:

- A. Manufacturers:
 - 1. Hoffman
 - 2. Carlon Electrical Products.
 - 3. Hubbell Wiring Devices.
 - 4. Or Equal.
- B. Boxes: Galvanized steel with removable end walls.
- C. Box Size: As shown on plans.
- D. Backboard: Furnish 3/4-inch thick plywood backboard for mounting terminal blocks. Paint matte white.
- E. Fronts: Steel, flush type with screw cover front, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- F. Furnish metal barriers to form separate compartments wiring of different systems and voltages.

- G. Furnish accessory feet for free-standing equipment.

PART 2 - EXECUTION

3.01 INSTALLATION:

- A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- B. Install cabinet fronts plumb.

3.02 CLEANING:

- A. 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.

END OF SECTION

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SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes the following:

1. Single and duplex receptacles, ground-fault circuit interrupters, integral surge suppression units, and isolated-ground receptacles.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Pin and sleeve connectors and receptacles.
5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.03 DEFINITIONS:

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.04 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.

1.05 QUALITY ASSURANCE:

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.06 COORDINATION:

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc./Hubbell Subsidiary.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Leviton Mfg. Company Inc.
 - e. Pass & Seymour/Legrand; Wiring Devices Div.

2.02 RECEPTACLES:

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- C. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch deep outlet box without an adapter.

2.03 SWITCHES:

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

2.04 WALL PLATES:

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high impact thermoplastic.
 - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 - 4. Material for Wet Locations: Thermoplastic with spring-loaded lift cover and listed and labeled for use in "wet locations."

2.05 FINISHES:

- A. Color:
 - 1. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required by NEPA 70.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install devices and assemblies, level, plumb, and square with building lines.
- B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- C. Remove wall plates and protect devices and assemblies during painting.

3.02 IDENTIFICATION:

- A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS:

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL:

- A. Perform the following field tests and inspections and prepare test reports:
 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 16231

PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.
- B. Coordinate with Section 16414 "Automatic Transfer Switches" Transfer switch and generator shall be furnished as a package supplied by a single manufacturer

1.02 SUMMARY:

- A. This Section includes packaged diesel engine generator set with the following features and accessories:
 - 1. Battery charger.
 - 2. Engine-generator set.
 - 3. Muffler.
 - 4. Exhaust piping external to set.
 - 5. Outdoor sound attenuation enclosure.
 - 6. Remote annunciator.
 - 7. Starting battery.
 - 8. Remote stop switch.
- B. Related Sections include the following:
 - 1. Division 16 Section "Automatic Transfer Switches" for transfer switch including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.03 DEFINITIONS:

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.04 SUBMITTALS:

- A. Product Data: Include the following:

1. Data on features, components, accessories ratings, and performance.
 2. Thermal damage curve for generator.
 3. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Dimensioned outline plan and elevation drawings of engine-generator set, and other components specified.
 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Welding certificates.
- D. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces. Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For Installer and manufacturer.
- F. Certified summary of prototype-unit test report.
- G. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
- H. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria for sensitive loads.
- I. Test Reports:

1. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 2. Report of sound generation.
 3. Report of exhaust emissions showing compliance with applicable regulations.
 4. Field quality-control test reports.
- J. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- K. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures and Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- L. Warranty: Special warranty specified in this Section.
- 1.05 QUALITY ASSURANCE:
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated.
- E. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX for welding exhaust system piping.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 99.
- J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries of 75 decibels at 23'-0" due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- 1.06 COORDINATION:
- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- 1.07 WARRANTY:
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.
- 1.08 MAINTENANCE SERVICE:
- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.
- 1.09 EXTRA MATERIALS:
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but not less than one of each.
2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Caterpillar; Engine Div.
 2. Generac Power Systems, Inc.
 3. Kohler Co; Generator Division.
 4. MagneTek, Inc.
 5. Onan Corp./Cummins Power Generation; Industrial Business Group.
 6. Taylor Power Systems

2.02 ENGINE-GENERATOR SET:

- A. Packaged engine-generator set shall be a coordinated assembly of compatible components.
- B. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
- C. Output Connections: Three phase, four wire.
- D. Safety Standard: Comply with ASME B15.1.
- E. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, and model and serial number of component.
- F. Fabricate engine-generator set mounting frame and attachment of components to resist generator-set movement during a seismic event when generator-set mounting frame is anchored to building structure.
- G. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

2.03 GENERATOR-SET PERFORMANCE:

- A. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.

- B. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
- C. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- F. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
- G. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
- H. Sustained Short-Circuit Current: For a 3-phase bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
- I. Start Time: Comply with NEMA 110, Type 10, system requirements.

2.04 SERVICE CONDITIONS:

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 5 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

2.05 ENGINE:

- A. Rated Engine Speed: 1800 rpm.
- B. 100KW/125KVA
- C. 277/480V 3 Phase 4 wire
- D. Fuel: Diesel
- E. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

F. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

G. Governor: Adjustable isochronous, with speed sensing.

H. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

2.06 ENGINE COOLING SYSTEM:

A. Radiator: Vertical or Horizontal air discharge. Unit is rated for specified coolant.

1. Radiator Core Tubes: Nonferrous-metal construction other than aluminum.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Fan: Driven by multiple belts from engine shaft.

B. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

C. Radiator: Rated for specified coolant.

D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

E. Description: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

F. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gauge glass and petcock.

G. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

H. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

1. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.07 ENGINE EXHAUST SYSTEM:

- A. Muffler: Critical type, sized as recommended by engine manufacturer; sound level measured at a distance of 10 feet (3 m) from exhaust discharge shall be 75 dBA or less.
- B. Condensate Drain for Muffler: Schedule 40, black steel pipe connected to muffler drain outlet through a petcock.
- C. Connection from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.
- D. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liner.
- E. Exhaust Piping External to Engine: ASTM A 53/A 53M, Schedule 40, welded, black steel, with welded joints and fittings.

2.08 COMBUSTION-AIR INTAKE:

1. Description: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

2.09 STARTING SYSTEM:

- A. Description: 12 Volt electric with negative ground and including the following items:
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to

maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.10 CONTROL AND MONITORING:

- A. Functional Description: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- C. Indicating and protective devices and controls shall include those required by NFPA 110 for a Level 1 system, and the following:

D. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil low-pressure prealarm.
7. Low coolant level.
8. Overcrank shutdown.
9. Coolant low-temperature alarm.
10. Control switch not in auto position.
11. Battery-charger malfunction alarm.
12. Battery low-voltage alarm.

G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.11 GENERATOR OVERCURRENT AND FAULT PROTECTION:

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit that continuously monitors current level in each phase of generator output, integrates generator heating effect over time, and predicts when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.
3. As the overcurrent heating effect on the generator approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

C. Ground-Fault Indication: Comply with NFPA 70, Article 700-7(d). Integrate ground-fault alarm indication with other generator-set alarm indications.

2.12 GENERATOR, EXCITER AND VOLTAGE REGULATOR:

- A. Comply with NEMA MG 1 and specified performance requirements.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.
- G. Enclosure: Drip proof.
- H. Instrument Transformers: Mounted within generator enclosure.

- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 12 percent, maximum.

2.13 FINISHES:

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.14 SOURCE QUALITY CONTROL:

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2.
 - 2. Generator Tests: Comply with IEEE 115.
 - 3. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype shall have been factory tested to demonstrate compatibility and reliability.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Full load run.
 - 2. Maximum power.
 - 3. Voltage regulation.
 - 4. Transient and steady-state governing.
 - 5. Single-step load pickup.
 - 6. Safety shutdown.
 - 7. Observation of Factory Tests: Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
- C. Report factory test results within 10 days of completion of test.

2.15 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 30.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with manufacturers requirements. Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Fuel-Tank Capacity: 48 hours at 50% load and/or 24 hours at 100% load whichever is greater.
 - 3. Leak detection in interstitial space. Reporting to SCADA.
 - 4. Vandal-resistant fill cap.
 - 5. Containment Provisions: Comply with requirements of authorities having jurisdiction.
- G.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES:

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 16 Section "Basic Electrical Materials and Methods".

3.03 INSTALLATION:

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generators level on concrete base.
 - 1. Vibration Isolation: Mount packaged engine generators on manufacturers recommended vibration isolation.
- C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Install cooling-system piping, accessories, hangers and supports, and anchors for complete installation.
 - 1. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - c. Spring hangers to support vertical runs.
 - 2. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 1 and Smaller: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - b. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - c. NPS 2 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 3. Support cooling-system piping with pipe hangers spaced horizontally and at each floor vertically.
 - 4. Restrain cooling-system piping with cable-type bracing assemblies.
 - 5. Extend drain piping from heat exchangers to point of disposition.
- E. Install exhaust-system piping. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
 - 1. Install condensate drain piping for engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.
 - 2. Support exhaust piping and muffler with pipe hangers spaced a maximum of 20 feet horizontally.
 - 3. Restrain exhaust piping and mufflers with cable-type bracing assemblies.
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.04 CONNECTIONS:

- A. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 - 1. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
 - 2. Connect cooling-system water supply and drain piping to gas engine heat exchangers. Install flexible connectors at connections to engine generator and remote radiator.
 - 3. Connect exhaust-system piping to engines.
- B. Ground equipment according to Division 16 Section "Electrical Work – General Provisions".
- C. Connect wiring according to Division 16 Section "Conductors and Cables."
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 IDENTIFICATION:

- A. Identify system components according to Division 16 Section "Basic Electrical Materials and Methods."

3.06 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
 - 2. Perform tests recommended by manufacturer.
 - 3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
 - a. Single-step full-load pickup test.
 - 4. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

- a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 7. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 8. Exhaust Emissions Test: Comply with applicable government test criteria.
 9. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified.
 10. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 11. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at two locations on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
 - D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - H. Remove and replace malfunctioning units and retest as specified above.

- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.07 STARTUP SERVICE:

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. 1-day start-up testing
 - 2. One ½ day installation supervision
 - 3. One ½ day O & M review and operations instructions
- B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
- C. Complete installation and startup checks according to manufacturer's written instructions.

3.08 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.
 - 1. Coordinate this training with that for transfer switches.

END OF SECTION

SECTION 16289

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.02 SERVICE ENTRANCE SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB USA.
 - 2. Current Technology Inc.
 - 3. Eaton.
 - 4. General Electric Company.
 - 5. Square D; by Schneider Electric.
- B. SPDs: Comply with UL 1449, Type 1.
 - 1. SPDs with the following features and accessories:
 - a. Integral disconnect switch.
 - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - c. Indicator light display for protection status.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V.
 - 3. Line to Line: 2000 V for 480Y/277 V.
- E. SCCR: Equal or exceed 200 kA.
- F. Inominal Rating: 20 kA.

2.03 PANEL SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. Current Technology Inc.
 2. Eaton.
 3. General Electric Company.
 4. Schneider Electric USA, Inc.
 5. Square D; by Schneider Electric.
- B. SPDs: Comply with UL 1449, Type 1.
1. Include LED indicator lights for power and protection status.
 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V for 208Y/120 V.
 2. Line to Ground: 700 V for 208Y/120 V.
 3. Neutral to Ground: 700 V for 208Y/120 V.
 4. Line to Line: 1200 V for 208Y/120 V
- E. SCCR: Equal or exceed 100 kA.
- F. Inominal Rating: 20 kA.

2.04 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.

3.02 FIELD QUALITY CONTROL

- A. Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- C. An SPD will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.03 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
 - 1. Feeder and branch-circuit protection.
 - 2. Motor and equipment disconnecting means.
- B. Related Sections include the following:
 - 1. Division 16 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.

1.03 DEFINITIONS:

- A. GFCI: Ground-fault circuit interrupter.
- B. SPDT: Single pole, double throw.

1.04 SUBMITTALS:

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Current and voltage ratings.
 - c. Short-circuit current rating.

- d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
 - D. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - E. Manufacturer's field service report.
 - F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for components.
 - 2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
 - 3. Time-current curves, including selectable ranges for each type of circuit breaker.
- 1.05 QUALITY ASSURANCE:
- A. Testing Agency Qualifications: Testing agency that is a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with NEMA AB 1 and NEMA KS 1.
 - D. Comply with NFPA 70.
 - E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.06 PROJECT CONDITIONS:

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.07 COORDINATION:

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.08 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Spares: For the following:
 - a. Fuses and Fusible Devices for Fused Circuit Breakers: one each type
 - b. Fuses for Fused Switches: one each type

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Fusible Switches:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.

2.02 ENCLOSED SWITCHES:

- A. Enclosed, Non-fusible Switch: NEMA KS 1, Type HD, with lockable handle.

- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.04 ENCLOSURES:

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.03 FACTORY FINISHES:

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.04 CONNECTIONS:

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL:

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
 - 2. Test continuity of each line- and load-side circuit.
- B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA A-15, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 ADJUSTING:

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.07 CLEANING:

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 16414
AUTOMATIC TRANSFER SWITCHES

PART 1 – GENERAL

1.01 GENERAL PROVISIONS:

- A. Requirements of general conditions of this Specification apply to work of this Section. Attention is directed to other Divisions of this Specification which affect the work of this Section. All applicable paragraphs of sections that apply, whether specifically referred to or not, shall be considered as part of this Section.

1.02 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.
- B. Coordinate with Section 16231 “Packaged Engine Generator” Transfer switch and Generator shall be furnished as a package supplied by a single manufacturer

1.03 SCOPE:

- A. Furnish and install the automatic transfer switches to automatically transfer between the normal and emergency power source.

1.04 APPLICABLE STANDARDS:

- A. The automatic transfer switches covered by these specifications shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, UL, IEEE and NEMA.

1.05 SUBMITTALS:

- A. Manufacturer shall submit shop drawings for review, which shall include the following, as a minimum:
 - 1. Descriptive literature
 - 2. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.
 - 3. Schematic diagrams.
 - 4. Wiring diagrams.
 - 5. Accessory list.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Transfer switch shall be as provided by the generator manufacturer.

2.02 CONSTRUCTION:

A. General

1. The automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown.
2. On 3 phase, 4 wire Systems, utilizing ground fault protection, a true 4 pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
3. The transfer switch shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
4. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
5. The transfer switch shall be top and bottom accessible.
6. The main contacts shall be capable of being replaced without removing the main power cables.
7. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
8. All bolted bus connections shall have Belleville compression type washers.
9. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
10. Control components and wiring shall be front accessible. All control wires shall be multi-conductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.
11. The switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.
12. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

B. Automatic Transfer Switch

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer

mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.

2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungston alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.
3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

C. Automatic Transfer Switch Controls

1. The transfer switch shall be equipped with a microprocessor-based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.
2. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory, I/O and communication circuits, with a watchdog/power fail circuit.
3. The controller shall use industry standard open architecture communication protocol for high-speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.
4. The serial communication port shall allow interface to either the manufacturers or the owner's furnished remote supervisory control.
5. The controller shall have password protection required to limit access to qualified and authorized personnel.
6. The controller shall include a 20-character, LCD display, with a keypad, which allows access to the system.
7. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
8. The controller shall be capable of storing the following records in memory for access either locally or remotely:
 - a. Number of hours transfer switch is in the emergency position (total since record reset).
 - b. Number of hours emergency power is available (total since record reset).
 - c. Total transfer in either direction (total since record reset).
 - d. Date, time, and description of the last four source failures.

- e. Date of the last exercise period.
- f. Date of record reset.

D. Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

E. Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.

6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
13. A plant exerciser shall be provided with (10) day events, programmable for any day of the week and (24) calendar events, programmable for any month/day/hour, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.
14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of it's rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
15. Two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
17. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
18. An LCD readout shall display normal source and emergency source availability.

F. The following accessories shall be available by simple activation, via the key pad, if required.

1. Include (2) time delay contacts that open simultaneously just (milliseconds) prior to transfer in either direction. These contacts close

after a time delay upon transfer. Programmable 0-9999 seconds after transfer.

2. A block transfer function shall be included, energized from a 24VDC signal from the generator control switchgear, to allow transfer to emergency.
3. A load shed function shall be included, energized from a 24VDC signal from the generator control switchgear, to disconnect the load from the emergency source when an overload condition occurs.
4. A peak shave function shall be included, energized from a 24VDC signal from the generator control switchgear. This function will start the emergency generator and transfer the ATS to the emergency source reducing the utility supply to the building. After the peak shave signal is removed, the transfer switch will retransfer to the normal supply, bypassing the retransfer time delay.

G. Approval

1. As a condition of approval, the manufacturer of the automatic transfer switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes 480 VAC

<u>Amperes</u>	<u>Closing and Withstand</u>	<u>Current Limiting Fuse Rating</u>
100-400	42,000	200,000
600-800	65,000	200,000

2. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contacts separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.
3. When conducting temperature rise tests to UL-1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.
4. The microprocessor controller shall meet the following requirements:
 - Storage conditions - 25 degrees C to 85 degrees C
 - Operation conditions - 20 degrees C to 70 degrees C ambient
 - Humidity 0 to 99% relative humidity, noncondensing
 - Capable of withstanding infinite power interruptions
 - Surge withstand per ANSI/IEEE C-37.90A-1978
5. Manufacturer shall provide copies of test reports upon request.

H. Manufacturer

1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.
2. The manufacture shall include an 800 telephone number, for field service contact, affixed to each enclosure.
3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Automatic Transfer Switches shall be provided with adequate lifting means for ease of installation of wall or floor mounted enclosures.
- B. Provide access and working space as indicated or as required.

3.02 ADJUSTMENTS:

- A. Tighten assembled bolted connections with appropriate tools to manufacturer's torque recommendations prior to first energization.

END OF SECTION

SECTION 16421

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ac general-purpose controllers rated 600 V and less that are supplied as enclosed units.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. UL listing for series rating of overcurrent protective devices in combination controllers.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

- D. Manufacturer Seismic Qualification Certification: Submit certification that enclosed controllers, accessories, and components will withstand seismic forces. Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- F. Field Test Reports: Written reports specified in Part 3.
- G. Manufacturer's field service report.
- H. Maintenance Data: For enclosed controllers and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
1. Routine maintenance requirements for enclosed controllers and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- I. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- J. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

- B. Testing Agency Qualifications: An independent testing agency with the experience and capability to satisfactorily conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, including clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subjected to weather, cover enclosed controllers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with utility interruptions without Architect's written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every fuse installed, but not less than one set of **three** of each type and rating.
 - 2. Indicating Lights: One of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Manual and Magnetic Enclosed Controllers:
 - a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - b. Eaton Corp.; Cutler-Hammer Products.
 - c. General Electrical Distribution & Control.
 - d. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
 - e. Siemens/Furnas Controls.
 - f. Square D Co.
 - 2. Variable-Frequency Controllers:
 - a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - b. Danfoss Inc.; Danfoss Electronic Drives Div.
 - c. Eaton Corp.; Cutler-Hammer Products.
 - d. General Electrical Distribution & Control.
 - e. MagneTek Drives and Systems.

- f. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
- g. Siemens/Furnas Controls.
- h. Square D Co.

2.2 MANUAL ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.

2.3 MAGNETIC ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V; obtained from **integral control power transformer** of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch.
 - 1. Fusible Disconnecting Means: NEMA BS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.
 - 2. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible switch.
 - 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class **10** tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
- E. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class **10** tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- F. Star-Delta Controller: NEMA ICS 2, closed transition with adjustable time delay.
- G. Part-Winding Controller: NEMA ICS 2, closed transition with separate overload relays for starting and running sequences.
- H. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

- I. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 3. LED indicators showing motor and control status, including the following conditions:
 - a. Control power available.
 - b. Controller on.
 - c. Overload trip.
 - d. Loss of phase.
 - e. Shorted silicon-controlled rectifier.
 4. Automatic voltage-reduction controls to reduce voltage when motor is running at light load.
 5. Motor running contactor operating automatically when full voltage is applied to motor.

2.4 ENCLOSURES

- A. Description: Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.

- E. Elapsed Time Meters: Heavy duty with digital readout in hours.
- F. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide transfer device with an off position. Meters shall indicate the following:
1. Ammeter: Output current, with current sensors rated to suit application.
 2. Voltmeter: Output voltage.
 3. Frequency Meter: Output frequency.
- G. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 2. Switch-selectable digital display of the following:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power: Plus or minus 2 percent.
 - e. Three-Phase Reactive Power: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Integrated Demand with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
 - i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
 3. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.
- H. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- I. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.6 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine **surfaces** to receive enclosed controllers for compliance with requirements, installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. See Division 16 Section "Basic Electrical Materials and Methods" for general installation requirements.
- B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 16 Section "Basic Electrical Materials and Methods."
- C. Install freestanding equipment on concrete bases complying with Division 3 Section "Cast-in-Place Concrete."

3.4 IDENTIFICATION

- A. Identify enclosed controller components and control wiring according to Division 16 Section "**Basic Electrical Materials and Methods.**"

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 16 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each enclosed controller bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality-control testing:
 1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, sections 7.5, 7.6, and 7.16.
 2. Certify compliance with test parameters.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting solid-state controllers.
- D. Test Reports: Prepare a written report to record the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

- A. Clean enclosed controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that enclosed controllers are installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.
- D. Complete installation and startup checks according to manufacturer's written instructions.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "O and M Manuals."
 - 3. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

END OF SECTION

SECTION 16442

PANELBOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
- B. Related Sections include the following:
 - 1. Division 16 Sections

1.03 DEFINITIONS:

- A. GFCI: Ground-fault circuit interrupter.
- B. SPDT: Single pole, double throw.
- C. TVSS: Transient voltage surge suppressor.

1.04 SUBMITTALS:

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.

- e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
 - C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
 - D. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
 - F. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Project Closeout," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- 1.05 QUALITY ASSURANCE:
- A. Testing Agency Qualifications: Testing agency that is a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with NEMA PB 1.
 - D. Comply with NFPA 70.
- 1.06 COORDINATION:
- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.07 EXTRA MATERIALS:

- A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.
 - e. Or approved equal.

2.02 FABRICATION AND FEATURES:

- A. Enclosures: Flush and/or surface mounted cabinets as indicated on plans. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.
 3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity.
- G. Main and Neutral Lugs: Compression or Mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

- I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- K. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- L. Gutter Barrier: Arrange to isolate individual panel sections.

2.03 PANELBOARD SHORT-CIRCUIT RATING:

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.05 DISTRIBUTION PANELBOARDS:

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and smaller: plug in or Bolt-on circuit breakers.

2.06 OVERCURRENT PROTECTIVE DEVICES:

- A. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical or Compression style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.07 ACCESSORY COMPONENTS AND FEATURES:

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install panelboards and accessories according to NFPA 70-1.
- B. Comply with mounting and anchoring requirements specified in Division 16 Sections
- C. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.
- D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."

- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS:

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL:

- A. Prepare for acceptance tests as follows:
 - 1. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.05 ADJUSTING:

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.06 CLEANING:

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

Greater New Haven Water Pollution Control Authority

APPENDIX A – ASSET FORMS

WOODBIDGE PUMP STATION REHABILITATION (PROJECT SSF 2021-01)

Greater New Haven Water Pollution Control Authority Asset Forms

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

ASSET SUMMARY FORM

Owner Name: GNHWPCA Project Number/Name: _____

General:

Description: _____ Tag #: _____

Type: _____

Area: _____

Building/Room: _____

Vendor: _____ Website: _____

Manufacturer: _____ Website: _____

Model #: _____ Serial #: _____ Mfg Job #: _____
if Serial # is unavailable

Install Date: _____ Purchase Date: _____

Start-up Date: _____ Warranty End Date: _____

Specification(s):

Pump Size/Size	Pump Flow	Pump Head	Pump Media

HP	Frame	RPM	Voltage

Component(s):

Component(s):		Specifications (if applicable)			
ID	Component Name - Mfg.	HP	Frame	RPM	Voltage
1					
2					
3					
4					
5					

ASSET SUMMARY FORM cont.

Attachment(s):

ID	Attachment Name
1	
2	
3	

Existing Asset(s):

If replacing existing asset, record the tag and description of each existing asset:

Tag	Description

Contact Information:

General Contr.: _____

Email: _____

Phone: _____

Design Engineer: _____

Email: _____

Phone: _____

Sub-Contractor: _____

Email: _____

Phone: _____

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

CMMS Asset ID: _____

MAINTENANCE SUMMARY FORM

Manufacturer's Local Rep: _____

Name: _____

Address: _____

Telephone: _____

Weight of Individual Components (Over 100 Pounds): _____

Maintenance Requirements:

Maintenance Task	Frequency	Lubricants
List each maintenance operation required and refer to specific information in the manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation	Refer by symbol to lubricant required.

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

MAINTENANCE SUMMARY FORM cont.

Lubricant List:

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

Recommended Spare Parts for Owners Inventory:

Part No.	Description	Unit	Qty	Unit Cost	Stored Location

Note: Identify parts provided by this Contract with two asterisks.
Stored Location is recorded by Owner

ASSET SUMMARY FORM - EXAMPLE 1 - ATTACHMENT A

Owner Name: GNHWPCA **Project Number/Name:** CWF2010-01

General:

EXAMPLE

Description: Return Activiated Sludge Pump 6 Tag #: P-32-1-06

Type: Centrifugal Pump Horizontal

Area: North Basement

Building/Room: Facility 52 Activated Sludge Pump Station

Vendor: Rodnev Co.

Website: www.rodnevco.com/

Manufacturer: GNH Pumps

Website: www.gnhpumps.com/

Model #: K250-400/G-3-F

Serial #: 315707

Mfg Job #: _____

if Serial # is unavailable

Install Date: 1/1/2016

Purchase Date: 12/1/2014

Start-up Date: 3/5/2016

Warranty End Date: 3/5/2017

Specification(s):

Pump Size/Size	Pump Flow	Pump Head	Pump Media
10" X 10"	3475 gpm	40	RAS

HP	Frame	RPM	Voltage
50		1180	460

Component(s):

Component(s)		Specifications (if applicable)			
ID	Component Name	HP	Frame	RPM	Voltage
1	Horizontal Motor - WEG	50	365T	1180	460
2	Coupling Drive				
3	Check Valve - Surge Buster				
4	Discharge Plug Valve - Milliken				
5	Suction Plug Valve - Milliken				

ASSET SUMMARY FORM cont.

EXAMPLE

Attachment(s):

ID	Attachment Name
1	RAS Pump O&M Manual
2	Electronic Photo - Pump 6
3	Start up/COPI

Existing Asset(s):

If replacing existing asset, record the tag and description of each existing asset:

Tag	Description
Ex29765	Auma Centrifugal Pump Horizontal

Contact Information:

General Contr.: _____

Email: _____

Phone: _____

Design Engineer: _____

Email: _____

Phone: _____

Sub-Contractor: _____

Email: _____

Phone: _____

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

CMMS Asset ID: _____

ASSET SUMMARY FORM - EXAMPLE 2 - ATTACHMENT B

Owner Name: GNHWPCA Project Number/Name: CWF2010-01

EXAMPLE

General:

Description: Air Flow Control Valve Tag #: FCV-21-4 - 1

Type: Flow Control Valve

Area: BRB Basin 1 - Zone 3

Building/Room: Facility 50 - BRB Basins

Vendor: Rodnev Co. Website: www.rodnevco.com/

Manufacturer: GNH Autovalve Website: www.gnhvalve.com/

Model #: Series 400 Serial #: AH145900 Mfg Job #:
if serial # is unavailable

Install Date: 7/27/2015 Purchase Date: 5/27/2015

Start-up Date: 7/27/2015 Warranty End Date: 7/27/2016

Specification(s):

Pump Size/Size	Pump Flow	Pump Head	Pump Media
6"			

Frame	RPM	Voltage

Component(s):

Component(s):		Specifications (if applicable)			
ID	Component Name	HP	Frame	RPM	Voltage
1	Electric Valve Actuator - GNH				460
2					
3					
4					
5					

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

ASSET SUMMARY FORM cont.

EXAMPLE

Attachment(s):

ID	Attachment Name
1	Valve O&M Manual
2	Electronic Photo - ABZ Valve
3	Start up/COPI

Existing Asset(s):

If replacing existing asset, record the tag and description of each existing asset:

Tag	Description

Contact Information:

General Contr.: _____

Email: _____

Phone: _____

Design Engineer: _____

Email: _____

Phone: _____

Sub-Contractor: _____

Email: _____

Phone: _____

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

CMMS Asset ID: _____

MAINTENANCE SUMMARY FORM - Example 1 - ATTACHMENT A

Manufacturer's Local Rep: Rodnev Co.

Name: John Daley

Address: 345 Main St. New Haven, CT 06511

Telephone: 203-555-5555

Weight of Individual Components (Over 100 Pounds): 2850 lbs

EXAMPLE

Maintenance Requirements:

Maintenance Task	Frequency	Lubricants
List each maintenance operation required and refer to specific information in the manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation	Refer by symbol to lubricant required.
Inspect Coupling Rubber inserts for wear	1/yr	NA
Grease Motor Bearings	1-2 years or 15,000 hrs	mobil polyrex em
Change seal oil	1-2 years or 10,000 hrs	Vegetable oil or any SAE 30 non detergent oil

MAINTENANCE SUMMARY FORM cont.

EXAMPLE

Lubricant List:

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				
Bearing Grease		Mobile Polyrex EM			
Seal Oil					Vegetable

Recommended Spare Parts for Owners Inventory:

Part No.	Description	Unit	Qty	Unit Cost	Stored Location
**433.01	Inner Seal		2		
433.02	Outer Seal		2		
502	Case Wear Ring		2		
932,01-4	Circlip	4	2		
421.01,421.02	Lip Seals	2	2		
411	Oring Kit		4		
Note: Identify parts provided by this Contract with two asterisks. Stored Location is recorded by Owner					

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

ASSET SUMMARY FORM

Project Number/Name: _____

Owner Name: _____

General Contractor: _____

Design Engineer: _____

Sub-Contractor: _____

Email: _____

Email: _____

Email: _____

Phone: _____

Phone: _____

Phone: _____

Tag #	Description	Type	Area	Building/Room	Vendor	Vendor Website	Manufacturer

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

Project Number/Name: _____

Owner Name: _____

Tag #	Description	Manufacturer Website	Model #	Serial #	Mfg Job #	Install Date	Start-up Date	Purchase Date	Pump Size

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

Project Number/Name: _____

Owner Name: _____

Tag #	Description	Pump Flow	Pump Head	Pump Media	HP	Frame	RPM	Voltage	Component(s)	HP	Frame	RPM

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

Project Number/Name: _____

Owner Name: _____

Tag #	Description	Voltage	Existing Asset(s)	Attachment(s)

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

For Owner Use Only:

Representative: _____

CMMS Upload Date: _____

Greater New Haven Water Pollution Control Authority

APPENDIX B – PREVAILING WAGE RATES

WOODBIDGE PUMP STATION REHABILITATION (PROJECT SSF 2021-01)

§ 102 19 Prevailing Wage Rates

Project specific prevailing wage rates will be obtained from the Connecticut Department of Labor, Wage and Workplace Standards Division.

These rates are to be the minimum paid to workers employed in these occupations on this Project and shall remain in effect until completion, unless adjusted prior thereto. The Contractor remains fully liable for the increase in any prevailing wages rates which may be made during the course of the Project.

Please direct any questions pertaining to this matter to the Wage and Workplace Standards Division, Telephone No. 860-263-6790

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY



THIS IS A PUBLIC WORKS PROJECT

Covered by the

PREVAILING WAGE LAW

CT General Statutes Section 31-53

**If you have QUESTIONS regarding your wages
CALL (860) 263-6790**

Section 31-55 of the CT State Statutes requires every contractor or subcontractor performing work for the state to post in a prominent place the prevailing wages as determined by the Labor Commissioner.

STATUTE 31-55a

- SPECIAL NOTICE -

To: All State and Political Subdivisions, Their Agents, and Contractors

Connecticut General Statute 31-55a - Annual adjustments to wage rates by contractors doing state work.

Each contractor that is awarded a contract on or after October 1, 2002, for (1) the construction of a state highway or bridge that falls under the provisions of section 31-54 of the general statutes, or (2) the construction, remodeling, refinishing, refurbishing, rehabilitation, alteration or repair of any public works project that falls under the provisions of section 31-53 of the general statutes shall contact the Labor Commissioner on or before July first of each year, for the duration of such contract, to ascertain the prevailing rate of wages on an hourly basis and the amount of payment or contributions paid or payable on behalf of each mechanic, laborer or worker employed upon the work contracted to be done, and shall make any necessary adjustments to such prevailing rate of wages and such payment or contributions paid or payable on behalf of each such employee effective each July first.

- The prevailing wage rates applicable to any contract or subcontract awarded on or after October 1, 2002 are subject to annual adjustments each July 1st for the duration of any project which was originally advertised for bids on or after October 1, 2002.
- Each contractor affected by the above requirement shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.
- It is the **contractor's** responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's Web Site. The annual adjustments will be posted on the Department of Labor Web page: www.ctdol.state.ct.us. For those without internet access, please contact the division listed below.
- The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project. All subsequent annual adjustments will be posted on our Web Site for contractor access.

Any questions should be directed to the Contract Compliance Unit, Wage and Workplace Standards Division, Connecticut Department of Labor, 200 Folly Brook Blvd., Wethersfield, CT 06109 at (860)263-6790.

NOTICE

TO ALL CONTRACTING AGENCIES

Please be advised that Connecticut General Statutes Section 31-53, requires the contracting agency to certify to the Department of Labor, the total dollar amount of work to be done in connection with such public works project, regardless of whether such project consists of one or more contracts.

Please find the attached “Contracting Agency Certification Form” to be completed and returned to the Department of Labor, Wage and Workplace Standards Division, Public Contract Compliance Unit.

Inquiries can be directed to 860.263.6790.



CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION

Contracting Agency Certification Form

I, _____, acting in my official capacity as _____,
Authorized Representative Title
for _____, located at _____,
Contracting Agency Address

do hereby certify that the total dollar amount of work to be done in connection with

_____, located at _____,
Project name and number Address

shall be \$_____, which includes all work, regardless of whether such project
contains of one or more contracts.

Contractor Information

Name: _____

Address: _____

Authorized Representative: _____

Approximate Starting Date: _____

Approximate Completion Date: _____

Signature Date

Return to:

Connecticut Department of Labor
Wage & Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

Rate Schedule Issued (Date): _____

CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION

CONTRACTORS WAGE CERTIFICATION FORM
Construction Manager at Risk/General Contractor/Prime Contractor

I, _____ of _____
Officer, Owner, Authorized Rep. Company Name

do hereby certify that the _____
Company Name

Street

City

and all of its subcontractors will pay all workers on the

Project Name and Number

Street and City

the wages as listed in the schedule of prevailing rates required for such project (a copy of which is attached hereto).

Signed

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

Notary Public

Return to:

Connecticut Department of Labor
Wage & Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

Rate Schedule Issued (Date): _____

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.												PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS												Connecticut Department of Labor Wage and Workplace Standards Division 200 Folly Brook Blvd. Wethersfield, CT 06109					
CONTRACTOR NAME AND ADDRESS:												SUBCONTRACTOR NAME & ADDRESS						WORKER'S COMPENSATION INSURANCE CARRIER POLICY # EFFECTIVE DATE: EXPIRATION DATE:											
PAYROLL NUMBER		Week-Ending Date		PROJECT NAME & ADDRESS																									
PERSON/WORKER, ADDRESS and SECTION		APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION		DAY AND DATE						Total ST Hours	BASE HOURLY RATE	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY								
						S	M	T	W	TH	F	S				FICA	FEDERAL	STATE	LIST OTHER										
				Trade License Type & Number - OSHA 10 Certification Number								Total O/T Hours																	
						HOURS WORKED EACH DAY																							
													\$ Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$ Cash Fringe															
													\$ Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$ Cash Fringe															
													\$ Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$ Cash Fringe															
													\$ Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$ Cash Fringe															

12/9/2013

WWS-CP1

*IF REQUIRED

*SEE REVERSE SIDE

PAGE NUMBER ____

OF

***FRINGE BENEFITS EXPLANATION (P):**

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker’s compensation, income taxes, etc.).

Please specify the type of benefits provided:

- 1) Medical or hospital care _____
- 4) Disability_____
- 2) Pension or retirement _____
- 5) Vacation, holiday_____
- 3) Life Insurance _____
- 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of _____,

I, _____ of _____, (hereafter known as Employer) in my capacity as _____ (title) do hereby certify and state:

Section A:

1. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

- a) The records submitted are true and accurate;
- b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such person to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such person to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;
- c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);
- d) Each such person is covered by a worker’s compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;
- e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a prime contractor in connection with a subcontractor relating to a prime contractor; and
- f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.
2. OSHA~The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such persons name first appears.

(Signature)

(Title)

Submitted on (Date)

Weekly Payroll Certification For
Public Works Projects (Continued)

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

Week-Ending Date:
Contractor or Subcontractor Business Name:

WEEKLY PAYROLL

PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION Trade License Type & Number - OSHA 10 Certification Number	DAY AND DATE							Total ST Hours	BASE HOURLY RATE	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY
				S	M	T	W	TH	F	S	FICA				FEDERAL	STATE	OTHER			
				HOURS WORKED EACH DAY							Total O/T Hours	TOTAL FRINGE BENEFIT PLAN CASH								
											\$ Base Rate	1. \$ 2. \$ 3. \$								
											\$ Cash Fringe	4. \$ 5. \$ 6. \$								
											\$ Base Rate	1. \$ 2. \$ 3. \$								
											\$ Cash Fringe	4. \$ 5. \$ 6. \$								
											\$ Base Rate	1. \$ 2. \$ 3. \$								
											\$ Cash Fringe	4. \$ 5. \$ 6. \$								
											\$ Base Rate	1. \$ 2. \$ 3. \$								
											\$ Cash Fringe	4. \$ 5. \$ 6. \$								
											\$ Base Rate	1. \$ 2. \$ 3. \$								
											\$ Cash Fringe	4. \$ 5. \$ 6. \$								

*IF REQUIRED

12/9/2013
WWS-CP2

NOTICE: THIS PAGE MUST BE ACCOMPANIED BY A COVER PAGE (FORM # WWS-CP1)

PAGE NUMBER ____ OF

EXAMPLE

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.										PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS										Connecticut Department of Labor Wage and Workplace Standards Division 200 Folly Brook Blvd. Wethersfield, CT 06109											
CONTRACTOR NAME AND ADDRESS: Landon Corporation, 15 Connecticut Avenue, Northford, CT 06472										SUBCONTRACTOR NAME & ADDRESS XYZ Corporation 2 Main Street Yantic, CT 06389										WORKER'S COMPENSATION INSURANCE CARRIER Travelers Insurance Company POLICY # #BAC8888928 EFFECTIVE DATE: 1/1/09 EXPIRATION DATE: 12/31/09											
PAYROLL NUMBER 1		Week-Ending Date 9/26/09		PROJECT NAME & ADDRESS DOT 105-296, Route 82								Total ST Hours		BASE HOURLY RATE		TYPE OF FRINGE BENEFITS		GROSS PAY FOR ALL WORK PERFORMED THIS WEEK		TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB		CHECK # AND NET PAY					
PERSON/WORKER, ADDRESS and SECTION		APPR RATE %		MALE/FEMALE AND RACE*		WORK CLASSIFICATION		DAY AND DATE								Total ST Hours		BASE HOURLY RATE		TYPE OF FRINGE BENEFITS		GROSS PAY FOR ALL WORK PERFORMED THIS WEEK		TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB		CHECK # AND NET PAY	
								S	M	T	W	TH	F	S																	
								20	21	22	23	24	25	26																	
								HOURS WORKED EACH DAY								Total ST Hours		BASE HOURLY RATE		TYPE OF FRINGE BENEFITS		GROSS PAY FOR ALL WORK PERFORMED THIS WEEK		TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB		CHECK # AND NET PAY	
																Total ST Hours		BASE HOURLY RATE		TYPE OF FRINGE BENEFITS		GROSS PAY FOR ALL WORK PERFORMED THIS WEEK		TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB		CHECK # AND NET PAY	
Robert Craft 81 Maple Street Willimantic, CT 06226				M/C		Electrical Lineman E-1 1234567 Owner OSHA 123456			8		8		8		8																
Ronald Jones 212 Elm Street Norwich, CT 06360		65%		M/B		Electrical Apprentice OSHA 234567			8		8		8																		
Franklin T. Smith 234 Washington Rd. New London, CT 06320 SECTION B				M/H		Project Manager					8																				

7/13/2009 WWS-CP1 *IF REQUIRED *SEE REVERSE SIDE PAGE NUMBER 1 OF 2

OSHA 10 ~ATTACH CARD TO 1ST CERTIFIED PAYROLL

EXAMPLE

*FRINGE BENEFITS EXPLANATION (P):

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker's compensation, income taxes, etc.).

Please specify the type of benefits provided:

- 1) Medical or hospital care Blue Cross 4) Disability _____
2) Pension or retirement _____ 5) Vacation, holiday _____
3) Life Insurance Utopia 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of 9/26/09,

I, Robert Craft of XYZ Corporation, (hereafter known as

Employer) in my capacity as Owner (title) do hereby certify and state:

Section A:

1. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

a) The records submitted are true and accurate;

b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;

c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);

d) Each such employee of the Employer is covered by a worker's compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;

e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a prime contractor in connection with a subcontractor relating to a prime contract; and

f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.

2. OSHA~The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such employee's name first appears.

Robert Craft owner
(Signature) (Title)

10/2/09
Submitted on (Date)

Section B: Applies to CONNDOT Projects ONLY

That pursuant to CONNDOT contract requirements for reporting purposes only, all employees listed under Section B who performed work on this project are not covered under the prevailing wage requirements defined in Connecticut General Statutes Section 31-53.

Robert Craft owner
(Signature) (Title)

10/2/09
Submitted on (Date)

Note: CTDOL will assume all hours worked were performed under Section A unless clearly delineated as Section B WWS-CP1 as such. Should an employee perform work under both Section A and Section B, the hours worked and wages paid must be segregated for reporting purposes.

THIS IS A PUBLIC DOCUMENT
DO NOT INCLUDE SOCIAL SECURITY NUMBERS

Information Bulletin *Occupational Classifications*

The Connecticut Department of Labor has the responsibility to properly determine "job classification" on prevailing wage projects covered under C.G.S. Section 31-53(d).

Note: This information is intended to provide a sample of some occupational classifications for guidance purposes only. It is not an all-inclusive list of each occupation's duties. This list is being provided only to highlight some areas where a contractor may be unclear regarding the proper classification. If unsure, the employer should seek guidelines for CTDOL.

Below are additional clarifications of specific job duties performed for certain classifications:

- **ASBESTOS WORKERS**

Applies all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems.

- **ASBESTOS INSULATOR**

Handle, install apply, fabricate, distribute, prepare, alter, repair, dismantle, heat and frost insulation, including penetration and fire stopping work on all penetration fire stop systems.

- **BOILERMAKERS**

Erects hydro plants, incomplete vessels, steel stacks, storage tanks for water, fuel, etc. Builds incomplete boilers, repairs heat exchanges and steam generators.

- **BRICKLAYERS, CEMENT MASONS, CEMENT FINISHERS, MARBLE MASONS, PLASTERERS, STONE MASONS, PLASTERERS. STONE MASONS, TERRAZZO WORKERS, TILE SETTERS**

Lays building materials such as brick, structural tile and concrete cinder, glass, gypsum, terra cotta block. Cuts, tools and sets marble, sets stone, finishes concrete, applies decorative steel, aluminum and plastic tile, applies cements, sand, pigment and marble chips to floors, stairways, etc.

- **CARPENTERS, MILLWRIGHTS. PILEDRIVERMEN. LATHERS. RESILEINT FLOOR LAYERS, DOCK BUILDERS, DIKERS, DIVER TENDERS**

Constructs, erects, installs and repairs structures and fixtures of wood, plywood and wallboard. Installs, assembles, dismantles, moves industrial machinery. Drives piling into ground to provide foundations for structures such as buildings and bridges, retaining walls for earth embankments, such as cofferdams. Fastens wooden, metal or rockboard lath to walls, ceilings and partitions of buildings, acoustical tile layer, concrete form builder. Applies firestopping materials on fire resistive joint systems only. Installation of curtain/window walls only where attached to wood or metal studs. Installation of insulated material of all types whether blown, nailed or attached in other ways to walls, ceilings and floors of buildings. Assembly and installation of modular furniture/furniture systems. Free-standing furniture is not covered. This includes free standing: student chairs, study top desks, book box desks, computer furniture, dictionary stand, atlas stand, wood shelving, two-position information access station, file cabinets, storage cabinets, tables, etc.

- **LABORER, CLEANING**

- The clean up of any construction debris and the general (heavy/light) cleaning, including sweeping, wash down, mopping, wiping of the construction facility and its furniture, washing, polishing, and dusting.

- **DELIVERY PERSONNEL**

- If delivery of supplies/building materials is to one common point and stockpiled there, prevailing wages are not required. If the delivery personnel are involved in the distribution of the material to multiple locations within the construction site then they would have to be paid prevailing wages for the type of work performed: laborer, equipment operator, electrician, ironworker, plumber, etc.

- An example of this would be where delivery of drywall is made to a building and the delivery personnel distribute the drywall from one "stockpile" location to further sub-locations on each floor. Distribution of material around a construction site is the job of a laborer or tradesman, and not a delivery personnel.

- **ELECTRICIANS**

Install, erect, maintenance, alteration or repair of any wire, cable, conduit, etc., which generates, transforms, transmits or uses electrical energy for light, heat, power or other purposes, including the Installation or maintenance of telecommunication, LAN wiring or computer equipment, and low voltage wiring. ***License required per Connecticut General Statutes: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9.**

- **ELEVATOR CONSTRUCTORS**

Install, erect, maintenance and repair of all types of elevators, escalators, dumb waiters and moving walks. **License required by Connecticut General Statutes: R-1,2,5,6.*

- **FORK LIFT OPERATOR**

Laborers Group 4) Mason Tenders - operates forklift solely to assist a mason to a maximum height of nine (9) feet only.

Power Equipment Operator Group 9 - operates forklift to assist any trade, and to assist a mason to a height over nine (9) feet.

- **GLAZIERS**

Glazing wood and metal sash, doors, partitions, and 2 story aluminum storefronts. Installs glass windows, skylights, store fronts and display cases or surfaces such as building fronts, interior walls, ceilings and table tops and metal store fronts. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers, which require equal composite workforce.

- **IRONWORKERS**

Erection, installation and placement of structural steel, precast concrete, miscellaneous iron, ornamental iron, metal curtain wall, rigging and reinforcing steel. Handling, sorting, and installation of reinforcing steel (rebar). Metal bridge rail (traffic), metal bridge handrail, and decorative security fence installation. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers which require equal composite workforce.

- **INSULATOR**

- Installing fire stopping systems/materials for "Penetration Firestop Systems": transit to cables, electrical conduits, insulated pipes, sprinkler pipe penetrations, ductwork behind radiation, electrical cable trays, fire rated pipe penetrations, natural polypropylene, HVAC ducts, plumbing bare metal, telephone and communication wires, and boiler room ceilings.

- **LABORERS**

Acetylene burners, asphalt rakers, chain saw operators, concrete and power buggy operator, concrete saw operator, fence and guard rail erector (except metal bridge rail (traffic), decorative security fence (non-metal)).

installation.), hand operated concrete vibrator operator, mason tenders, pipelayers (installation of storm drainage or sewage lines on the street only), pneumatic drill operator, pneumatic gas and electric drill operator, powermen and wagon drill operator, air track operator, block paver, curb setters, blasters, concrete spreaders.

- **PAINTERS**

Maintenance, preparation, cleaning, blasting (water and sand, etc.), painting or application of any protective coatings of every description on all bridges and appurtenances of highways, roadways, and railroads. Painting, decorating, hardwood finishing, paper hanging, sign writing, scenic art work and drywall hhg for any and all types of building and residential work.

- **LEAD PAINT REMOVAL**

- Painter's Rate

1. Removal of lead paint from bridges.
2. Removal of lead paint as preparation of any surface to be repainted.
3. Where removal is on a Demolition project prior to reconstruction.

- Laborer's Rate

1. Removal of lead paint from any surface NOT to be repainted.
2. Where removal is on a *TOTAL* Demolition project only.

- **PLUMBERS AND PIPEFITTERS**

Installation, repair, replacement, alteration or maintenance of all plumbing, heating, cooling and piping. **License required per Connecticut General Statutes: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2 S-1,2,3,4,5,6,7,8/B-1,2,3,4 D-1,2,3,4.*

- **POWER EQUIPMENT OPERATORS**

Operates several types of power construction equipment such as compressors, pumps, hoists, derricks, cranes, shovels, tractors, scrapers or motor graders, etc. Repairs and maintains equipment. **License required, crane operators only, per Connecticut General Statutes.*

- **ROOFERS**

Covers roofs with composition shingles or sheets, wood shingles, slate or asphalt and gravel to waterproof roofs, including preparation of surface. (demolition or removal of any type of roofing and or clean-up of any and all areas where a roof is to be relaid.)

- **SHEETMETAL WORKERS**

Fabricate, assemble, install and repairs sheetmetal products and equipment in such areas as ventilation, air-conditioning, warm air heating, restaurant equipment, architectural sheet metal work, sheetmetal roofing, and aluminum gutters. Fabrication, handling, assembling, erecting, altering, repairing, etc. of coated metal material panels and composite metal material panels when used on building exteriors and interiors as soffits, fascia, louvers, partitions, canopies, cornice, column covers, awnings, beam covers, cladding, sun shades, lighting troughs, spires, ornamental roofing, metal ceilings, mansards, copings, ornamental and ventilation hoods, vertical and horizontal siding panels, trim, etc. The sheet metal classification also applies to the vast variety of coated metal material panels and composite metal material panels that have evolved over the years as an alternative to conventional ferrous and non-ferrous metals like steel, iron, tin, copper, brass, bronze, aluminum, etc. Fabrication, handling, assembling, erecting, altering, repairing, etc. of architectural metal roof, standing seam roof, composite metal roof, metal and composite bathroom/toilet partitions, aluminum gutters, metal and composite lockers and shelving, kitchen equipment, and walk-in coolers. To include testing and air –balancing ancillary to installation and construction.

- **SPRINKLER FITTERS**

Installation, alteration, maintenance and repair of fire protection sprinkler systems.

****License required per Connecticut General Statutes: F-1,2,3,4.***

- **TILE MARBLE AND TERRAZZO FINISHERS**

Assists and tends the tile setter, marble mason and terrazzo worker in the performance of their duties.

- **TRUCK DRIVERS**

~How to pay truck drivers delivering asphalt is under REVISION~

Truck Drivers are requires to be paid prevailing wage for time spent "working" directly on the site. These drivers remain covered by the prevailing wage for any time spent transporting between the actual construction location and facilities (such as fabrication, plants, mobile factories, batch plant, borrow pits, job headquarters, tool yards, etc.) dedicated exclusively, or nearly so, to performance of the contract or project, which are so located in proximity to the actual construction location that it is reasonable to include them. ****License required, drivers only, per Connecticut General Statutes.***

For example:

- Material men and deliverymen are not covered under prevailing wage as long as they are not directly involved in the construction process. If, they unload the material, they would then be covered by prevailing wage for the classification they are performing work in: laborer, equipment operator, etc.
- Hauling material off site is not covered provided they are not dumping it at a location outlined above.
- Driving a truck on site and moving equipment or materials on site would be considered covered work, as this is part of the construction process.

➤ *Any questions regarding the proper classification should be directed to:*

*Public Contract Compliance Unit
Wage and Workplace Standards Division
Connecticut Department of Labor
200 Folly Brook Blvd, Wethersfield, CT 06109
(860) 263-6790.*

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Minimum Rates and Classifications
for Building Construction

ID#: 22-34787

Connecticut Department of Labor
Wage and Workplace Standards Division

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number: Project Town: Woodbridge
State#: FAP#:
Project: Woodbridge Pump Station Rehabilitation

CLASSIFICATION	Hourly Rate	Benefits
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters. **See Laborers Group 7**		
1c) Asbestos Worker/Heat and Frost Insulator	43.72	30.99
2) Boilermaker	38.34	26.01
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	37.75	34.62 + a
3b) Tile Setter	37.1	30.52
3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
3d) Tile, Marble & Terrazzo Finishers	31.07	24.23
3e) Plasterer	33.48	32.06

-----LABORERS-----

4) Group 1: Laborers (common or general), acetylene burners, concrete specialists, wrecking laborers, fire watchers.	32.0	24.40
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofer/mixer/nozzleman (Person running mixer and spraying fireproof only).	32.25	24.40
4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	32.5	24.40
4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe sections) P6 and P7 rate is \$26.80.	33.0	24.40
4d) Group 5: Air track operator, sand blaster and hydraulic drills.	32.75	24.40
4e) Group 6: Blasters, nuclear and toxic waste removal.	35.0	24.40
4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	33.0	24.40
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	30.28	24.40
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	29.74	24.40
4i) Group 10: Traffic Control Signalman	18.0	24.40
5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	36.07	26.15
5a) Millwrights	36.32	26.81

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6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	39.6	31.21+3% of gross wage
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	58.9	36.885+a+b
-----LINE CONSTRUCTION-----		
Groundman	26.5	6.5% + 9.00
Linemen/Cable Splicer	48.19	6.5% + 22.00
8) Glazier (Trade License required: FG-1,2)	39.98	22.90 + a
9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	38.17	38.02 + a
-----OPERATORS-----		
Group 1: Crane Handling or Erecting Structural Steel or Stone; Hoisting Engineer (2 drums or over). (Trade License Required)	50.27	26.80 + a
Group 1a: Front End Loader (7 cubic yards or over); Work Boat 26 ft. and Over	46.07	26.80 + a
Group 2: Cranes (100 ton rate capacity and over); Bauer Drill/Caisson. (Trade License Required)	49.91	26.80 + a
Group 2a: Cranes (under 100 ton rated capacity).	49.06	26.80 + a
Group 2b: Excavator over 2 cubic yards; Pile Driver (\$3.00 premium when operator controls hammer)	45.71	26.80 + a
Group 3: Excavator; Gradall; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar); Grader Operator; Bulldozer Finegrade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	44.86	26.80 + a

Group 4: Trenching Machines; Lighter Derrick; CMI Machine or Similar; Koehring Loader (Skooper); Goldhofer.	44.42	26.80 + a
Group 5: Specialty Railroad Equipment; Asphalt Spreader, Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24 mandrel).	43.73	26.80 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	43.73	26.80 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	43.38	26.80 + a
Group 7: Asphalt Roller; Concrete Saws and Cutters (ride on types); Vermeer Concrete Cutter; Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under mandrel).	42.99	26.80 + a
Group 8: Mechanic; Grease Truck Operator; Hydroblaster; Barrier Mover; Power Stone Spreader; Welding; Work Boat Under 26 ft.; Transfer Machine; Rigger Foreman.	42.54	26.80 + a
Group 9: Front End Loader (under 3 cubic yards); Skid Steer Loader regardless of attachments; (Bobcat or Similar); Forklift, Power Chipper; Landscape Equipment (including Hydroseeder); Vacuum Excavation Truck and Hydrovac Excavation Truck (27 HP pressure or greater).	42.04	26.80 + a
Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	39.7	26.80 + a
Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	39.7	26.80 + a
Group 12: Wellpoint Operator.	39.63	26.80 + a
Group 13: Compressor Battery Operator.	38.97	26.80 + a

Group 14: Elevator Operator; Tow Motor Operator (solid tire no rough terrain).	37.66	26.80 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	37.2	26.80 + a
Group 16: Maintenance Engineer.	36.46	26.80 + a
Group 17: Portable Asphalt Plant Operator; Portable Crusher Plant Operator; Portable Concrete Plant Operator; Portable Grout Plant Operator; Portable Water Filtration Plant Operator.	41.39	26.80 + a
Group 18: Power Safety Boat; Vacuum Truck; Zim Mixer; Sweeper; (Minimum for any job requiring a CDL license); Rigger; Signalman.	38.61	26.80 + a
-----PAINTERS (Including Drywall Finishing)-----		
10a) Brush and Roller	36.42	22.90
10b) Taping Only/Drywall Finishing	37.17	22.90
10c) Paperhanger and Red Label	36.92	22.90
10e) Blast and Spray	39.42	22.90
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	45.83	33.50
12) Well Digger, Pile Testing Machine	37.26	24.05 + a
Roofer: Cole Tar Pitch	43.75	20.05 + a
Roofer: Slate, Tile, Composition, Shingles, Singly Ply and Damp/Waterproofing	42.25	20.05 + a

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15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	40.08	40.53
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16) Pipefitter (Including HVAC work) License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	(Trade 45.83	33.50
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-----TRUCK DRIVERS-----

17a) 2 Axle, Helpers	31.16	28.78 + a
17b) 3 Axle, 2 Axle Ready Mix	31.27	28.78 + a
17c) 3 Axle Ready Mix	31.33	28.78 + a
17d) 4 Axle	31.39	28.78 + a
17e) 4 Axle Ready Mix	31.44	28.78 + a
17f) Heavy Duty Trailer (40 Tons and Over)	33.66	28.78 + a
17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi Trailers, Including Euclids)	31.44	28.78 + a
17h) Heavy Duty Trailer up to 40 tons	32.39	28.78 + a
17i) Snorkle Truck	31.54	28.78 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	47.55	29.38 + a
19) Theatrical Stage Journeyman	25.76	7.34

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.*

***Note: Hazardous waste premium \$3.00 per hour over classified rate*

Crane with 150 ft. boom (including jib) - \$1.50 extra

Crane with 200 ft. boom (including jib) - \$2.50 extra

Crane with 250 ft. boom (including jib) - \$5.00 extra

Crane with 300 ft. boom (including jib) - \$7.00 extra

Crane with 400 ft. boom (including jib) - \$10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyman instructing and supervising the work of each apprentice in a specific trade.

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

Effective October 1, 2005 - Public Act 05-50, any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

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

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: May 13, 2022

Minimum Rates and Classifications for
Heavy/Highway Construction

ID#: 22-34787

Connecticut Department of Labor
Wage and Workplace Standards Division

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number: Project Town: Woodbridge
State#: FAP#:
Project: Woodbridge Pump Station Rehabilitation

CLASSIFICATION	Hourly Rate	Benefits
1) Boilermaker	33.79	34% + 8.96
1a) Bricklayer, Cement Masons, Cement Finishers, Plasterers, Stone Masons	38.27	34.47
2) Carpenters, Piledrivermen	36.07	26.15
2a) Diver Tenders	36.07	26.15
3) Divers	44.53	26.15
03a) Millwrights	36.32	26.81
4) Painters: (Bridge Construction) Brush, Roller, Blasting (Sand, Water, etc.), Spray	54.0	22.90
4a) Painters: Brush and Roller	36.42	22.90
4b) Painters: Spray Only	39.42	22.90
4c) Painters: Steel Only	38.42	22.90

4d) Painters: Blast and Spray	39.42	22.90
4e) Painters: Tanks, Tower and Swing	38.42	22.90
5) Electrician (Trade License required: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	39.6	31.21+3% of gross wage
6) Ironworkers: Ornamental, Reinforcing, Structural, and Precast Concrete Erection	38.17	38.02 + a
7) Plumbers (Trade License required: (P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2) and Pipefitters (Including HVAC Work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4 G-1, G-2, G-8, G-9)	45.83	33.50
----LABORERS----		
8) Group 1: Laborer (Unskilled), Common or General, acetylene burner, concrete specialist	32.0	24.40
9) Group 2: Chain saw operators, fence and guard rail erectors, pneumatic tool operators, powdermen	32.25	24.40
10) Group 3: Pipelayers	32.5	24.40
11) Group 4: Jackhammer/Pavement breaker (handheld); mason tenders (cement/concrete), catch basin builders, asphalt rakers, air track operators, block paver, curb setter and forklift operators	32.5	24.40
12) Group 5: Toxic waste removal (non-mechanical systems)	34.0	24.40
13) Group 6: Blasters	33.75	24.40
Group 7: Asbestos/lead removal, non-mechanical systems (does not include leaded joint pipe)	33.0	24.40

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Group 8: Traffic control signalmen	18.0	24.40
Group 9: Hydraulic Drills	32.75	24.40
----LABORERS (TUNNEL CONSTRUCTION, FREE AIR). Shield Drive and Liner Plate Tunnels in Free Air.----		
13a) Miners, Motormen, Mucking Machine Operators, Nozzle Men, Grout Men, Shaft & Tunnel Steel & Rodmen, Shield & Erector, Arm Operator, Cable Tenders	34.23	24.40 + a
13b) Brakemen, Trackmen, Miners' Helpers and all other men	33.26	24.40 + a
----CLEANING, CONCRETE AND CAULKING TUNNEL----		
14) Concrete Workers, Form Movers, and Strippers	33.26	24.40 + a
15) Form Erectors	33.59	24.40 + a
----ROCK SHAFT LINING, CONCRETE, LINING OF SAME AND TUNNEL IN FREE AIR:----		
16) Brakemen, Trackmen, Tunnel Laborers, Shaft Laborers, Miners Helpers	33.26	24.40 + a
17) Laborers Topside, Cage Tenders, Bellman	33.15	24.40 + a
18) Miners	34.23	24.40 + a
----TUNNELS, CAISSON AND CYLINDER WORK IN COMPRESSED AIR: ----		
18a) Blaster	40.72	24.40 + a

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19) Brakemen, Trackmen, Groutman, Laborers, Outside Lock Tender, Gauge Tenders	40.52	24.40 + a
20) Change House Attendants, Powder Watchmen, Top on Iron Bolts	38.54	24.40 + a
21) Mucking Machine Operator, Grout Boss, Track Boss	41.31	24.40 + a
----TRUCK DRIVERS----(*see note below)		
Two Axle Trucks, Helpers	31.16	28.78 + a
Three Axle Trucks; Two Axle Ready Mix	31.27	28.78 + a
Three Axle Ready Mix	31.33	28.78 + a
Four Axle Trucks	31.39	28.78 + a
Four Axle Ready-Mix	31.44	28.78 + a
Heavy Duty Trailer (40 tons and over)	33.66	28.78 + a
Specialized earth moving equipment other than conventional type on-the road trucks and semi-trailer (including Euclids)	31.44	28.78 + a
Heavy Duty Trailer (up to 40 tons)	32.39	28.78 + a
Snorkle Truck	31.54	28.78 + a
----POWER EQUIPMENT OPERATORS----		
Group 1: Crane Handling or Erecting Structural Steel or Stone, Hoisting Engineer (2 drums or over). (Trade License Required)	50.27	26.80 + a

Group 1a: Front End Loader (7 cubic yards or over); Work Boat 26 ft. and over.	46.07	26.80 + a
Group 2: Cranes (100 ton rate capacity and over); Bauer Drill/Caisson. (Trade License Required)	49.91	26.80 + a
Group 2a: Cranes (under 100 ton rated capacity).	49.06	26.80 + a
Group 2b: Excavator over 2 cubic yards; Pile Driver (\$3.00 premium when operator controls hammer).	45.71	26.80 + a
Group 3: Excavator; Gradall; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar); Grader Operator; Bulldozer Fine Grade (slopes, shaping, laser or GPS, etc.). (Trade License Required)	44.86	26.80 + a
Group 4: Trenching Machines; Lighter Derrick; CMI Machine or Similar; Koehring Loader (Skooper).	44.42	26.80 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Spreader; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24" mandrel)	43.73	26.80 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	43.73	26.80 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	43.38	26.80 + a
Group 7: Asphalt Roller; Concrete Saws and Cutters (ride on types); Vermeer Concrete Cutter; Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under Mandrel)	42.99	26.80 + a
Group 8: Mechanic, Grease Truck Operator, Hydroblaster, Barrier Mover, Power Stone Spreader; Welder; Work Boat under 26 ft.; Transfer Machine.	42.54	26.80 + a
Group 9: Front End Loader (under 3 cubic yards), Skid Steer Loader regardless of attachments (Bobcat or Similar); Fork Lift, Power Chipper; Landscape Equipment (including hydroseeder), Vacuum Excavation Truck	42.04	26.80 + a

and Hydrovac Excavation Truck (27 HG pressure or greater).

Group 10: Vibratory Hammer, Ice Machine, Diesel and Air Hammer, etc.	39.7	26.80 + a
Group 11: Conveyor, Earth Roller; Power Pavement Breaker (whiphammer), Robot Demolition Equipment.	39.7	26.80 + a
Group 12: Wellpoint Operator.	39.63	26.80 + a
Group 13: Compressor Battery Operator.	38.97	26.80 + a
Group 14: Elevator Operator; Tow Motor Operator (Solid Tire No Rough Terrain).	37.66	26.80 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	37.2	26.80 + a
Group 16: Maintenance Engineer.	36.46	26.80 + a
Group 17: Portable Asphalt Plant Operator; Portable Crusher Plant Operator; Portable Concrete Plant Operator. Portable Grout Plant Operator, Portable Water Filtration Plant Operator.	41.39	26.80 + a
Group 18: Power Safety Boat; Vacuum Truck; Zim Mixer; Sweeper; (minimum for any job requiring CDL license).	38.61	26.80 + a

****NOTE: SEE BELOW**

----LINE CONSTRUCTION----(Railroad Construction and Maintenance)----

20) Lineman, Cable Splicer, Technician	48.19	6.5% + 22.00
21) Heavy Equipment Operator	42.26	6.5% + 19.88

22) Equipment Operator, Tractor Trailer Driver, Material Men	40.96	6.5% + 19.21
23) Driver Groundmen	26.5	6.5% + 9.00
23a) Truck Driver	40.96	6.5% + 17.76
----LINE CONSTRUCTION----		
24) Driver Groundmen	30.92	6.5% + 9.70
25) Groundmen	22.67	6.5% + 6.20
26) Heavy Equipment Operators	37.1	6.5% + 10.70
27) Linemen, Cable Splicers, Dynamite Men	41.22	6.5% + 12.20
28) Material Men, Tractor Trailer Drivers, Equipment Operators	35.04	6.5% + 10.45

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.*

***Note: Hazardous waste premium \$3.00 per hour over classified rate*

Crane with 150 ft. boom (including jib) - \$1.50 extra

Crane with 200 ft. boom (including jib) - \$2.50 extra

Crane with 250 ft. boom (including jib) - \$5.00 extra

Crane with 300 ft. boom (including jib) - \$7.00 extra

Crane with 400 ft. boom (including jib) - \$10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyman instructing and supervising the work of each apprentice in a specific trade.

~~Connecticut General Statute Section 31-55a: Annual Adjustments to wage rates by contractors doing state work

~~

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page:

www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

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

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: May 13, 2022

NOT FOR BIDDING PURPOSES
REFERENCE COPY ONLY

**Connecticut Department of Labor
Wage and Workplace Standards Division
FOOTNOTES**

- ⇒ Please Note: If the “Benefits” listed on the schedule for the following occupations includes a letter(s) (+ a or + a+b for instance), refer to the information below.

Benefits to be paid at the appropriate prevailing wage rate for the listed occupation.

If the “Benefits” section for the occupation lists only a dollar amount, disregard the information below.

Bricklayers, Cement Masons, Cement Finishers, Concrete Finishers, Stone Masons
(Building Construction) and
(Residential- Hartford, Middlesex, New Haven, New London and Tolland Counties)

- a. Paid Holiday: Employees shall receive 4 hours for Christmas Eve holiday provided the employee works the regularly scheduled day before and after the holiday. Employers may schedule work on Christmas Eve and employees shall receive pay for actual hours worked in addition to holiday pay.

Elevator Constructors, Mechanics

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, Christmas Day, plus the Friday after Thanksgiving.
- b. Vacation: Employer contributes 8% of basic hourly rate for 5 years or more of service or 6% of basic hourly rate for 6 months to 5 years of service as vacation pay credit.

Glaziers

- a. Paid Holidays: Labor Day and Christmas Day.

Power Equipment Operators

(Heavy and Highway Construction & Building Construction)

- a. Paid Holidays: New Year's Day, Good Friday, Memorial day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, provided the employee works 3 days during the week in which the holiday falls, if scheduled, and if scheduled, the working day before and the working day after the holiday. Holidays falling on Saturday may be observed on Saturday, or if the employer so elects, on the preceding Friday.

Ironworkers

- a. Paid Holiday: Labor Day provided employee has been on the payroll for the 5 consecutive work days prior to Labor Day.

Laborers (Tunnel Construction)

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. No employee shall be eligible for holiday pay when he fails, without cause, to work the regular work day preceding the holiday or the regular work day following the holiday.

Roofers

- a. Paid Holidays: July 4th, Labor Day, and Christmas Day provided the employee is employed 15 days prior to the holiday.

Sprinkler Fitters

- a. Paid Holidays: Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day, provided the employee has been in the employment of a contractor 20 working days prior to any such paid holiday.

Truck Drivers

(Heavy and Highway Construction & Building Construction)

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas day, and Good Friday, provided the employee has at least 31 calendar days of service and works the last scheduled day before and the first scheduled day after the holiday, unless excused.

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