CITY OF NEWTON
PURCHASING DEPARTMENT

CONTRACT FOR PUBLIC WORKS
(M.G.L. Ch. 30, Sec. 39M)

PROJECT MANUAL:
WATER & WASTEWATER SUPERVISORY CONTROL AND DATA
ACQUISITION (SCADA) SYSTEMS UPGRADE

INVITATION FOR BID #15-99

Pre-Bid Meeting Date: April 30, 2015 at 9:30 a.m.
Bid Opening Date: May 14, 2015 at 9:30 a.m.

APRIL 2015
Setti D. Warren, Mayor
## CITY OF NEWTON
**PROJECT MANUAL TABLE OF CONTENTS**
**WATER & WASTEWATER SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS UPGRADE**

<table>
<thead>
<tr>
<th>Page #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cover Page</td>
</tr>
<tr>
<td>2-3</td>
<td>Table of Contents</td>
</tr>
</tbody>
</table>

### Part 1 - Bidding Documents, Contract Forms, and Conditions of the Contract

1. - Invitation for Bid
   - Page 4
2. - Instructions to Bidders
   - Pages 5-7
3. - Bid Form
   - Pages 8-9
   - Bid Item Sheets
   - Pages 11-19
4. - Bidder's Qualification Forms
   - Bidders Qualification and References Form
   - Pages 20-21
   - Certificate of Non Collusion
   - Page 22
   - Debarment Letter
   - Page 23
   - IRS Form W-9
   - Page 24
5. - Contract Forms (Informational only. Not required at time of bid submittal)
   - Owner - Contractor Contract
   - Pages 26-29
   - Certificate of Authority - Corporate
   - Page 30
   - Certification of Tax Compliance
   - Page 31
   - Payment Bond
   - Page 32
6. - General Conditions of the Contract
   - Pages 33-38
7. - Wage Rate Requirements
   - Pages 39
   - Department of Labor Minimum Wage Rates
   - Pages 40-78
   - Notice to Awarding Authorities
   - Page 79
   - Notice and Statement of Compliance
   - Page 80
   - Weekly Payroll Report Form
   - Page 81

### Part 2 - General Requirements and Project Specifications

1. - Division 1 - General Requirements
   - 011000 - Summary of Work
   - 14 pages
   - 011105 - Overall General Requirements
   - 50 pages
2. - Division 26 - Electrical
   - 26 05 00 - Common Work Results for Electrical
   - 16 pages
   - 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
   - 8 pages
   - 26 05 26 - Grounding and Bonding for Electrical Systems
   - 6 pages
   - 26 05 34 - Raceways, Boxes, and Supporting Devices
   - 14 pages
   - 26 05 43 - Underground Ducts and Raceways for Electrical Systems
   - 14 pages
   - 26 27 00 - Low Voltage Distribution Equipment
   - 4 pages
   - 26 27 26 - Wiring Devices
   - 8 pages
   - 26 29 13 - Enclosed Controllers and Motor Starters
   - 8 pages
3. Division 40 – Process Integration
   40 90 00 - Instrumentation and Control for Process Systems 6 pages
   40 91 00 - Primary Process Measurement Devices 16 pages
   40 94 33 - SCADA Computers & Software 6 pages
   40 94 43 - Programmable Logic Controllers 6 pages
   40 95 13 - Process Control Panels and Hardware 14 pages

4. 70 pages of drawings may be picked up at the Purchasing Department’s office or downloaded from the City’s website: www.newton.ma.us/bids
    Please contact the Purchasing Department at: 617-796-1220 for verify availability.

END OF SECTION
The City of Newton invites sealed bids in accordance with M.G.L. c.30, §39M from Contractors for:

**WATER & WASTEWATER SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS UPGRADE**

Pre-Bid Meeting: 9:30 a.m., Thursday, April 30, 2015, 136 Quinobequin Road, Newton, MA

Bids will be received until: 9:30 a.m., Thursday, May 14, 2015

at the Purchasing Department, Room 201, Newton City Hall, 1000 Commonwealth Avenue, Newton, MA 02459. The Pre-Bid Meeting is not mandatory. Bids will not be accepted nor may submitted bids be corrected, modified or withdrawn after the deadline for bids. Immediately following the deadline for bids, all bids received within the time specified will be publicly opened and read aloud.

Contract Documents will be available online at [www.newtonma.gov/bids](http://www.newtonma.gov/bids) or for pickup in the Purchasing Department after 10:00 a.m., April 23, 2015. There will be no charge for contract documents.

The work of this contract is set forth in Part 2 of this Invitation For Bids (General Requirements and Project Specifications) and includes but is not necessarily limited to electrical demolition and installation work at nineteen sites including the DPW office, water storage tanks, a covered reservoir, water pumping stations and a dewatering station. The electrical demolition work consists of removing old alarm and equipment cabinets, instruments, telephone modems and equipment inside old builer control panels. The electrical installation work consists of furnishing and installing control panels, radio equipment, antennas, instruments, cables, wires, junction boxes and conduit. It includes providing electrical contractor services including labor and materials as needed to install new SCADA control panels or rewiring existing panels.

**Time for completion of this project shall be 270 Calendar Days from the execution of the contract documents.**

All bids shall be submitted as one ORIGINAL and one COPY. The City will award the contract to the lowest responsible and eligible bidder.

A bid deposit in an amount that is not less than five percent (5%) of the value of the bid, including all alternates, is required. Bid deposits, payable to the City, shall be either in the form of a bid bond, or cash, or a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company. Bidders are reminded that the bid deposit covers the City for damages when a bidder withdraws its bid after the bid submission date. Be advised that to the extent permitted by law the City will retain all bid deposits for withdrawn bids. The costs of any bond and any insurance required in this Invitation For Bid are the responsibility of the bidder; such costs will not be reimbursed by City and should be included in your bid.

All bids are subject to the provisions of M.G.L., Chapter 30, §39M. **Wages are subject** to minimum wage rates determined by the Massachusetts Department of Labor Standards pursuant to M.G.L., c.149, §26 to 27H. The schedule of wage rates applicable to this contract is included in the bidding documents. In addition, the prevailing wage schedule will be updated annually for all public construction projects lasting longer than one (1) year. You will be required to pay the rates set out in any updated prevailing wage schedule. Increases in prevailing wage schedules will not be the basis for change order requests. The successful bidder will be required to provide a Certificate of Insurance demonstrating current coverage of the type and amounts set forth in the Project Manual. The successful bidder will be required to furnish a Labor and Materials Payment Bond in the amount of 50% of the contract total. Wages are paid to drivers for all “on-site” work.

All City bids are available on the City’s web site, [www.newtonma.gov/bids](http://www.newtonma.gov/bids). It is the sole responsibility of the contractor downloading these bids to ensure they have received any and all addenda prior to the bid opening. Addenda will be available online within the original bid document as well as a separate file. If you download bids from the internet site and would like to make it known that your company has done so, you may fax the Purchasing Department (617) 796-1227 or email to [purchasing@newtonma.gov](mailto:purchasing@newtonma.gov) with your NAME, ADDRESS, PHONE, FAX AND INVITATION FOR BID NUMBER.

The City will reject any and all bids in accordance with the above referenced General Laws. In addition, the City reserves the right to waive minor informalities in any or all bids, or to reject any or all bids (in whole or in part) if it be in the public interest to do so.

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**CITY OF NEWTON**

**Nicholas Read**

**Chief Procurement Officer**

**April 23, 2015**
ARTICLE 1 - BIDDER'S REPRESENTATION

1.1 Each General Bidder (hereinafter called the “Bidder”) by making a bid (hereinafter called “bid”) represents that:

1. The Bidder has read and understands the Bidding Documents, Contract Forms, General Conditions, Conditions of the Contract, General Requirements and Project Specifications (collectively, referred to as the “Contract Documents”) and the bid is made in accordance therewith.

2. The Bidder has visited the work site and is familiar with the local conditions under which the work has to be performed.

1.2 Failure to so examine the Contract Documents and work site will not relieve any Bidder from any obligation under the bid as submitted.

ARTICLE 2 - REQUEST FOR INTERPRETATION

2.1 Bidders shall promptly notify the City of any ambiguity, inconsistency, or error which they may discover upon examination of the Contract Documents, the site, and local conditions.

2.2 Bidders requiring clarification or interpretation of the Contract Documents shall make a written request to the Chief Procurement Officer, at purchasing@newtonma.gov or via facsimile (617) 796-1227. The City will only answer such requests if received by Friday, May 8, 2015 at 12:00 noon. In the event that the bid opening date is changed, the deadline for informational requests may also change as provided in an addendum issued by the City.

2.3 Interpretation, correction, or change in the Contract Documents will be made by addendum which will become part of the Contract Documents. The City will not be held accountable for any oral communication.

2.4 Addenda will be emailed to every individual or firm on record as having taken a set of Contract Documents. Addenda will be emailed to every individual or firm on record as having taken a set of Contract Documents. Receipt of all addenda issued must be acknowledged in the Bid Form. YOUR FAILURE TO ACKNOWLEDGE ALL ADDENDA MAY RESULT IN YOUR BID BEING REJECTED AS NON-RESPONSIVE.

2.5 Copies of addenda will be made available for inspection at the location listed in the Invitation for Bids where Contract Documents are on file, in addition to being available online at www.newtonma.gov/bids.

2.6 Bidders or proposers contacting ANY CITY EMPLOYEE regarding an Invitation for Bid (IFB) or a Request for Proposal (RFP), outside of the Purchasing Department, once an IFB or RFP has been released, may be disqualified from the procurement process.

2.7 Bidders downloading information off the internet web site are solely responsible for obtaining any addenda prior to the bid opening. If the bidder makes itself known to the Purchasing Department, at purchasing@newtonma.gov or via facsimile (617) 796-1227, it shall be placed on the bidder’s list. Bidders must provide the Purchasing Department with their company’s name, street address, city, state, zip, phone, fax, email address and INVITATION FOR BID #15-99.

ARTICLE 3 - MBE PARTICIPATION

3.1 Notice is hereby given that the Mayor’s Affirmative Action Plan for the City of Newton in effect at the time of this solicitation is applicable to all construction contracts in excess of $10,000.00.

3.2 Notice is hereby given that the City of Newton Minority/Women Business Enterprise Plan and the Supplemental Equal Employment Opportunity Anti-Discrimination and Affirmative Action Program in effect at the time of this solicitation are applicable to all City contracts for goods and services in excess of $50,000.00.

3.3 Copies of the Plans and Program referred to in Sections 3.1 and 3.2 are available at: www.newtonma.gov/purchasing.
ARTICLE 4 - PREPARATION AND SUBMISSION OF BIDS

4.1 Bids shall be submitted on the "Bid Form #15-99" attached hereto.

4.2 All entries on the Bid Form shall be made by typewriter or in ink.

4.3 Where so indicated on the Bid Form, sums shall be expressed in both words and figures. Where there is a discrepancy between the bid sum expressed in words and the bid sum expressed in figures, the words shall control.

4.4 Bid Deposits shall be submitted in the amount specified in the Invitation for Bids. They shall be made payable to the City and shall be either in the form of cash, certified check, treasurer's or cashier's check issued by a responsible bank or trust company, or a bid bond issued by a surety licensed to do business in the Commonwealth of Massachusetts; and shall be conditioned upon the faithful performance by the principal of the agreements contained in the bid. Bidders are reminded that the bid deposit covers the City for damages when a bidder withdraws its bid after the bid submission date. Be advised that to the extent permitted by the law the City will retain all bid deposits for withdrawn bids.

Bid deposits of the three (3) lowest responsible and eligible Bidders shall be retained until the execution and delivery of the City-Contractor agreement.

4.5 The Bid, including the bid deposit shall be enclosed in a sealed envelope with the following plainly marked on the outside:

* GENERAL BID FOR: #15-99

* NAME OF PROJECT: Water & Wastewater Supervisory Control & Data Acquisition (SCADA) Systems Upgrade

* BIDDER’S NAME, BUSINESS ADDRESS, AND PHONE NUMBER

4.6 Date and time for receipt of bids is set forth in the Invitation for Bids.

4.7 Timely delivery of a bid at the location designated shall be the full responsibility of the Bidder. In the event that Newton City Hall is closed on the date or at the time that bids are due, the date and time for receipt of bids shall be on the next business day following that the Newton City Hall and the Purchasing Department are open.

4.8 Bids shall be submitted with one original and one copy.

4.9 Be advised that a new Massachusetts law has been enacted that required all employees who work on Massachusetts public works construction sites must have no less than 10 hours of OSHA-approved safety and health training. See Chapter 306 of the Acts of 2004, which became effective July 1, 2006.

1. This requirement will apply to any general bid or sub bid submitted.
2. This law directs the Massachusetts Attorney General to restrain the award of construction contracts to any contractor who is in violation to this requirement and to restrain the performance of these contracts by non-complying contractors.
3. The contractor and all subcontractors on this project will be required to provide certification of compliance with this requirement. Non-compliance with this law will disqualify you from bidding on public contracts.

ARTICLE 5 - ALTERNATES

5.1 Each Bidder shall acknowledge alternates (if any) in Section C on the Bid Form.

5.2 In the event an alternate does not involve a change in the amount of the base bid, the Bidder shall so indicated by writing "No Change", or "N/C" or "0" in the space provided for that alternate.

5.3 Bidders shall enter on the Bid Form a single amount for each alternate which shall consist of the amount for work performed by the Contractor.

5.4 The low Bidder will be determined on the basis of the sum of the base bid and the accepted alternates.
ARTICLE 6 - WITHDRAWAL OF BIDS

6.1 Any bid may be withdrawn prior to the time designated for receipt of bids on written or electronic request. Electronic withdrawal of bids must be confirmed over the Bidder’s signature by written notice postmarked on or before the date and time set for receipt of bids.

6.2 Withdrawn bids may be resubmitted up to the time designated for the receipt of bids.

6.3 No bids may be withdrawn within sixty (60) days, Saturdays, Sundays and legal holidays excluded, after the opening of the bids.

ARTICLE 7 - CONTRACT AWARD

7.1 The City is soliciting prices for materials and labor set forth in the Item Sheets attached hereto. It is the City’s intent to award one (1) contract to the responsible and eligible bidder offering the lowest Total Bid Items 1-50. A contract will be awarded within sixty (60) days, Saturdays, Sundays, and legal holidays excluded, after the opening of bids.

7.2 The City reserves the right to waive minor informalities in or to reject any or all Bids if it be in the public interest to do so.

7.3 The City reserves the right to reject any bidder who has failed to pay any local taxes, fees, assessments, betterments, or any other municipal charge, unless the bidder has a pending abatement application or has entered into a payment agreement with the collector-treasurer.

7.4 As used herein, the term "lowest responsible and eligible Bidder" shall mean the Bidder (1) whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the work; (2) who has met all the requirements of the invitation for bids; (3) who shall certify that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (4) who, where the provisions of section eight B of chapter twenty-nine apply, shall have been determined to be qualified thereunder.

7.5 Subsequent to the award and within five (5) days, Saturday, Sundays and legal holidays excluded, after the prescribed forms are presented for signature, the successful Bidder shall execute and deliver to the City a contract in the form included in the Contract Documents in such number of counterparts as the City may require.

7.6 In the event that the City receives low bids in identical amount from two or more responsive and responsible Bidders, the City shall select the successful Bidder by a blind selection process chosen by the City such as flipping a coin or drawing names from a hat. The low Bidders who are under consideration will be invited to attend and observe the selection process.

ARTICLE 8 - TAXES

8.1 The Bidder shall not include in this bid any tax imposed upon the sale or rental of tangible personal property in this Commonwealth, such as any and all building materials, supplies, services and equipment required to complete the work.

8.2 The City is exempt from payment of the Massachusetts Sales Tax, and the Bidder shall not include any sales tax on its bid. The City’s exemption Number is E-046-001-404.

ARTICLE 9 – PROPRIETARY SPECIFICATIONS

9.1 The City has used a proprietary specification to describe the supply listed in the specifications. Such specifications are permitted under M.G.L. c. 30, §39M(b), provided that the City state in writing that use of the proprietary specification is in its best interest and that it will accept an “equal” of the item specified. An item is considered equal if (i) it is at least equal in quality, durability, appearance, strength, and design; (ii) will perform the intended function at least equally; and (iii) conforms substantially, even with deviations, to the detailed requirements contained in the specifications. Bidders wishing to provide an equal item should do so with their bids. The City shall have the sole right to determine whether or not said item is equal.

9.2 The required determination and justification have been duly prepared, and a copy may be requested in accordance with the Massachusetts Public Records Law, M.G.L. c. 66, §10.
CITY OF NEWTON
DEPARTMENT OF PURCHASING

BID FORM #15-99

A. The undersigned proposes to furnish all labor and materials required in accordance with the Contract Documents supplied by the City of Newton entitled:

WATER & WASTEWATER SCADA SYSTEMS UPGRADE

for the contract price specified below, subject to additions and deduction according to the terms of the specifications.

B. This bid includes addenda number(s) _____  _____  _____  _____.

C. The proposed contract price is:

_________________________________________________________ DOLLARS ($ ________________).
(The figure inserted above shall be the Total Bid Items 1-50 as computed on the Item Sheets attached hereto.)

COMPANY: ____________________________________________

D. Prompt Payment Discounts. Bidders are encouraged to offer discounts in exchange for an expedited payment. Payments may be issued earlier than the general goal of within 30 days of receipt of the invoice only when in exchange for discounted prices. Discounts will not be considered in determining the lowest responsible bidder.

Prompt Payment Discount ___________% ___________ Days
Prompt Payment Discount ___________% ___________ Days
Prompt Payment Discount ___________% ___________ Days

E. The undersigned has completed and submits herewith the following documents: 1

- Bid Item Sheets, 9 pages
- Signed Bid Form, 2 pages
- Bidder's Qualifications and References Form; 2 pages
- Certificate of Non-Collusion, 1 page
- Debarment Letter, 1 page
- IRS Form W-9, 1 page
- A five percent (5%) bid deposit/bid guarantee.

F. The undersigned agrees that, if s/he is selected as general contractor, s/he will within five days, Saturdays, Sundays and legal holidays excluded, after presentation thereof by the awarding authority, execute a contract in accordance with the terms of this bid and furnish a labor and materials or payment bond, each of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority and each in the sum of the contract price, the premiums for which are to be paid by the general contractor and are included in the contract price.

1 Failure to submit all listed documents completed and signed may result in your bid being disqualified as nonresponsive.
The undersigned hereby certifies that s/he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work and that s/he will comply fully with all laws and regulations applicable to awards made subject to section forty-four A of M.G.L. Chapter 30, s 39M.

The undersigned certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration (“OSHA”) that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and (3) that all employees to be employed in the work subject to this bid have successfully completed a course in construction safety and health approved by the United States OSHA that is at least 10 hours in duration. The undersigned understands that any employee found on a worksite subject to this section without documentation of successful completion of a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration shall be subject to immediate removal.

The undersigned further certifies under the penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection the word “person” shall mean any natural person, joint venture, partnership, corporation or other business or legal entity. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of section twenty-nine F of chapter twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

Date _____________________

(Name of General Bidder)

BY: __________________________

(Printed Name and Title of Signatory)

(Business Address)

(City, State Zip)

(Telephone) / (FAX)

(E-mail Address)

NOTE: If the bidder is a corporation, indicate state of incorporation under signature, and affix corporate seal; if a partnership, give full names and residential addresses of all partners; if an individual, give residential address if different from business address; and, if operating as a d/b/a give full legal identity. Attach additional pages as necessary.

END OF SECTION
INSTRUCTIONS FOR ITEM SHEETS

The Contractor shall insert prices for each item in ink, in both words and figures, and is to show a total bid price. In the event a discrepancy between the written words and figures, the written words shall govern. In the event an error in the bidders total bid price, the corrected total bid obtained by the summation of the products of the unit prices multiplied by the respective quantities shall stand as the bidder’s total bid price.

The Contractor is required to review any related plans, conduct a full site review, and read all the provisions in the document before inserting prices, and is further advised to make his own determination as to the accuracy of the estimated quantities before inserting bid prices.

The Item Sheets are a list of 50 separate tasks or materials requirements. Bidders are to provide a lump sum for each, the total of which will be each Bidder’s final bid.
### ITEM DESCRIPTION & BID PRICE

<table>
<thead>
<tr>
<th>ITEM: 1 - Edgewater Park Wastewater Pump Station Demolition Labor</th>
<th>Est. Unit Total Cost Qty. Measure</th>
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<tbody>
<tr>
<td>THE SUM OF: (________________________________________________ DOLLARS AND________________________________________________ CENTS) PER LUMP SUM</td>
<td>1 L.S. $___________</td>
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<th>ITEM: 2 – Edgewater Park Wastewater Pump Station Installation Labor</th>
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<tr>
<td>THE SUM OF: (________________________________________________ DOLLARS AND________________________________________________ CENTS) PER LUMP SUM</td>
<td>1 L.S. $___________</td>
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<th>ITEM: 3 – Edgewater Park Wastewater Pump Station Equipment &amp; Materials</th>
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<td>THE SUM OF: (________________________________________________ DOLLARS AND________________________________________________ CENTS) PER LUMP SUM</td>
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<th>ITEM: 4 - Elliot Street Wastewater Pump Station Demolition Labor</th>
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<th>ITEM: 5 – Elliot Street Wastewater Pump Station Installation Labor</th>
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<td>THE SUM OF: (________________________________________________ DOLLARS AND________________________________________________ CENTS) PER LUMP SUM</td>
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<td>ITEM</td>
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<td>7</td>
<td>Grayson Lane Wastewater Pump Station Demolition Labor</td>
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<td>8</td>
<td>Grayson Lane Wastewater Pump Station Installation Labor</td>
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<td>9</td>
<td>Grayson Lane Wastewater Pump Station Equipment &amp; Materials</td>
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<td>10</td>
<td>Hamlet Street Wastewater Pump Station Demolition Labor</td>
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<td>11</td>
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</tr>
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<td>18</td>
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<td>DESCRIPTION &amp; BID PRICE</td>
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<td>ITEM: 19 - Oldham Road Wastewater Pump Station Demolition Labor</td>
<td>THE SUM OF: ____________________________ DOLLARS AND ____________________________ CENTS ($__________________) PER LUMP SUM 1 L.S.</td>
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<td>ITEM: 20 – Oldham Road Wastewater Pump Station Installation Labor</td>
<td>THE SUM OF: ____________________________ DOLLARS AND ____________________________ CENTS ($__________________) PER LUMP SUM 1 L.S.</td>
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<td>ITEM: 21 – Oldham Road Wastewater Pump Station Equipment &amp; Materials</td>
<td>THE SUM OF: ____________________________ DOLLARS AND ____________________________ CENTS ($__________________) PER LUMP SUM 1 L.S.</td>
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<td>ITEM: 22 - Prairie Avenue Wastewater Pump Station Demolition Labor</td>
<td>THE SUM OF: ____________________________ DOLLARS AND ____________________________ CENTS ($__________________) PER LUMP SUM 1 L.S.</td>
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<td>ITEM: 23 – Prairie Avenue Wastewater Pump Station Installation Labor</td>
<td>THE SUM OF: ____________________________ DOLLARS AND ____________________________ CENTS ($__________________) PER LUMP SUM 1 L.S.</td>
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<td>ITEM: 24 – Prairie Avenue Wastewater Pump Station Equipment &amp; Materials</td>
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<td>ITEM: 25 – DPW Office Demolition Labor</td>
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<td>THE SUM OF:</td>
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<td>($___________________________) PER LUMP SUM</td>
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<td>ITEM: 26 - Quinobequin Road Wastewater Pump Station Demolition Labor</td>
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<td>ITEM: 27 – Quinobequin Road Wastewater Pump Station Installation Labor</td>
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<td>THE SUM OF:</td>
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<td>ITEM: 28 – Quinobequin Road Wastewater Pump Station Equipment &amp; Materials</td>
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<td>ITEM: 29 - Waban Avenue Wastewater Pump Station Demolition Labor</td>
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<td>THE SUM OF:</td>
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<td>ITEM: 31</td>
<td>Waban Avenue Wastewater Pump Station Equipment &amp; Materials</td>
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<td>ITEM: 32</td>
<td>Engine 10 Water Pump Station Demolition Labor</td>
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<td>ITEM: 33</td>
<td>Engine 10 Water Pump Station Installation Labor</td>
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<td>ITEM: 34</td>
<td>Engine 10 Water Pump Station Equipment &amp; Materials</td>
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<td>ITEM: 35</td>
<td>Flowed Meadow Dewatering Station Installation Labor</td>
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<td>ITEM: 36</td>
<td>Flowed Meadow Dewatering Station Equipment &amp; Materials</td>
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<td>($___________________) PER LUMP SUM</td>
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### ITEM DESCRIPTION & BID PRICE

<table>
<thead>
<tr>
<th>ITEM: 37 - Langley Road Water Booster Station Demolition Labor</th>
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<tbody>
<tr>
<td>THE SUM OF:</td>
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<td>DOLLARS</td>
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<td>AND CENTS</td>
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<td>($ ) PER LUMP SUM $_____________</td>
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<td>1 L.S.</td>
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<thead>
<tr>
<th>ITEM: 38 – Langley Road Water Booster Station Installation Labor</th>
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<tr>
<td>THE SUM OF:</td>
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<td>DOLLARS</td>
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<td>($ ) PER LUMP SUM $_____________</td>
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<td>1 L.S.</td>
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<tr>
<th>ITEM: 39 – Langley Road Water Booster Station Equipment &amp; Materials</th>
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<tr>
<td>THE SUM OF:</td>
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<td>DOLLARS</td>
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<td>($ ) PER LUMP SUM $_____________</td>
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<td>1 L.S.</td>
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<tr>
<th>ITEM: 40 - Manet Water Booster Station Demolition Labor</th>
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<tr>
<td>THE SUM OF:</td>
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<td>DOLLARS</td>
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<td>($ ) PER LUMP SUM $_____________</td>
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<td>1 L.S.</td>
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<tr>
<th>ITEM: 41 – Manet Water Booster Station Installation Labor</th>
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<tr>
<td>THE SUM OF:</td>
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<td>($ ) PER LUMP SUM $_____________</td>
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<td>1 L.S.</td>
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<tr>
<th>ITEM: 42 – Manet Water Booster Station Equipment &amp; Materials</th>
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<tr>
<td>THE SUM OF:</td>
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<td>DOLLARS</td>
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<td>AND CENTS</td>
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<td>($ ) PER LUMP SUM $_____________</td>
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<td>1 L.S.</td>
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<td>ITEM</td>
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<td>48</td>
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<tr>
<td>ITEM DESCRIPTION &amp; BID PRICE</td>
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<td>--------------------------------</td>
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<tr>
<td>ITEM: 49 – Waban Hill Covered Reservoir Installation Labor</td>
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<tr>
<td>THE SUM OF:                                 DOLLARS AND CENT$</td>
</tr>
<tr>
<td>(____________________________ ) PER LUMP SUM</td>
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</table>

| ITEM: 50 – Waban Hill Covered Reservoir Equipment & Materials | 1         | L.S.         | $_________ |
| THE SUM OF:                                 DOLLARS AND CENT$ |
| (____________________________ ) PER LUMP SUM |

TOTAL BID ITEMS 1-50  $__________

*The total bid amount must be placed in paragraph “C” of the bid form.*

END OF SECTION
CITY OF NEWTON

BIDDER'S QUALIFICATIONS AND REFERENCES FORM

All questions must be answered, and the data given must be clear and comprehensive. Please type or print legibly. If necessary, add additional sheet for starred items. This information will be utilized by the City for purposes of determining bidder responsiveness and responsibility with regard to the requirements and specifications of the Contract.

1. FIRM NAME: __________________________________________________________

2. WHEN ORGANIZED: ________________________________

3. INCORPORATED? _____ YES _____ NO DATE AND STATE OF INCORPORATION: _______________

4. IS YOUR BUSINESS A MBE? _____ YES _____ NO WBE? _____ YES _____ NO or MWBE? _____ YES _____ NO

* 5. LIST ALL CONTRACTS CURRENTLY ON HAND, SHOWING CONTRACT AMOUNT AND ANTICIPATED DATE OF COMPLETION:
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

* 6. HAVE YOU EVER FAILED TO COMPLETE A CONTRACT AWARDED TO YOU? _____ YES _____ NO
IF YES, WHERE AND WHY?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

* 7. HAVE YOU EVER DEFAULTED ON A CONTRACT? _____ YES _____ NO
IF YES, PROVIDE DETAILS.
_____________________________________________________________________________________
_____________________________________________________________________________________

* 8. LIST YOUR VEHICLES/EQUIPMENT AVAILABLE FOR THIS CONTRACT:
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

* 9. IN THE SPACES FOLLOWING, PROVIDE INFORMATION REGARDING CONTRACTS COMPLETED BY YOUR FIRM SIMILAR IN NATURE TO THE PROJECT BEING BID. A MINIMUM OF FOUR (4) CONTRACTS SHALL BE LISTED. PUBLICLY BID CONTRACTS ARE PREFERRED, BUT NOT MANDATORY.

PROJECT NAME: ________________________________
OWNER: _______________________________________
CITY/STATE: ___________________________________
10. The undersigned certifies that the information contained herein is complete and accurate and hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the City in verification of the recitals comprising this statement of Bidder's qualifications and experience.

DATE: ___________

BIDDER: ____________________________________________

SIGNATURE: ____________________________________________

PRINTED NAME: ___________________________________ TITLE: ____________________________

END OF SECTION
CERTIFICATE OF NON-COLLUSION

The undersigned certifies under penalties of perjury that this bid or proposal has been made and submitted in good faith and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word “person” shall mean any natural person, business, partnership, corporation, union, committee club, or other organization, entity, or group or individuals.

____________________________________
(Signature of individual)

____________________________________
Name of Business
Purchasing Department
Nicholas Read ☞ Chief Procurement Officer
1000 Commonwealth Avenue
Newton Centre, MA 02459-1449
purchasing@newtonma.gov

Date

Vendor

Re: Debarment Letter for Invitation For Bid #15-99

As a potential vendor on the above contract, the City requires that you provide a debarment/suspension certification indicating that you are in compliance with the below Federal Executive Order. Certification can be done by completing and signing this form.

**Debarment:**

Federal Executive Order (E.O.) 12549 “Debarment and Suspension“ requires that all contractors receiving individual awards, using federal funds, and all sub-recipients certify that the organization and its principals are not debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal department or agency from doing business with the Federal Government.

I hereby certify under pains and penalties of perjury that neither I nor any principal(s) of the Company identified below is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

____________________________________ (Name)
____________________________________ (Company)
____________________________________ (Address)
____________________________________ (Address)

PHONE ________________ FAX ________________

EMAIL ________________________________

____________________________________ Signature

____________________________________ Date

If you have questions, please contact Nicholas Read, Chief Procurement Officer at (617) 796-1220.
Request for Taxpayer Identification Number and Certification

Give form to the requester. Do not send to the IRS.

Name (as shown on your income tax return)

Business name, if different from above

Check appropriate box: ☐ Individual/sole proprietor ☐ Corporation ☐ Partnership
☐ Limited liability company. Enter the tax classification (disregarded entity, disregarded entity, Partnership, etc.)
☐ Other tax classification: __________________________

X Exempt payee

Address (number, street, and a city or state no.)

City, state, and ZIP code

List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on Line 1 to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see How to get a TIN on page 3.

Note: If the account is in more than one name, see the chart on page 4 for guidelines on whose name to enter.

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and

2. I am not subject to backup withholding because:
   (a) I am exempt from backup withholding; or
   (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or
   (c) the IRS has notified me that I am no longer subject to backup withholding,

3. I am a U.S. citizen or other U.S. person (as defined below).

Certification Instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN. See the instructions on page 4.

Sign Here

Signature of U.S. person ▶

Date ▶

Name ▶

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Purpose of Form

A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued).

2. Certify that you are not subject to backup withholding, or

3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income.

Note: If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

• An individual who is a U.S. citizen or U.S. resident alien.
• A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States,
• An estate (other than a foreign estate), or
• A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax on any foreign partners' share of income from such business. Further, in certain cases where a Form W-9 has not been received, a partnership is required to presume that a partner is a foreign partner, and pay the withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid withholding on your share of partnership income.

The person who gives Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States is in the following cases:

• The U.S. owner of a disregarded entity and not the entity.
CONTRACT FORMS

The awarded bidder will be required to complete and submit documents substantially similar in form to the following.

These forms may need to be modified on account of changed circumstances, and are provided for informational purposes only.
CITY - CONTRACTOR AGREEMENT

CONTRACT NO. C -

AGREEMENT made this __ day of ______ in the year Two Thousand and ______ by and between the CITY OF NEWTON, a municipal corporation organized and existing under the laws of the Commonwealth of Massachusetts, hereinafter referred to as the CITY, acting through its Chief Procurement Officer, but without personal liability to him, and hereinafter referred to as the CONTRACTOR.

The parties hereto for the considerations hereinafter set forth agree as follows:

I. SCOPE OF WORK. The Contractor agrees to furnish and to deliver to the City at such times, at such place or places, in such manner, and in such quantities as the City may direct, and at the unit prices quoted in the Contractor's bid the following item or items:

WATER & WASTEWATER SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS UPGRADE

II. CONTRACT DOCUMENTS. The Contract Documents consist of the following documents, which are either attached to this Agreement or are incorporated herein by reference:

   a. This CITY-CONTRACTOR Agreement;
   b. The City's Invitation For Bid # #15-99 issued by the Purchasing Department;
   c. The Project Manual for Water & Wastewater Supervisory Control & Data Acquisition (SCADA) Systems Upgrade including the Instructions to Bidders; General Conditions; Special Conditions; MWBE/AA Requirements, Wage Rate Requirements and Wage Rate Schedule(s) including any updated prevailing wage rate schedules if applicable; The Supplementary Special Conditions; General Requirements and Project Specifications; and Drawings, if included or referenced therein;
   d. Addenda Number(s) n/a;
   e. The Bid Response of the CONTRACTOR submitted for this Project and accompanying documents and certifications;
   f. Certificate(s) of Insurance and surety bond(s), if any, submitted by the CONTRACTOR in connection with this Project;
   g. Duly authorized and executed Amendments, Change Orders or Work Orders issued by the CITY after execution of this CITY-CONTRACTOR Agreement.

This CITY-CONTRACTOR Agreement, together with the other documents enumerated in this Article, constitute the entire Agreement between the CITY and the CONTRACTOR.

III. PRIORITY OF DOCUMENTS. In the event of inconsistency between the terms of this CITY-CONTRACTOR Agreement and the Project Manual, the terms of this Agreement shall prevail.

IV. APPLICABLE STATUTES. All applicable federal, state and local laws and regulations are incorporated herein by reference and the Contractor agrees to comply with same.
V. CONTRACT TERM. The term of this contract shall be 270 Calendar Days from the execution of the contract documents.

VI. QUANTITIES. The quantities specified in the Project Manual are approximate and are based on previous consumption. It is specifically understood the City does not agree to purchase any specific quantity, and purchases will be made to cover actual requirements only. The City may increase or decrease the quantity of any item specified without change in price per unit of quantity as stated in the Contractor’s Bid Response.

VII. MATERIALS. The Contractor agrees, unless otherwise specified, that all equipment, materials and supplies furnished under this contract are to be first quality, new and unused.

VIII. AUTHORIZATION OF AND PAYMENT FOR WORK PERFORMED. The execution of this contract does not constitute a notice to proceed or authorization to perform work or make deliveries. No work shall be commenced or deliveries made unless authorized by a written Work Order issued by the City specifying the equipment, materials or supplies to be delivered. The Contractor will be paid following completed delivery and acceptance of the equipment, materials or supplies ordered in accordance with the Contract. The City will use best efforts to pay within thirty (30) days of receipt of an invoice for the delivered equipment, materials or supplies or acceptance of same whichever date is later.

IX. CLAIMS FOR MATERIALS OR LABOR. In the event any claims have been filed with the City for material or labor delivered or performed pursuant to this contract, the City shall be under no obligation to make any payment until such claims are adjusted to the satisfaction of the City. Any and all liens for supplies may be paid off by the City within twenty (20) days after the filing for record as provided by law of a notice of such liens, except where the claim on which the lien is filed is being litigated by the Contractor, and in such case the City may pay the amount of any final judgment or decree on any such claim. All money paid by the City in settlement of liens and claims as aforesaid, with the costs and expenses incurred by the City in connection therewith shall be charged to the Seller, bearing interest at the rate of six percent (6%) per annum, and be deducted from the next payment falling due the Seller under the terms of this contract.

X. UNIT PRICES. It is agreed that the unit prices listed are maximum prices and that the City shall be entitled to take advantage of any decreasing market conditions, decreases to be governed by the manufacturers’ price listing as might be generally adopted in the trade, or by the same percentage that the Seller may reduce prices to others who purchase in similar quantities and under similar conditions.

XI. RESPONSIBILITY FOR THE WORK/INDEMNIFICATION. In the performance of any work, including the delivery of equipment, materials or supplies, pursuant to this Contract, the Contractor shall take all responsibility for the work, and shall take all precautions for preventing injuries to persons and property in or about the work and shall defend, indemnify and hold the City harmless from all loss, cost, damage or expense arising from injuries to persons or property in or about the work. The Contractor shall be responsible for any damage, which may be caused by the failure or insufficiency of any temporary works. He shall effectively protect his work and shall be liable for all damage and loss by delay or otherwise caused by his neglect or failure so to do.

XII. WARRANTY. Except as may be otherwise provided in the Project Manual, the Contractor shall replace, repair or make good, without cost to the City, any defects or faults arising within one (1) year after date of acceptance of equipment, materials or supplies furnished hereunder (acceptance not to be unreasonably delayed) resulting from imperfect or defective work done or materials furnished by the Contractor.

XIII. PATENT INDEMNIFICATION. The Contractor agrees to assume the defense of and shall indemnify and save harmless the City and all persons acting for or on behalf of it from all suits and claims against them, or any of them, arising from or occasioned by the use of any material, equipment or apparatus, or any part thereof which infringes or is alleged to infringe on any patent rights. In case such material, equipment or apparatus, or any part thereof, in any such suit is held to constitute infringement, the Contractor, within a reasonable time, shall at its own expense, and as the City may elect, replace such material, equipment or apparatus with non-infringing material, equipment or apparatus, or remove the material, equipment, or apparatus and refund the sums paid therefor.

XIV. INSPECTION. For the purposes of inspection of the equipment, materials and supplies covered by this contract, the Contractor shall give the City free access to his works and furnish every facility for properly inspecting such equipment, materials and supplies, and shall furnish full information, whenever requested, relating thereto. Approval by any inspector of the City shall not relieve the Contractor from his obligation to comply in all respects with the contract.

XV. ASSIGNMENT/SUB-CONTRACTING. The Contractor agrees that he will not sell, assign or transfer this Contract or any part thereof or interest therein without the prior written consent of the City.
XVI. INSTALLATION. If any of the equipment, materials and supplies covered by this contract is to be installed by either the Contractor or the City, the Contractor shall, upon request of the City, furnish a competent employee to supervise the installation without expense to the City, unless otherwise provided herein. Such supervisor, or other employees furnished by the Contractor, shall be the agents of the Contractor and not of the City, and the Contractor hereby agrees to indemnify the City and hold it harmless from and against any and all loss, costs, damage, and expense sustained as the result of negligence or other conduct on the part of such supervisor or employee.

XVII. TERMINATION. The City of Newton may, by written notice of default to the Contractor, terminate the whole or any part of this Contract or any Work Order issued pursuant thereto in any one of the following circumstances:

   a. If the Contractor fails to make delivery of the equipment, goods or supplies or to perform the services within the time specified herein or any extension thereof;

   b. If the Contractor fails to perform any of the other provisions of this contract or, if in the opinion of the City, Contractor so fails to make progress as to endanger performance of this contract in accordance with its terms, and in either of these two circumstances does not correct such failure within thirty (30) days (or such longer period as the City may authorize in writing) after receipt of notice from the City specifying such failure.

XVIII. GOVERNING LAW. This Contract shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts.

XIX. SEVERABILITY. The provisions of this Contract are severable. If any section, paragraph, clause or provision of this Contract shall be finally adjudicated by a court of competent jurisdiction to be invalid, the remainder of this Contract shall be unaffected by such adjudication and all of the remaining provisions of this Contract shall remain in full force and effect as though such section, paragraph, clause or provision, or any part thereof so adjudicated to be invalid, had not been included herein, unless such remaining provisions, standing alone, are incomplete and incapable of being executed in accordance with the intent of the parties to this Contract.

XX. AMENDMENTS TO THIS CONTRACT. This Contract may not be amended except in writing executed in the same manner as this CITY-CONTRACTOR Agreement.

THIS SPACE INTENTIONALLY LEFT BLANK
IN WITNESS WHEREOF, the parties have caused this instrument to be executed under seal the day and year first above written.

CONTRACTOR

By_______________________________
Print Name ______________________________
Title ______________________________
Date ______________________________

CITY OF NEWTON

By_______________________________
Chief Procurement Officer
Date ______________________________

By_______________________________
Commissioner of Public Works
Date ______________________________

Affix Corporate Seal Here

Certified that additional funds are in the following accounts:
27A401Y3-R586005
28A401Z5-R586011

Approved as to Legal Form and Character

By_______________________________
Associate City Solicitor
Date ______________________________

I further certify that the Mayor, or his designee, is authorized to execute contracts and approve change orders.

By_______________________________
Comptroller of Accounts
Date ______________________________

CONTRACT AND BONDS APPROVED

By_______________________________
Mayor or his designee
Date ______________________________
CERTIFICATE OF AUTHORITY - CORPORATE

1. I hereby certify that I am the Clerk/Secretary of ________________________________
   (insert full name of Corporation)

2. corporation, and that __________________
   (insert the name of officer who signed the contract and bonds)

3. is the duly elected ________________________________
   (insert the title of the officer in line 2)

4. of said corporation, and that on ____________________________
   (insert a date that is ON OR BEFORE the date the officer signed the contract and bonds)

   at a duly authorized meeting of the Board of Directors of said corporation, at which all the directors were present or waived, notice, it was voted that

5. ____________________________ the ____________________________
   (insert name from line 2) (insert title from line 3)

   of this corporation be and hereby is authorized to execute contracts and bonds in the name and on behalf of said corporation, and affix its Corporate Seal thereto, and such execution of any contract of obligation in this corporation’s name and on its behalf, with or without the Corporate Seal, shall be valid and binding upon this corporation; and that the above vote has not been amended or rescinded and remains in full force and effect as of the date set forth below.

6. ATTEST: ____________________________
   (Signature of Clerk or Secretary)*

   AFFIX CORPORATE
   SEAL HERE

7. Name: ____________________________
   (Please print or type name in line 6)*

8. Date: ____________________________
   (insert a date that is ON OR AFTER the date the officer signed the contract and bonds)

* The name and signature inserted in lines 6 & 7 must be that of the Clerk or Secretary of the corporation.
CERTIFICATION OF TAX COMPLIANCE

Pursuant to MG c. 62C, § 49A and requirements of the City of Newton, the undersigned acting on behalf of the Contractor certifies under the penalties of perjury that the Contractor is in compliance with all laws of the Commonwealth relating to taxes including payment of all local taxes, fees, assessments, betterments and any other local or municipal charges (unless the Contractor has a pending abatement application or has entered into a payment agreement with the entity to which such charges were owed), reporting of employees and contractors, and withholding and remitting child support.*

**Signature of Individual or Corporate Contractor (Mandatory)**

*** Contractor's Social Security Number (Voluntary) or Federal Identification Number

Print Name: __________________________

By: ______________________________
    Corporate Officer (Mandatory, if applicable)
    Date: ______________________________

Print Name: __________________________

* The provision in this Certification relating to child support applies only when the Contractor is an individual.

** Approval of a contract or other agreement will not be granted until the City receives a signed copy of this Certification.

*** Your social security number may be furnished to the Massachusetts Department of Revenue to determine whether you have met tax filing or tax payment obligations. Providers who fail to correct their non-filing or delinquency will not have a contract or other agreement issued, renewed, or extended.
CITY OF NEWTON, MASSACHUSETTS

PAYMENT BOND

Know All Men By These Presents:

That we, ____________________________, as PRINCIPAL, and ____________________________, as SURETY, are held and firmly bound unto the City of Newton as Obligee, in the sum of dollars ($_________________) to be paid to the Obligee, for which payments well and truly to be made, we bind ourselves, our respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Whereas, the said PRINCIPAL has made a contract with the Obligee, bearing the date of _______ 2015, for the construction of ____________________________ in Newton, Massachusetts.

(Project Title)

Now, the conditions of this obligation are such that if the PRINCIPAL and all Sub-contractors under said contract shall pay for all labor performed or furnished and for all materials used or employed in said contract and in any and all duly authorized modifications, alterations, extensions of time, changes or additions to said contract that may hereafter be made, notice to the SURETY of such modifications, alterations, extensions of time, changes or additions being hereby waived, the foregoing to include any other purposes or items set out in, and to be subject to, provisions of M.G.L. c.30, §39A, and M.G.L. c.149, §29, as amended, then this obligation shall become null and void; otherwise it shall remain in full force, virtue and effect.

In Witness Whereof, the PRINCIPAL and SURETY have hereto set their hands and seals this _______ day of _______ 2015.

PRINCIPAL

______________________________

BY ________________

(SEAL)

>Title

SURETY

______________________________

BY ________________

(ATTORNEY-IN-FACT) (SEAL)

Title

ATTEST: ____________________________

ATTEST: ____________________________
CITY OF NEWTON
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

1.0 DEFINITIONS

1.1 THE CONTRACT DOCUMENTS

The term "Contract Documents" sometimes also referred to as the "Contract", means the contract entered into between the City of Newton (hereinafter "City") and the Contractor. It includes the Invitation for Bid, General Bid Form, Contract Form, these General Conditions of the Contract, Supplements and Amendments to the General Conditions (if any), Contract Specifications, Drawings, all addenda issued prior to execution of the contract, the Bid Bond, the Labor and Material Payment Bond, or other assurances of completion, the applicable wage rate determinations, and other documents listed in the Agreement and modifications issued after execution of the contract.

1.2 THE WORK

The term "Work", sometimes also referred to as the "Project", means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligation.

1.3 OWNER

The term "Owner" is the City of Newton.

1.4 CONTRACT OFFICER

The term "Contract Officer" means the person appointed by the Owner to administer the terms of the Contract between the Owner and the Contractor, who is also empowered to take certain actions under this Agreement.

1.5 CONTRACTOR

1.5.1 The Contractor, sometimes referred to as the General Contractor, is the person or entity identified as such throughout the Contract Documents as if singular in number. The term Contractor means the Contractor or its authorized representative.

1.5.2 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work under the Contract.

1.6 SUBSTANTIAL COMPLETION

The term "Substantial Completion" means the value of the work remaining to be performed by the Contractor is, in the estimate of the awarding authority, less than one percent (1%) of the original contract price.

2.0 CONTRACT ADMINISTRATION

2.1 PRE-CONSTRUCTION CONFERENCE

2.1.1 Prior to commencement of the Work, the Contractor shall meet in conference with representatives of the Owner regarding the Owner's requirements under the Contract for administration of the quality assurance program, safety program, labor provisions, the schedule of work, and other Contract procedures.

2.1.2 The Contractor shall begin work upon receipt of a written Notice to Proceed from the Contract Officer or designee. The Contractor shall not begin work prior to receiving such notice.
2.2 CONTRACT PERIOD

The Contractor shall complete all work required under this contract within the timeframe specified elsewhere in this document, or within the time schedule established in the notice to proceed issued by the Contracting Officer.

2.3 REJECTION OF DEFECTIVE MATERIALS AND WORK

The Owner's inspection of the Work shall not relieve the Contractor of any of its responsibilities to fulfill the Contract obligations, and defective work shall be corrected without cost to the Owner. Unsuitable work may be rejected by the Owner, notwithstanding that such work and materials have been previously overlooked or misjudged by the Owner and accepted for payment. If the Work or any part thereof shall be found defective at any time before the final acceptance of the whole Work, the Contractor shall forthwith correct such defect in a manner satisfactory to the Owner, and if any material brought upon the site for use in the Work, or selected for the same, shall be rejected by the Owner as unsuitable or not in conformity with the Contract requirements, the Contractor shall forthwith remove such materials from the vicinity of the Work.

2.4 CHANGES

2.4.1 All changes in the work including any increase, decrease, or other equitable adjustment in the Contract price or in the time for performing the Contract, shall be authorized in writing by the Owner and/or Contract Officer prior to commencement.

2.5 CONTRACT PRICE

The Contract Price is stated in the Contract Form, and including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

2.6 APPLICATIONS FOR PAYMENT

2.6.1 Once each month, on a date established by the Owner at the beginning of the Work, the Contractor shall deliver to the Owner an itemized Application for Payment, supported by such data substantiating the Contractor's right to payment as the Owner may require, and reflecting a minimum of 5% retainage until the final acceptance and payment by the Owner.

2.6.2 The Owner shall make payment to the Contractor within 30 days of receipt of said application, less any applicable retainage.

2.6.3 The Owner may make changes in any application for payment submitted by the Contractor for:
   i. Retention based on the value of its claims against the Contractor,
   ii. Retention of 5% of the approved amount of the Application for Payment.

2.7 FINAL PAYMENT

The acceptance by the Contractor of the last payment due under this Contract or the execution of the Final Certificate of Completion, shall operate as a release to the Owner from all claims and liability related to this Contract.

2.8 GUARANTY AND WARRANTY

2.8.1 WARRANTY

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

2.8.2 GENERAL GUARANTY

If at any time during the period of one (1) year from the date of Substantial Completion of the Work to be performed under this Contract, any part of the Work shall, in the reasonable determination of the Owner, require replacing or repairing due to the fact that it is broken, defective, or otherwise does not conform to the Contract Documents, the Owner will notify the Contractor to make the required repairs or replacement. If the Contractor shall neglect to commence such repairs or replacement to the satisfaction of
the Owner within ten (10) days from the date of giving or mailing such notice, then the Owner may employ other persons to make
the same. The Contractor agrees, upon demand, to pay to the Owner all amounts which the Owner expends for such repairs or
replacements. During this one year guarantee period any corrective work shall be performed in accordance with the applicable
terms of this Contract. For items of work completed after use and occupancy has been taken, the one year guarantee shall
commence at the time the Owner accepts such items. This one year guarantee shall not limit any express guaranty or warranty
provided elsewhere in the Contract.

2.9 INSURANCE REQUIREMENTS

2.9.1 The Contractor shall provide insurance coverage as listed below. This insurance shall be provided at the Contractor's
expense and shall be in full force and effect during the full term of this Contract.

WORKER'S COMPENSATION

Worker's Compensation: Per M.G.L. c.. 149, s. 34 and c.. 152 as amended.

COMMERCIAL GENERAL LIABILITY

Personal Injury $500,000 each occurrence $1,000,000 aggregate
Property Damage $500,000 each occurrence $1,000,000 aggregate

VEHICLE LIABILITY

Personal Injury $500,000 each person $1,000,000 aggregate
Property Damage $300,000 each occurrence $500,000 aggregate

2.9.2 OWNER AS CO-INSURED

The Owner shall be named as additional insureds on the Contractor's Liability Policies.

2.9.3 CERTIFICATES OF INSURANCE, POLICIES

i. The Contractor shall not commence the work until proof of compliance with this Section 2.9 has been furnished
to the Owner by submitting one copy of a properly endorsed insurance certificate issued by a company authorized to
write insurance in the Commonwealth. This certificate shall indicate that the contractual liability coverage is in force.

ii. The Contractor shall file the original and one certified copy of all policies with the Owner within fifteen (15)
days after contract award. If the Owner is damaged by the Contractor's failure to maintain such insurance and to so
notify the Owner, then the Contractor shall be responsible for all reasonable costs attributable thereto.

2.9.4 CANCELLATION

Cancellation of any insurance required by this contract, whether by the insurer or the insured, shall not be valid unless written
notice thereof is given by the party proposing cancellation to the other party and Owner at least thirty days prior to the effective
date thereof, which shall be expressed in said notice.

2.10 INDEMNIFICATION

The Contractor shall take all responsibility for the Work and take all precautions for preventing injuries to persons and property in
or about the Work; shall bear all losses resulting to or on account of the amount or character of the Work. The Contractor shall pay
or cause payment to be made for all labor performed or furnished and for all materials used or employed in carrying out this
Contract. The Contractor shall assume the defense of, and indemnify and save harmless the Owner, and the Owner's officers and
agents from all claims relating to labor performed or furnished and materials used or employed for the Work; to inventions, patents
and patent rights used in and in doing the Work unless such patent infringement is due to a product or process specified by the
Owner; to injuries to any person or corporation received or sustained by or from the Contractor and any employees, and
subcontractors and employees, in doing the work, or in consequence of any improper materials, implements or labor used or employed therein; and to any act, omission or neglect of the Contractor and any employees therein.

2.11 BONDS

The Contractor shall provide the Owner with a performance and with a payment or labor and materials bond in the form provided by the Owner, executed by a surety company licensed by the Commonwealth of Massachusetts' Division of Insurance. Such bond shall be in an amount equal to at least one half of the Contract price unless otherwise stated in the Contract Documents. All bonds shall be accompanied by a current power of attorney.

2.12 TERMINATION

2.12.1 TERMINATION FOR CAUSE

i. The Owner may terminate this contract for cause if it determines that any of the following circumstances have occurred:
   a. The Contractor is adjudged bankrupt or has made a general assignment for the benefit of its creditors.
   b. A receiver has been appointed of the Contractor's property.
   c. All or a part of the Work has been abandoned.
   d. The Contractor has sublet or assigned all or any portion of the Work, the Contract, or claims thereunder, without the prior written consent of the Owner, except as provided in the Contract.
   e. The Owner has determined that the rate of progress required on the project is not being met.
   f. The Contractor has substantially violated any provisions of this Contract.

ii. The Owner may complete the Work, or any part thereof, and charge its expense of so completing the Work or part thereof, to the Contractor.

iii. The Owner may take possession of and use any materials, machinery, implements and tools found upon the site of said Work. The Owner shall not be liable for any depreciation, loss or damage to said materials, machinery, implements or tools during said use and the Contractor shall be solely responsible for their removal from the Project site after the Owner has no further use for them.

2.12.2 TERMINATION - NO FAULT

i. In the event that this Contract is terminated by the Owner, prior to the completion of construction and termination is not based on a reason listed in Paragraph 2.12.1, the Contractor shall be compensated for its costs incurred on the Project, including reasonable costs of de-mobilization, covering the period of time between the last approved application for payment and the date of termination.

ii. Payment by the Owner pursuant to Section 2.7 shall be considered to fully compensate the Contractor for all claims and expenses and those of any consultants, subcontractors, and suppliers, directly or indirectly attributable to the termination, including any claims for lost profits.

2.13 PERMITS, FEES, AND NOTICES

2.13.1 The Contractor shall secure and the Owner shall pay for the building permit, if required. The Contractor shall coordinate all efforts required to obtain this permit. All other permits and governmental fees, licenses, and inspections necessary for proper execution and completion of the Work shall be secured and paid for by the Contractor.

2.13.2 The Contractor shall comply with and give notices required by laws, ordinances rules, regulations, and lawful orders of public authorities bearing on performance of the Work.
2.13.3 If the Contractor performs Work that it knows or reasonably should know is contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Owner, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs.

2.14 SAFETY REQUIREMENTS

2.14.1 The Contractor shall comply with all Federal, State, and local safety laws and regulations applicable to the Work performed under this Contract.

2.15 TEMPORARY HEATING

Not required; do not install Removal & Installation of Gym Flooring in any space which is not heated properly.

2.16 AVAILABILITY AND USE OF UTILITY SERVICES

2.16.1 The City shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the Contract. Unless otherwise provided in the Contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the City or, where the utility is produced by the City, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

2.17 DISPUTES

2.17.1 "Claim," as used in this section, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to the contract. A claim arising under the Contract, unlike a claim relating to the Contract, is a claim that can be resolved under a Contract clause that provides for the relief sought by the claimant. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim. The submission may be converted to a claim by complying with the requirements of this section, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

2.17.2 All disputes arising under or relating to this Contract, including any claims for damages for the alleged breach thereof which are not disposed of by agreement, shall be resolved under this section.

2.17.3 All claims by the Contractor shall be made in writing and submitted to the Contract Officer for a written decision. A claim by the City against the Contractor shall be subject to a written decision by the Contract Officer.

2.17.4 The Contract Officer shall, within thirty (30) days after receipt of the request, decide the claim or notify the Contractor of the date by which the decision will be made.

2.17.5 The Contract Officer's decision shall be final unless the Contractor (1) appeals in writing to a higher level in the City, (2) refers the appeal to an independent mediator or arbitrator, or (3) files suit in a court of competent jurisdiction. Such appeal must be made within thirty (30) days after receipt of the Contract Officer's decision.

2.17.6 The Contractor shall proceed diligently with performance of this Contract and/or any authorized change thereof, pending final resolution of any request for relief, claim, appeal, or action arising under or relating to the Contract and/or any authorized change thereof, and comply with any decision of the Contract Officer.

2.18 LIQUIDATED DAMAGES

2.18.1 If the Contractor fails to complete the Work within the time specified in the contract, or any extension thereof, the Contractor shall pay to the City as liquidated damages, the sum of $250.00, for each site, for each day of delay. The completion date is specified in the Contract. In the context of this paragraph, “delay” means failure to provide install and complete all work set forth in Part 2 – General Requirements and Project Specifications. To the extent that the Contractor's delay or nonperformance is excused under another section in this Contract, liquidated damages shall not be due the City. The Contractor remains liable for damages caused other than by delay.
2.18.2 If the City terminates the Contractor's right to proceed pursuant to section 2.12.1, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the Work together with any increased costs to the City in completing the Work.

2.18.3 If the City does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the Work is completed or accepted.

3.0 SALES TAX EXEMPTION AND OTHER TAXES

3.0.1 To the extent that materials and supplies are used or incorporated in the performance of this Contract, the Contractor is considered an exempt purchaser under the Massachusetts Sales Act, Chapter 14 of the Acts of 1966.

3.0.2 The Contractor shall be responsible for paying all other taxes and tariffs of any sort, related to the Work.

3.1 PROHIBITION AGAINST LIENS

The Contractor is prohibited from placing a lien on the City's property. This prohibition shall apply to all subcontractors at any tier and all materials suppliers.

3.2 ORDER OF PRECEDENCE

In the event of a conflict between these General Conditions and the Specifications, the General Conditions shall prevail. In the event of a conflict between the Contract and any applicable state or local law or regulation, the state or local law or regulation shall prevail; provided that such state or local law or regulation does not conflict with, or is less restrictive than applicable federal law, regulation, or Executive Order. In the event of such a conflict, applicable federal law, regulation, and Executive Order shall prevail.

3.3 EXAMINATION AND RETENTION OF CONTRACTOR'S RECORDS

The City of Newton shall, until three (3) years after final payment under this Contract, have access to and the right to examine any of the Contractor's directly pertinent books, documents, papers, or other records involving transactions related to this Contract for the purpose of making audit, examination, excerpts, and/or transcriptions.

END OF GENERAL CONDITIONS
CITY OF NEWTON

WAGE RATE REQUIREMENTS

1. GENERAL

A. This section summarizes the requirements for the payment of wages to laborers and mechanics employed under the Contract.

B. Other duties and requirements of law which may not be specified in this section apply and are inherently a part of the Contract.

2. WAGE RATES

A. The rate per hour to be paid to mechanics, apprentices, teamsters, chauffeurs, and laborers employed on the Work shall not be less than the rate of wages in the attached "Minimum Wage Rates" as determined by the Commissioner of Labor and Industries. This schedule shall continue to be the minimum rate of wages for said employees during the life of this Contract.

B. Keep posted on the site a legible copy of said schedule. Keep on file the wage rates and classifications of labor employed on this Work in order that they may be available for inspection by the Owner, Administrator, or the Architect.

C. Apprentices employed pursuant to this determination of wage rates must be registered and approved by the State Apprenticeship Council wherever rates for journeymen or apprentices are not listed.

D. Pay reserve police officers employed on the Work the prevailing rate of wages paid to regular police officers as required by M.G.L. c149, Sec. 34B, as amended. Such police officers shall be covered by Workmen's Compensation Insurance and Employers Liability Insurance by the Contractor.

E. The Contractor and all subcontractors shall, on a weekly basis throughout the term of the contract, provide to the City of Newton certified payroll affidavits verifying compliance with M.G.L. c.149, Sec. 27, 27A and 27B. The Contractor is obligated to provide such records to the City directly on a weekly basis. The City may assess a penalty of $100 for each day beyond the required submission date that such records are received, which amount shall be deducted from any amounts to the Contractor from the City. In the event of chronic late submissions, the City shall report the same to the Office of the Attorney General.

F. The Contractor and all subcontractors shall provide a Statement of Compliance within 15 days of the completion of its portion of the work. This statement shall be submitted to the Owner on the form found elsewhere in this section.

G. The Contractor shall maintain accurate and complete records, including payroll records, during the Contract term and for three years thereafter.

END OF SECTION
THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates
As determined by the Director under the provisions of the
Massachusetts General Laws, Chapter 149, Sections 26 to 27H

Awarding Authority: City of Newton
Contract Number: 15-99
City/Town: NEWTON
Description of Work: Water and Wastewater Supervisory Control and Data Acquisition (SCADA) Systems Upgrade

Job Location: Various locations

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the “Wage Request Number” on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule from the Department of Labor Standards (“DLS”) if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM at RISK projects (bid pursuant to G.L., c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or any sub-contractor.
- All apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentice must keep his/her apprentice identification card on his/her person during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. If an apprentice is not listed on the prevailing wage schedule for the trade in which an apprentice is registered with the DAS, the apprentice must be paid the journeyworker’s rate for the trade.
- The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule. Awarding authorities are required to request these updates no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor. For multi-year CM at RISK projects, awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. Contractors are required to obtain the wage schedules from awarding authorities, and to pay no less than these rates to covered workers. The annual update requirement is not applicable to 27F “rental of equipment” contracts.
- Every contractor or subcontractor which performs construction work on the project is required to submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee’s name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. A sample of a payroll reporting form may be obtained at http://www.mass.gov/dols/pw.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may report the violation to the Fair Labor Division of the office of the Attorney General at (617) 727-3465.
- Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.

Issue Date: 04/15/2015  Wage Request Number: 20150415-011
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**Notes:**

- Apprentice to Journeyworker Ratio: 1:5

### BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)

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| Issue Date: 04/15/2015 | Wage Request Number: 20150415-011 | Page 3 of 39 |
### Apprentice - BRICK/PLASTER/CEMENT MAISON - Local 3 Newton

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### Notes:

Apprentice to Journeyworker Ratio: 1:5

**BULLDOZER/GRADER/SCRAPER**

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For apprentice rates see "Apprentice - Operating Engineers"

**CAISSON & UNDERPINNING BOTTOM MAN**

Laborers - Foundation and Marine

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For apprentice rates see "Apprentice - Laborer"

**CAISSON & UNDERPINNING LABORER**

Laborers - Foundation and Marine

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For apprentice rates see "Apprentice - Laborer"

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Issue Date: 04/15/2015  
Wage Request Number: 20150415-011  
Page 4 of 39
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**Effective Date:** 03/01/2015

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**Notes:**

Apprentice to Journeyworker Ratio: 1:5

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**Issue Date:** 04/15/2015  **Wage Request Number:** 20150415-011  **Page 5 of 39**
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[Notes: Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.]

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Issue Date: 04/15/2015   Wage Request Number: 20150415-011   Page 6 of 29
### Project Manual No. #15-99 – Water & Wastewater Supervisory Control and Data Acquisition (SCADA) Systems Upgrade

#### Page 46 of 81

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### Apprentice - PAINTER Local 35 - BRIDGES/TANKS

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### Apprentice to Journeyworker Ratio 1:1

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Issue Date: 04/15/2015  Wage Request Number: 20150415-011  Page 8 of 39
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**Notes:**
- App Prior 1/1/03; 30/35/40/45/50/55/65/70/75/80
- Apprentice to Journeyworker Ratios

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**Wage Request Number:** 20150415-011
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**Notes:**

Steps are 750 hrs.

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### FORK LIFT/CHERRY PICKER

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For apprentice rates see "Apprentice - OPERATING ENGINEERS"

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### GENERATOR/LIGHTING PLANT/HEATERS

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For apprentice rates see "Apprentice - OPERATING ENGINEERS"

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**Issue Date:** 04/15/2015  
**Wage Request Number:** 20150415-011  
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**Notes:**
- Steps are 750 hrs.
- Apprentice to Journeyworker Ratio 1:1

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**Issue Date:** 04/15/2015  
**Wage Request Number:** 20150415-011  
**Page 13 of 39**
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HVAC (DUCTWORK)

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For apprentice rates see "Apprentice-SHEET METAL WORKER"

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**Apprentice - ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston**

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**Notes:**
Steps are 1 year

Apprentice to Journeyworker Ratio: 1:4

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**Issue Date:** 04/15/2015  
**Wage Request Number:** 20150415-011
## Project Manual No. #15-99 – Water & Wastewater Supervisory Control and Data Acquisition (SCADA) Systems Upgrade

### Page 55 of 81

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**Notes:**
- **Structural 1:6; Ornamental 1:4**

### Apprentice to Journeyworker Ratio:**

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**Notes:**
- **Apprentice to Journeyworker Ratio:1:5**

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| LABORER: CEMENT FINISHER TENDER                     | 12/01/2014     | $34.60    | $7.30  | $12.95  | $0.00                     | $54.85     |
| LABORERS - ZONE 1                                   | 06/01/2015     | $35.35    | $7.30  | $12.95  | $0.00                     | $55.60     |
| LABORERS - ZONE 1                                   | 12/01/2015     | $36.10    | $7.30  | $12.95  | $0.00                     | $56.35     |
| LABORERS - ZONE 1                                   | 06/01/2016     | $36.85    | $7.30  | $12.95  | $0.00                     | $57.10     |
| LABORERS - ZONE 1                                   | 12/01/2016     | $37.85    | $7.30  | $12.95  | $0.00                     | $58.10     |

For apprentice rates see "Apprentice - LABORER"

| LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER           | 12/01/2014     | $34.75    | $7.30  | $12.95  | $0.00                     | $55.00     |
| LABORERS - ZONE 1                                   | 06/01/2015     | $35.50    | $7.30  | $12.95  | $0.00                     | $55.75     |
| LABORERS - ZONE 1                                   | 12/01/2015     | $36.25    | $7.30  | $12.95  | $0.00                     | $56.50     |

For apprentice rates see "Apprentice - LABORER"

| LABORER: MASON TENDER                               | 12/01/2014     | $34.85    | $7.30  | $12.95  | $0.00                     | $55.10     |
| LABORERS - ZONE 1                                   | 06/01/2015     | $35.60    | $7.30  | $12.95  | $0.00                     | $55.85     |
| LABORERS - ZONE 1                                   | 12/01/2015     | $36.35    | $7.30  | $12.95  | $0.00                     | $56.60     |
| LABORERS - ZONE 1                                   | 06/01/2016     | $37.10    | $7.30  | $12.95  | $0.00                     | $57.35     |
| LABORERS - ZONE 1                                   | 12/01/2016     | $38.10    | $7.30  | $12.95  | $0.00                     | $58.10     |

For apprentice rates see "Apprentice - LABORER"

| LABORER: MULTI-TRADE TENDER                         | 12/01/2014     | $34.60    | $7.30  | $12.95  | $0.00                     | $54.85     |
| LABORERS - ZONE 1                                   | 06/01/2015     | $35.35    | $7.30  | $12.95  | $0.00                     | $55.60     |
| LABORERS - ZONE 1                                   | 12/01/2015     | $36.10    | $7.30  | $12.95  | $0.00                     | $56.35     |
| LABORERS - ZONE 1                                   | 06/01/2016     | $36.85    | $7.30  | $12.95  | $0.00                     | $57.10     |
| LABORERS - ZONE 1                                   | 12/01/2016     | $37.85    | $7.30  | $12.95  | $0.00                     | $58.10     |

For apprentice rates see "Apprentice - LABORER"

| LABORER: TREE REMOVER                               | 12/01/2014     | $34.60    | $7.30  | $12.95  | $0.00                     | $54.85     |
| LABORERS - ZONE 1                                   | 06/01/2015     | $35.35    | $7.30  | $12.95  | $0.00                     | $55.60     |
| LABORERS - ZONE 1                                   | 12/01/2015     | $36.10    | $7.30  | $12.95  | $0.00                     | $56.35     |
| LABORERS - ZONE 1                                   | 06/01/2016     | $36.85    | $7.30  | $12.95  | $0.00                     | $57.10     |
| LABORERS - ZONE 1                                   | 12/01/2016     | $37.85    | $7.30  | $12.95  | $0.00                     | $58.10     |

For apprentice rates see "Apprentice - LABORER"

| LASER BEAM OPERATOR                                 | 12/01/2014     | $34.85    | $7.30  | $12.95  | $0.00                     | $55.10     |
| LABORERS - ZONE 1                                   | 06/01/2015     | $35.60    | $7.30  | $12.95  | $0.00                     | $55.85     |
| LABORERS - ZONE 1                                   | 12/01/2015     | $36.35    | $7.30  | $12.95  | $0.00                     | $56.60     |
| LABORERS - ZONE 1                                   | 06/01/2016     | $37.10    | $7.30  | $12.95  | $0.00                     | $57.35     |
| LABORERS - ZONE 1                                   | 12/01/2016     | $38.10    | $7.30  | $12.95  | $0.00                     | $58.10     |

For apprentice rates see "Apprentice - LABORER"

| MARBLE & TILE FINISHERS                             | 02/01/2015     | $37.37    | $10.18 | $17.18  | $0.00                     | $64.73     |
| BRICKLAYS LOCAL 1 - MARBLE & TILE                  | 08/01/2015     | $38.08    | $10.18 | $17.25  | $0.00                     | $65.51     |
| LABORERS - ZONE 1                                   | 02/01/2016     | $38.53    | $10.18 | $17.25  | $0.00                     | $65.96     |
| LABORERS - ZONE 1                                   | 08/01/2016     | $39.23    | $10.18 | $17.33  | $0.00                     | $66.74     |
| LABORERS - ZONE 1                                   | 02/01/2017     | $39.69    | $10.18 | $17.33  | $0.00                     | $67.20     |

Issue Date: 04/15/2015  Wage Request Number: 20150415-011  Page 17 of 39
### Apprentice - MARBLE & TILE FINISHER - Local 3 Marble & Tile

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**Apprentice to Journeyworker Ratio: 1:3**

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**Issue Date:** 04/15/2015

**Wage Request Number:** 20150415-011

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**Notes:**

Apprentice to Journeyworker Ratio: 1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES)
Operating Engineers Local 4

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For apprentice rates see "Apprentice - OPERATING ENGINEERS"

MECHANICS MAINTENANCE
Operating Engineers Local 4

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For apprentice rates see "Apprentice - OPERATING ENGINEERS"

MILLWRIGHT (Zone 1)
MILLWRIGHTS LOCAL 1121 - Zone 1

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**Notes:**
- Steps are 2,000 hours
- Apprentice to Journeyworker Ratio: 1:5

**MORTAR MIXER**

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For apprentice mix see "Apprentice - LABORER"

**OILER (OTHER THAN TRUCK CRANES, GRADALLS)**

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For apprentice mix see "Apprentice - OPERATING ENGINEERS"

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For apprentice mix see "Apprentice - OPERATING ENGINEERS"

**OTHER POWER DRIVEN EQUIPMENT - CLASS II**

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For apprentice mix see "Apprentice - OPERATING ENGINEERS"

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**Issue Date:** 04/15/2015  
**Wage Request Number:** 20150415-011  
**Page 20 of 39**
### Water & Wastewater Supervisory Control and Data Acquisition (SCADA) System Upgrade

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#### Apprentice - PAINTER Local 35 - BRIDGES/TANKS

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**Notes:**
- Steps are 750 hrs.
- Apprentice to Journeyworker Ratio 1:1

**PAINTER (SPRAY OR SANDBLAST, NEW)**

*If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2*

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**Issue Date:** 04/15/2015  **Wage Request Number:** 20150415-011  **Page 21 of 39**
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Notes:
- Steps are 750 hrs.

Apprentice to Journeyworker Ratio: 1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT)
PAINTER LOCAL 35 - ZONE 2

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### Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint

**Effective Date:** 01/01/2015

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**Effective Date:** 07/01/2015

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**Notes:**
- Steps are 750 hrs.
- Apprentice to Journeyworker Ratio: 1:1

PAINTER (TRAFFIC MARKINGS)

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For Apprentice rates see "Apprentice - LABORER"

PAINTER / TAPER (BRUSH, NEW) *

* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.

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Issue Date: 04/15/2015  
Wage Request Number: 20150415-011  
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Notes:
Steps are 750 hrs.
Apprentice to Journeyworker Ratio 1:1

PAINTER / TAPER (BRUSH, REPAINT)
PAINTERS LOCAL 35 - ZONE 2

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Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio 1:1

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Effective Date - 08/01/2015

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Notes:  
Apprentice to Journeyworker Ratio: 1:3

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Issue Date: 04/15/2015  Wage Request Number: 20150415-011  Page 26 of 39
### Classification

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**Notes:**

- **1/2:** 1/15; 1/10 thereafter / Steps are 1 yr.
- Refrigeration Mechanic **2:** 1/2; 2/1; 3/1; 4/1; 5/3; 6/4; 7/5; 8/12; 9/14; 10/17/19; 20/10/23 (Max)
- Apprentices to Journeyworker Ratio**

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### PLUMBERS & GASFITTERS

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Issue Date: 04/15/2015  
Wage Request Number: 20150415-011  
Page 27 of 39
### Apprentices - PLUMBER/GASFITTER - Local 12

**Effective Date:** 03/01/2015

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**Notes:**
- **1:** 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12
- **Steps:** an 1 yr
- **Step 1:** with lic $55.03
- **Step 5:** with lic $62.48

**Apprentice to Journeyworker Ratio:**

**PNFUMATIC CONTROLS (TEMP.)**

Pipefitters Local 337

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**PNFUMATIC DRILL/TOOL OPERATOR**

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**POWDERMAN & BLASTER**

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For apprentice rates see "Apprentice- Pipfitter" or "PLUMBER/PIPEFITTER"
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Issue Date: 04/15/2015   Wage Request Number: 20150415-011   Page 29 of 39
### Project Manual No. #15-99 – Water & Wastewater Supervisory Control and Data Acquisition (SCADA) Systems Upgrade

**Page 69 of 81**

#### Classification

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**Notes:**

Apprentice to Journeyworker Ratio: 1:5

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For apprentice rates see "Apprentice - LABORER".

#### ROLLER/SPREADER/MULCHING MACHINE OPERATING ENGINEERS LOCAL 4

| 12/01/2014 | $41.99 | $10.00 | $14.30 | $0.00 | $66.29 |
| 06/01/2015 | $42.73 | $10.00 | $14.30 | $0.00 | $67.03 |
| 12/01/2015 | $43.97 | $10.00 | $14.30 | $0.00 | $68.27 |
| 06/01/2016 | $44.72 | $10.00 | $14.30 | $0.00 | $69.02 |
| 12/01/2016 | $45.95 | $10.00 | $14.30 | $0.00 | $70.25 |
| 06/01/2017 | $46.94 | $10.00 | $14.30 | $0.00 | $71.24 |
| 12/01/2017 | $47.93 | $10.00 | $14.30 | $0.00 | $72.23 |

For apprentice rates see "Apprentice - OPERATING ENGINEERS".

#### ROOFER (Ins.Roof Waterproofing &Roofers Dampproofing) ROOFERS LOCAL 33

| 02/01/2015 | $40.11 | $10.50 | $11.60 | $0.00 | $62.21 |
| 08/01/2015 | $41.01 | $10.50 | $11.60 | $0.00 | $63.11 |
| 02/01/2016 | $41.91 | $10.50 | $11.60 | $0.00 | $64.01 |
## Apprentice - ROOFER - Local 33

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**Notes:** **1:** 1-5, 2-6-10, the 1:10; Renoofing: 1-4, then 1:1
Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.

Apprentice to Journeyworker Ratio: **1:1**

- **ROOFER SLATE / TILE / PRECAST CONCRETE**
  - ROOFER LOCAL 33
    - 02/01/2015: $40.36
    - 08/01/2015: $41.26
    - 02/01/2016: $42.16
    - Total: $62.66
    - 02/01/2015: $43.28
    - 08/01/2015: $44.28
    - 02/01/2016: $45.98
    - 08/01/2016: $46.43
    - 02/01/2017: $47.53
    - 08/01/2017: $48.63
    - 02/01/2018: $49.78
    - Total: $64.26

- **SHEETMETAL WORKER**
  - SHEETMETAL WORKERS LOCAL 17 - A
    - 02/01/2015: $43.28
    - 08/01/2015: $44.28
    - 02/01/2016: $45.98
    - 08/01/2016: $46.43
    - 02/01/2017: $47.53
    - 08/01/2017: $48.63
    - 02/01/2018: $49.78
    - Total: $76.24

The above rates are for Apprentice - ROOFER.

Issue Date: 04/15/2015  Wage Request Number: 20150415-011  Page 31 of 29
### Project Manual No. #15-99 – Water & Wastewater Supervisory Control and Data Acquisition (SCADA) Systems Upgrade

#### Sign Erector

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**Notes:**
- Steps are 6 mos.
- Apprentice to Journeyworker Ratio: 1:4

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**Notes:**
Steps are 4 mos.

Apprentice to Journeyworker Ratio: 1:1

| SPECIALIZED EARTH MOVING EQUIP < 35 TONS TEAMSTERS, JOURNEYMAN, #10 ZONE A |
|-----------------------------|----------------|--------|---------|--------------|------------|
| 12/01/2014 | $32.69 | $9.91 | $9.33 | $0.00 | $51.93 |
| 06/01/2015 | $33.04 | $9.91 | $9.33 | $0.00 | $52.28 |
| 08/01/2015 | $33.04 | $10.41 | $9.33 | $0.00 | $52.78 |
| 12/01/2015 | $33.04 | $10.41 | $10.08 | $0.00 | $53.53 |
| 06/01/2016 | $33.54 | $10.41 | $10.08 | $0.00 | $54.03 |
| 08/01/2016 | $33.54 | $10.41 | $10.08 | $0.00 | $54.53 |
| 12/01/2016 | $33.54 | $10.41 | $10.08 | $0.00 | $55.53 |

| SPECIALIZED EARTH MOVING EQUIP > 35 TONS TEAMSTERS, JOURNEYMAN, #10 ZONE A |
|-----------------------------|----------------|--------|---------|--------------|------------|
| 12/01/2014 | $32.98 | $9.91 | $9.33 | $0.00 | $52.22 |
| 06/01/2015 | $33.33 | $9.91 | $9.33 | $0.00 | $52.57 |
| 08/01/2015 | $33.33 | $10.41 | $9.33 | $0.00 | $53.07 |
| 12/01/2015 | $33.33 | $10.41 | $10.08 | $0.00 | $53.82 |
| 06/01/2016 | $33.83 | $10.41 | $10.08 | $0.00 | $54.32 |
| 08/01/2016 | $33.83 | $10.91 | $10.08 | $0.00 | $54.82 |
| 12/01/2016 | $33.83 | $10.91 | $10.08 | $0.00 | $55.63 |

| SPRINKLER FITTER SPRINKLER FITTERS LOCAL 510 - (Section 4) Zone 1 |
|-----------------------------|----------------|--------|---------|--------------|------------|
| 03/01/2015 | $24.43 | $8.42 | $14.90 | $0.00 | $57.75 |
| 10/01/2015 | $8.55 | $8.42 | $14.90 | $0.00 | $38.90 |
| 01/01/2016 | $55.58 | $8.67 | $15.05 | $0.00 | $79.30 |
| 03/01/2016 | $56.58 | $8.67 | $15.05 | $0.00 | $80.30 |
| 10/01/2016 | $77.73 | $8.67 | $15.05 | $0.00 | $81.15 |
| 03/01/2017 | $87.73 | $8.67 | $15.05 | $0.00 | $82.45 |

**Issue Date:** 04/15/2015  
**Wage Request Number:** 20150415-011  
**Page 33 of 39**
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Notes: Apprentice entered prior 9/30/10: 40/45/50/55/60/65/70/75/80/85.
Steps are 850 hours.

For apprentice rates see "Apprentice—OPERATING ENGINEERS".

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Issue Date: 04/15/2015  Wage Request Number: 20150415-011  Page 34 of 39
### Telecommunication Technician - Local 103

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### Notes:

- Apprentice to Journeycraft Worker Ratio: 1:1

Issue Date: 04/15/2015  
Wage Request Number: 20150415-011  
Page 38 of 39
## Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile

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### Notes:
- Apprentice to Journeyworker Ratio: 1:3

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## TEST BORING DRILLER

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### Notes:
- For apprentice rates see "Apprentice-LABORER"

## TEST BORING DRILLER HELPER

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### Notes:
- For apprentice rates see "Apprentice-LABORER"

## TEST BORING LABORER

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Issue Date: 04/15/2015  Wage Request Number: 20150415-011  Page 37 of 39
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Issue Date: 04/15/2015  Wage Request Number: 201501-011  Page 38 of 39
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**Notes:**

- Apprentice to Journeymen Ratio: 1:2

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**TELEDATA CABLE SPLICER**

Outside Electrical Workers - East Local 104

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This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company’s equipment, and (c) by a person who is using hand or mechanical cutting methods and is not on the ground.

---

**TELEDATA LINEMAN/EQUIPMENT OPERATOR**

Outside Electrical Workers - East Local 104

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**TELEDATA WIREMAN/INSTALLER/TECHNICIAN**

Outside Electrical Workers - East Local 104

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**TREE TRIMMER**

Outside Electrical Workers - East Local 104

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This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company’s equipment, and (c) by a person who is using hand or mechanical cutting methods and is on the ground. This classification does not apply to wholesale tree removal.

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**TREE TRIMMER GROUNDMAN**

Outside Electrical Workers - East Local 104

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**Additional Apprentice Information:**

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27B. Apprentice rates are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11B-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11B-11L.

All steps are six months (1900 hours).

Rates are expressed as a percentage of the base wage or fraction thereof, unless otherwise specified.

**Multiple rates are listed in the comment field.**

**APP to JMC: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, etc.**

**APP to JHC: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, etc.**

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Issue Date: 04/15/2015  
Wage Request Number: 20150415-011
Massachusetts Prevailing Wage Law
M.G.L. ch. 149, §§ 26 – 27

NOTICE TO AWARDING AUTHORITIES

➢ 'The enclosed wage schedule applies only to the specific project listed at the top and will be updated for any public construction project lasting longer than one (1) year.

➢ 'You should request an updated wage schedule from the Division of Occupational Safety if you have not opened bids or selected a contractor within 90 days of the date of issuance of the enclosed wage schedule.

➢ 'The wage schedule shall be incorporated in any advertisement or call for bids for the project for which it has been issued.

➢ 'Once a contractor has been selected by the awarding authority, the wage schedule shall be made a part of the contract for that project.

NOTICE TO CONTRACTORS

➢ The enclosed wage schedule, and any updated schedule, must be posted in a conspicuous place at the work site during the life of the project.

➢ The wages listed on the enclosed wage schedule must be paid to employees on public works projects regardless of whether they are employed by the prime contractor, a filed sub-bidder, or any sub-contractor.

➢ The enclosed wage schedule applies to all phases of the project including the final clean-up. Contractors whose only role is to perform final clean-up must pay their employees according to this wage schedule.

➢ All apprentices must be registered with the Massachusetts Division of Apprentice Training in order to be paid at the reduced apprentice rates. If a worker is not registered with the Division of Apprentice Training, they must be paid the “total rate” listed on the wage schedule regardless of experience or skill level. For further information, please call (617) 727-3486 or write to the Division of Apprentice Training, 399 Washington Street, 4th Floor, Boston, MA 02108
WEEKLY PAYROLL RECORDS REPORT & STATEMENT OF COMPLIANCE

In accordance with Massachusetts General Law c.149, §27B, a true and accurate record must be kept of all persons employed on the public works project for which the enclosed rates have been provided. A Payroll Form has been printed on the reverse of this page and includes all the information required to be kept by law. Every contractor or subcontractor is required to keep these records and preserve them for a period of three years from the date of completion of the contract.

In addition, every contractor and subcontractor is required to submit a copy of their weekly payroll records to the awarding authority. This is required to be done on a weekly basis. Once collected, the awarding authority is also required to preserve those records for three years.

In addition, each such contractor, subcontractor or public body shall furnish to the Department of Labor & Workforce Development/Division of Occupational Safety within fifteen days after completion of its portion of the work a statement, executed by the contractor, subcontractor or public body who supervises the payment of wages, in the following form:

STATEMENT OF COMPLIANCE

________________________, 2015

I, ____________________________________________________________,
(Name of signatory party) (Title)
do hereby state:
That I pay or supervise the payment of the persons employed by
___________________________________ on the ______________________________
(Contractor, subcontractor or public body) (Building or project)
and that all mechanics and apprentices, teamsters, chauffeurs and laborers employed on said project have been paid in accordance with wages determined under M.G.L. c149, §§26-27.

Signature _________________________
Title ______________________________

DIVISION OF OCCUPATIONAL SAFETY, 399 WASHINGTON STREET, 5TH FL., BOSTON, MA. 02108
PART 1 – GENERAL

1.01 PROJECT WORK/IDENTIFICATION

A. General: The name of this project is the CITY OF NEWTON – SCADA UPGRADES PHASE 1. The project is for the Department of Public Works, City of Newton, Massachusetts. The project number is 221942.01 on documents by Woodard & Curran, Inc., Consulting Engineers, dated February 2015.

B. Summary of References: Work under this contract can be summarized by reference to the Agreement, General Conditions, Supplementary Conditions, Specification Sections as listed in the Table of Contents bound herewith and Addenda issue.

1.02 DESCRIPTION OF WORK

A. Location: The electrical installation WORK will be performed at seventeen remote sites, a main control station and the DPW office. All of the sites are located in Newton, Massachusetts.

B. Pre-Bid Meeting: The CONTRACTOR shall attend a MANDATORY Pre-Bid meeting and walk through for all sites to evaluate site conditions and note exceptions.

C. Demolition: The demolition work consists of removing old alarm and equipment cabinets, instruments, telephone modems, and equipment inside old bubbler control panels.

D. Installation: The WORK consists of furnishing and installing control panels, radio equipment, antennas, instruments, floats, cables, wires, junction boxes conduit for use in upgrading controls that are part of the Newton SCADA system. It includes providing electrical contractor services including the labor and materials (wiring, conduits, junction boxes, grounding materials, mounting brackets, etc.) as needed to install new SCADA control panels or rewiring existing panels. The work includes furnishing computer equipment and software as specified.

The WORK shall be performed at nineteen sites including the DPW office, water storage tanks, a covered reservoir, water pumping stations, wastewater pumping stations and a dewatering station.

The OWNER shall cut the road, trench and repave the road at the Oldham wastewater pumping station to assist the electrical work. Any equipment removed during demolition shall be returned to the OWNER. Radio configuration, antenna
cable termination and radio testing done shall be by the ENGINEER under a separate contract. Programming of PLC equipment in SCADA control panels shall be done by the ENGINEER under a separate contract.

The contractor is responsible for provide a climber to install radio equipment as needed.

1.03 SITE SPECIFIC SUMMARY

A. Edgewater Park Wastewater Pump Station


   a. Demolition

      1) Demolish existing alarm panel, associated conduit and wiring.

      2) Demolish the telephone modem from existing SCADA panel.

      3) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation

      1) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.

      2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

      3) Mount antenna, cable and surge protection on outside wall of building behind SCADA control panel. Install antenna within 1 degree of level and plumb. Exact location of antenna and surge box to be determined by Engineer prior to installation.

      4) Provide the new level transducer, floats, and intrinsic barriers.

      5) Provide all conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

      6) Provide new ISB subpanel in bubbler panel.
B. Elliot Street Wastewater Pump Station

1. Reference drawings I-201 through I-210, E-001, E-002, E-200.

   a. Demolition

      1) Relocate existing flow transmitter currently inside the existing SCADA control panel, to the wall next to the existing SCADA cabinet.

      2) Demolish existing SCADA control panel.

      3) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation

      1) Provide new SCADA control panel. Install in place of existing control panel.

      2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

      3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

      4) Provide the new level transducers, floats, and intrinsic barriers.

      5) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

      6) Provide new station flooding float switch.

C. Grayson Lane Wastewater Pump Station


   a. Demolition

      1) Demolish existing Mercoid controller, associated conduit and wiring.
2) Demolish the telephone modem from the existing SCADA panel.

b. Installation
1) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.

2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

4) Provide the new level transducers, floats, and intrinsic barrier panel.

5) Provide (2) new HOA switches for pumps. Install the HOA switches in the door of the old bubbler control cabinet.

6) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC

D. Hamlet Street Wastewater Pump Station


a. Demolition
1) Demolish existing Mercoid controller, associated conduit and wiring

2) Demolish the telephone modem from the existing SCADA panel.

b. Installation
1) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.

2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.
3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

4) Provide the new level transducers, floats, and intrinsic barrier panel.

5) Provide conduit, wire, cable junction boxes and miscellaneous materials as needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

E. Islington Road Wastewater Pump Station


   a. Demolition

      1) Demolish the chart recorder from the existing SCADA cabinet door.

      2) Demolish existing alarm panel, associated conduit and wiring.

      3) Demolish the telephone modem from existing SCADA panel.

      4) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation

      1) Provide a painted metal cover plate on the SCADA panel door to cover chart recorder cutout. Match the cover of the existing enclosure.

      2) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.

      3) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

      4) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
5) Provide the new level transducers, floats, and intrinsic barrier panel.

6) Provide conduit, wire, cable junction boxes and miscellaneous materials as needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

F. Longfellow Road Wastewater Pump Station


   a. Demolition
      1) Demolish existing alarm panel, associated conduit and wiring.
      2) Demolish the telephone modem from existing SCADA panel.
      3) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation
      1) Provide (2) new HOA switches for pumps. Install the HOA switches in the door of the SCADA cabinet.
      2) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.
      3) Provide new radio, antenna, cable, surge arrestor and surge enclosure.
      4) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
      5) Provide the new level transducers, floats, and intrinsic barrier subpanel.
      6) Provide conduit, wire, cable junction boxes and miscellaneous materials as needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.
G. Oldham Road Wastewater Pump Station


   a. Demolition
      1) Demolish existing alarm panel, associated conduit and wiring.
      2) Demolish the telephone modem from existing SCADA panel.
      3) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation
      1) Provide (2) new HOA switches for pumps. Install the HOA switches in the door of the SCADA cabinet.
      2) Move the existing SCADA control panel to the above ground enclosure by the side of the street. Rework electrical equipment in above ground cabinet as needed to accept SCADA cabinet.
      3) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.
      4) Provide new radio, antenna, cable, surge arrestor and surge enclosure.
      5) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
      6) Provide the new level transducers, floats, and intrinsic barrier subpanel.
      7) Provide conduit, wire, cable junction boxes and miscellaneous materials as needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.
      8) The OWNER shall cut road, trench and repave road between the existing underground station and the existing electrical enclosure on the sidewalk.
H. Prairie Avenue Wastewater Pump Station


   a. Demolition
      1) Demolish existing alarm panel, associated conduit and wiring.
      2) Demolish the telephone modem from existing SCADA panel.
      3) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation
      1) Provide new equipment in existing SCADA panel as indicated in the control panel drawings.
      2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.
      3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
      4) Provide the new level transducers, floats, and intrinsic barrier subpanel.
      5) Provide conduit, wire, cable junction boxes and miscellaneous materials as needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

I. DPW Office

   a. Demolition
      1) Remove the SCADA control panel and Verbatim alarm dialer from the DPW office.

   b. Installation
      1) None.

J. Quinobequin Road Wastewater Pump Station
1. Reference drawings I-101 through I-112, E-001, E-002, E-100

a. Demolition
   1) Demolish the telephone modem and CDMA modem from existing SCADA panel.
   2) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.
   3) Demolish the sub panel from the existing SCADA panel.
   4) Demolish all equipment indicated from the SCADA panel door as detailed on the control panel drawings.

b. Installation
   1) Provide (2) new SCADA computers and software as defined in sections 40 94 33. Installation of computer and software by others.
   2) Provide new sub panel. Install in place of the original control sub panel.
   3) Provide new radio, antenna, cable, surge arrester and surge enclosure.
   4) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
   5) Provide the new level transducers, floats, and intrinsic barriers.
   6) Provide a new set of doors on the existing Hoffman SCADA cabinet and install the existing Pump 1 - Pump 4 HOA switches and lights on those new doors. Paint the doors to match the existing enclosure.
   7) Provide (2) Cat5E Ethernet cables in a conduit between the SCADA control panel and the Operators room.
   8) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.
K. Waban Avenue Wastewater Pump Station


   a. Demolition
      1) Demolish existing alarm panel, associated conduit and wiring.
      2) Demolish existing SCADA control panel.
      3) Demolish the bubbler control system, air compressors, associated conduit, wiring, reset boxes and junction boxes.

   b. Installation
      1) Provide new SCADA control panel. Install in place of existing control panel.
      2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.
      3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
      4) Provide the new level transducers, floats, and intrinsic barrier panel.
      5) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

L. Engine 10 Water Pump Station


   a. Demolition
      1) Demolish the telephone modem from the SCADA panel.
SUMMARY OF WORK

WOODARD & CURRAN

20221942.01
Issue Date: February 2015
City of Newton, MA

SCADA Upgrades Phase 1

2) Demolish the (2) telephone tone telemetry circuits and associated converters from the SCADA panel.

b. Installation
1) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

2) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

3) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

M. Flowed Meadow Dewatering Station


a. Demolition
1) None

b. Installation
1) Provide new SCADA panel.

2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

4) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

N. Langley Road Water Booster Station


a. Demolition
1) Demolish the telephone modem from the SCADA panel.

2) Demolish Tigerflow control panel.

b. Installation

1) Provide a combination starter for the Jockey pump, to include fused disconnect, HOA switch, Run and Off indication, in a NEMA 12 enclosure. Field verify voltage and horse power for the motor and starter. Wire monitoring and control contacts to the PLC.

2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

4) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

O. Manet Water Booster Station


a. Demolition

1) Demolish the telephone modem from the SCADA panel.

2) Demolish the Modicon panel.

b. Installation

1) Provide a junction box where the existing Modicon control cabinet was located. Extend conduit and wire as needed to connect to SCADA cabinet.

2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
P. Oak Hill Water Storage Tank

   
a. Demolition
   1) None.

b. Installation
   1) Provide new SCADA panel next to the existing control cabinets. Support the enclosure by galvanized Unistrut posts with a concrete pad. Connect to existing load center. Provide one 20 Amp breaker to load center as needed to power SCADA panel.

   2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

   3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.

   4) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

Q. Stanton Water Storage Tank

   
a. Demolition
   1) Demolish the telephone modem from the SCADA panel.

b. Installation
   1) Provide new radio, antenna, cable, surge arrestor and surge enclosure.

   2) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of
antenna and surge box to be determined by Engineer prior to installation.

3) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

R. Waban Hill Covered Reservoir

   a. Demolition
      1) Demolish existing SCADA panel.
   b. Installation
      1) Provide new SCADA control panel.
      2) Provide new radio, antenna, cable, surge arrestor and surge enclosure.
      3) Mount antenna, cable and surge protection. Install antenna within 1 degree of level and plum. Exact location of antenna and surge box to be determined by Engineer prior to installation.
      4) Provide conduit, wire, cable junction boxes and miscellaneous materials needed to connect equipment identified for monitoring and control in the SCADA control panel drawings. Wire all the station IO to the Allen-Bradley PLC.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION
SECTION 01 11 05
OVERALL GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies the overall general requirements for execution of the Work, supplements some items in the General and *Special* *Supplementary* Conditions, and applies to all Specifications and Drawings, including:

1. Administrative and procedural requirements (relating to the process of contract administration, and the methods of communicating, controlling, and assuring quality);

2. Temporary facilities and controls (put into place for use only during the period of construction and that will be removed when no longer required for construction operations);

3. General execution requirements; and

4. Startup/commissioning and performance testing.

B. Section Includes

1.02 PRICE AND PAYMENT PROCEDURES
Schedule of Values
Payment Procedures
Change Procedures
Measurement and Payment Procedures
Correlation of Submittals

1.03 ADMINISTRATIVE REQUIREMENTS
Project Management and Coordination; Meetings
Documentation of Progress
Submittal Procedures
Closeout Procedures

1.04 QUALITY REQUIREMENTS
Reference Standards and Regulatory Requirements
Qualifications
PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL
   General
   Independent Testing Agency Certification
   Factory Testing

2.02 PRODUCT REQUIREMENTS
   General
   Transportation and Handling
   Storage and Protection

PART 3 - EXECUTION

3.01 TEMPORARY CONSTRUCTION FACILITIES
   Barriers
   Protection of Work
   Security
   Safety Facilities
   Access Roads
   Parking
   Field Offices
   Project Identification
   Progress Cleaning and Waste Removal

3.02 TEMPORARY UTILITIES

3.03 TEMPORARY CONTROLS
   Dust Control
   Water Control and Dewatering
   Erosion and Sediment Control
   Noise Control
   Pollution Control
   Traffic Regulation

3.04 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS
3.05 OVERALL EXECUTION REQUIREMENTS
   Coordination
   Existing Conditions
   Field Engineering
   Record Documents
   Cutting and Patching
   Electrolytic Corrosion Prevention
   Quality Assurance and Control of Installation
   Manufacturers’ Field Services
   Independent Testing

3.06 STARTUP, TESTING, AND COMMISSIONING
   Spare Parts
   Consumables
   Checkout and Starting Systems
   Starting, Adjusting, and Balancing
   Startup and Commissioning/Performance Testing
   Demonstration and Training

3.07 ATTACHMENTS

1.02 PRICE AND PAYMENT PROCEDURES

A. Schedule of Values
   1. Submit preliminary and final Schedule of Values.
   2. Provide sufficient detail to allow for determination of the value of the Work at any degree of completion. Identify number and title of related specification sections in accordance with the Table of Contents.

B. Payment Procedures
   1. Submit certified weigh slips for hot bituminous pavement ready mix concrete on a daily basis or as each truckload of pavement is placed.
   2. Payment Period: at intervals stipulated in the Agreement.

C. Change Procedures
   1. Utilize forms included in the Project Forms section.
      a. Field Order: issued by Engineer or Owner to advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time.
b. **Change Request**: issued by Engineer, Owner or Contractor to request or authorize minor variations and deviations, amendments or supplements to the Contract Documents. Initiate requests for substitute items using a Change Request.

1) Engineer or Owner to include a detailed description of a proposed change with supplementary or revised Drawings and Specifications, including a change in Contract Times related to the change (with a stipulation for any overtime work required) and the period of time during which the requested price will be considered valid. Prepare and submit an estimate within 15 days.

2) Contractor to describe the proposed change and its full effect on the Work. Describe the reason for the change and the effect on the Contract Price and Contract Time with full documentation (and a statement describing the effect on Work by separate or other contractors). Document any requested substitutions.

c. **Work Change Directive**: issued by Engineer or Owner, signed by Engineer or Owner and instructing Contractor to proceed with a change in the Work. Work authorized in a Work Change Directive will be included in a subsequent Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Price or Contract Time. Promptly execute the change.

d. **Change Order**: issued by Engineer or Owner.

1) **Stipulated Price Change Order**: based on Contractor’s maximum price quotation or Contractor’s request for a Change Order as approved by Engineer or Owner.

2) **Unit Price Change Order**: for pre-determined unit prices and quantities and executed on a fixed unit price basis. Execute Work under a Work Change Directive for unit costs or quantities of work not pre-determined. Changes in Contract Price and Contract Time to be computed as specified for Time and Material Change Order.

3) **Time and Material Change Order**: based on itemized account and supporting data after completion of change. Engineer or Owner and Contractor to determine the change allowable in Contract Price and Contract Time. Maintain detailed records of work done on this basis, provide full information required for evaluation of proposed changes, and substantiate costs for changes in the Work.
e. **Substitutes and “Or Equals”:** Request substitute items as a Change Request in accordance with subparagraph C.1.b. above, with complete data substantiating compliance of proposed substitution with Contract Documents.

1) Substitute items will be processed in accordance with subparagraph 1.03.C.6 below.

2) Substitute items will not be considered when indicated or implied on Shop Drawing or material and equipment data submittals without separate written request, or when acceptance will require revision to the Contract Documents.

D. **Measurement and Payment Procedures**

1. **Unit Prices**
   a. Take measurements in presence of Engineer and compute quantities. Engineer or Owner to verify and also take measurements and quantities. Notify Engineer or Owner in advance when measurements must be taken.
   b. Unit quantities and measurements indicated in the Bidding Documents, if any, are for Contract purposes only. Actual quantities and measurements supplied or placed in the Work determine amount of payment.

2. **Payment** includes full compensation for required labor, material and equipment, tools, plant, transportation, services and incidentals; erection, application or installation and construction of an item of the Work; and overhead and profit, unless otherwise indicated.

E. **Correlation of Submittals**

1. Promptly revise Schedule of Values (if any) and Applications for Payment to record each authorized Change Order as a separate line item and adjust the Contract Price.

2. Promptly revise Progress Schedule to reflect any change in Contract Times and revise sub-schedules to adjust time for other items of the Work affected by the change.

3. Promptly enter changes in Project Record Documents.
1.03 ADMINISTRATIVE REQUIREMENTS

A. Project Management and Coordination; Meetings

1. Contact information for Owner and other entities related to the Project and special coordination requirements and contacts during prosecution of the Work are included as an attachment to this Section.

2. Inform Owner and Engineer of the address for sending official correspondence and the address and telephone number of Contractor's representative who will be project manager and Site superintendent for the Contract and identify the 24 hour, 7 days per week emergency response telephone or cell phone number that is staffed by a person (not a passive answering machine) or provide that a phone call will be returned within one hour.

3. During periods of construction and testing keep Owner and Engineer informed in writing with name, address, and telephone number of Contractor's representative who will be responsible and available outside of normal working hours for emergency repairs and the maintenance of safety devices.

4. Identify correspondence, drawings, data and materials, packing slips or other items associated with this Contract.

5. Coordinate scheduling, submittals, and Work of the various Specifications to effectuate an efficient and orderly sequence for installing interdependent construction elements, with provisions for accommodating items installed later.

6. Preconstruction Conference and Site Mobilization Meeting

   a. Owner to schedule an initial preconstruction.

   b. Attendance required by Owner, Contractor, Engineer, Contractor's Superintendent, Project Manager, Subcontractors and major Suppliers as needed.

   c. Agenda

      • Distribute Contract Documents
      • Discuss design concepts
      • Discuss preliminary Progress Schedule, Schedule of Submittals, Schedule of Values and preliminary cash flow projections.
      • Designate personnel representing each party; communication procedures
• Procedures and processing of submittals, substitutions, applications for payments, Change Orders and Contract closeout procedures
• Scheduling
• Use of premises by Owner and Contractor
• Owner's requirements and partial occupancy
• Construction facilities and controls provided by Owner
• Temporary utilities provided by Owner and Contractor
• Survey and Site Layout
• Security and housekeeping procedures
• Schedules
• Procedures for testing
• Procedures for maintaining record documents
• Requirements for start-up
• Inspection and acceptance of equipment put into service during construction period
• Access, laydown and coordination with others

d. Engineer will record minutes and distribute draft copies prior to the next scheduled meeting to Owner and Contractor for review, then revise as required and distribute within 2 weeks thereafter to meeting participants, with copies to Owner and Contractor, and those affected by decisions made.

7. Progress Meetings

a. Owner to schedule progress meetings beginning no later than 60 days after the Initial Conference and continue thereafter on a monthly basis throughout progress of the Work.

b. Attendance required by Contractor, Contractor's Superintendent, major Subcontractors and Suppliers, Owner and Engineer as appropriate to agenda topics for each meeting.

c. Agenda:
• Review minutes of previous meetings
• Unresolved Issues
• Review Work progress
• Observations, problems, and decisions
• Identification of problems which impede planned progress
• Review of Schedule of Submittals and status of submittals
• Review of off-Site fabrication and delivery schedules
• Maintenance of progress schedule
• Corrective measures to regain projected schedules
• Planned progress during succeeding Work period
• Coordination of projected progress
• Maintenance of quality and Work standards
Effect of proposed changes on Progress Schedule and coordination

Other business relating to Work

d. Engineer will record minutes and distribute draft copies prior to the next scheduled meeting to Owner and Contractor for review, then revise as required and distribute within 2 weeks thereafter to meeting participants, with copies to Owner and Contractor, and those affected by decisions made.

8. Pre-installation Conference and Coordination Meetings

a. When required, convene a pre-installation conference at Site before commencing certain Work that requires coordination or has special requirements or approvals or convene coordination meetings as may be generally required.

b. Attendance required by parties directly affecting, or affected by, Work of the specific Specification section. Notify Owner and Engineer 5 days in advance of pre-installation conference. Party requesting general coordination meeting to notify other party.

c. Review conditions, preparation and procedures, and coordination with related Work.

B. Documentation of Progress

1. Submit preliminary and final Progress Schedules.

a. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

b. Indicate estimated percentage of completion for each item of Work at each submission.

c. Indicate dates for fabrication, factory testing, delivery, shipping and field testing, and material and equipment delivery dates, including those furnished by Owner. Coordinate with Schedule of Submittals.

2. Submit revised Progress Schedule on monthly basis and with each Application for Payment, identifying changes since previous version. Coordinate content with Schedule of Values, if any.

3. Provide documentation of pre-construction conditions and construction progress using Digital Video Recording.
a. Prior to the start of construction, video record, in color, all areas of the Project Site in the presence of the Engineer to establish a record of pre-construction conditions. Ensure existing conditions of roadway surfaces, curbing, berms, sidewalks, driveways, property bounds, landscaped areas, abutters’ property and any other items that might be affected by the Work are clearly recorded.

b. Arrange for video recordings to be conducted by a professional video-photographer in digital videodisc (DVD) format. Include clear and concise audio descriptions of the existing Project Site conditions.

c. Submit a copy of the first completed video recording to the Engineer for review of visual and audio quality. Once approved, submit 2 copies of video recordings. Re-record any recording furnished which, in the opinion of the Engineer, are poor quality or incomplete at no additional cost to Owner.

4. Submit weekly Safety Reports signed by the responsible on-Site person.

C. Submittal Procedures

1. Schedule submittals to expedite the Project and coordinate with schedules required by Paragraph 1.03.B above. Deliver each submittal in the quantity indicated to Engineer (with copy to Owner where required) as follows. Coordinate submission of related items.

   Engineer:
   Woodard & Curran
   980 Washington Street
   Dedham, MA 02026
   Attention: Steve Clark
   Telephone: (781) 251-0200
   Email: sclark@woodardcurran.com

   Owner:
   City of Newton, MA
   Water/Sewer, Department of Public Works
   1000 Commonwealth Avenue
   Newton Centre, MA 02459
   Attention: Ted Jerdee, Utilities Superintendent
   Telephone: (617) 796-1640
   Email: tjerdee@newtonma.gov

2. Present submittals in a clear and thorough manner, in English and using English units. Use sheet size of not less than 8 1/2 by 11 inches and not
more than 24 by 36 inches. Provide space for Contractor, Engineer, and Owner's review stamps.

3. Revise and resubmit documents as required. Identify all changes made since previous submittal. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions. Submittals not requested on the submittal schedule may not be recognized or processed.


   a. Include description of each submittal, date by which each submittal will be delivered to Engineer and Owner date by which each submittal must be approved to maintain project schedule, and relevant section reference.

   b. Allow 15-30 days from receipt of submittal/resubmittal for Engineer review of submittals and possible resubmittal.

5. Shop Drawings and Samples: Submit 6 prints and electronic files in PDF format by email in accordance with the Schedule of Submittals required in subparagraph 1.03.C.4 above.

   a. Complete the submittal transmittal form included as an attachment to this Section as is indicated, numbering each submittal consecutively. Assign resubmittals the same transmittal number as the original with a suffix of a sequential letter to indicate the resubmittal (e.g. the first resubmittal of submittal 25 would be number 25A.) Include only those documents previously issued under original transmittal number in resubmittals. Do not combine new submittals with resubmittals.

   b. Attach a transmittal form to each group of Shop Drawings, manufacturer's literature, equipment data and Samples submitted. Use a sufficient number of transmittal forms so that: items on a single transmittal form pertain to the same equipment item, specification section or element of Work; items on a single transmittal form are either original submittals or the same number resubmittal; and each Sample is listed on a separate transmittal form. Data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide.

   c. Submittals which do not have a fully completed transmittal form will be returned along with unreviewed attachments. Returned submittals, even though incomplete, will be counted as a submittal.
d. Before submitting each Shop Drawing or Sample, Contractor shall have:

1) reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

2) determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

3) determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4) determined and verified all information relative to Contractor’s responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

e. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor’s obligations under the Contract Documents with respect to Contractor’s review and approval of that submittal.

f. Engineer’s Review

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

2) Engineer’s review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3) Engineer’s review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of subparagraph C.6. below. Engineer’s review and approval shall not relieve Contractor from errors or omissions in a Shop Drawing or Sample.

g. Resubmittal Procedures

1) Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2) Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than 3 submittals. Engineer will record Engineer’s time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Contractor shall reimburse Owner for Engineer’s charges for such time.

3) In the event that Contractor requests a change of a previously approved item, Contractor shall reimburse Owner for Engineer’s charges for its review time unless the need for such change is beyond the control of Contractor.

6. Variations: Clearly identify requests for “Or-Equal” and substitute items and submit per subparagraph 1.02.C.1.b above. Substitute items will not be considered when indicated or implied on Shop Drawing or material and equipment data submittals without separate written request, or when acceptance will require revision to the Contract Documents. Identify variations from Contract Documents and material and equipment or system limitations which may be detrimental to successful performance of the completed Work and identify reasons therefor at no additional cost to Owner. Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made and may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No “or equal” or substitute will be ordered, installed or utilized until Engineer’s review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an “or equal.”

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

1) if in the exercise of reasonable judgment Engineer determines that it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics; it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and it has a proven record of performance and availability of responsive service; and

2) Contractor certifies that, if approved and incorporated into the Work there will be no increase in cost to the Owner or increase in Contract Times and it will conform substantially to the detailed requirements of the item named in the Contract Documents.

b. Substitute Items: If in Engineer’s sole discretion an item of material or equipment proposed by Contractor does not qualify as an “or-equal” item subparagraph 6.a above, it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

1) Contractor shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified.

2) Contractor shall state the extent, if any, to which the use of the proposed substitute item will prejudice Contractor’s achievement of Substantial Completion on time, whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and whether incorporation or use of the
proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

3) Contractor shall identify all variations of the proposed substitute item from that specified, available engineering, sales, maintenance, repair, and replacement services; and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

Engineer will advise Contractor in writing of any negative determination. Engineer will record Engineer’s costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

7. Manufacturers' Installation Instructions and Certificates: Submit 6 prints and electronic files PDF format by email of printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.

a. Submit manufacturers' certificates for recent or previous test results on material or equipment, but they must be acceptable to Engineer and Owner. Indicate material or equipment conforms to or exceeds specified requirements and provide supporting reference date, affidavits, and certifications as appropriate.

b. Submit test results, data, and reports and certifications to Engineer based on tests performed. Submit test reports and certifications for independent testing services specified.

8. Record Documents and Closeout Submittals: Submit record documents described in Paragraph 3.05.D. below and per Paragraph 1.03.D below.

a. As-Builts for Material and Equipment: Submit 6 prints and electronic files PDF format by email.. Indicate "As-Supplied" in revision block and sign. Show all changes and revisions to Final Completion per Paragraph 3.05.D.
b. **Conformed to Construction Record Drawings:** Submit 6 prints and electronic files in .DWG format and PDF format on CD for Engineer’s use in preparing final Record Drawings. Indicate "Conformed by Contractor to Construction Records" in revision block and sign. Show all changes and revisions to Final Completion per Paragraph 3.05.D.

c. **Warranties and Guarantees:** Submit duplicate notarized copies of warranty documents which are executed and transferable from Subcontractors, Suppliers, and manufacturers. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of Warranty Period. Assemble in three ring binders with durable plastic cover with a table of contents.

d. **Operation and Maintenance Data**

1) Submit one draft copy of completed volumes 15 days prior to final inspection. Include 2 copies of completed manuals with major equipment when equipment is shipped. Draft copies will be reviewed and returned after final inspection, with Engineer's comments. Revise content of all sets as required. For final submission, submit 6 copies of final volumes, with electronic files in .PDF format on CD, within 10 days after final inspection.

2) Submit data in ring binders with durable plastic covers with 8 1/2 by 11 inch text pages. Cover: title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.

3) Subdivide binder contents with permanent page dividers, logically organized as described below with laminated plastic tabs and clearly print the contents. Prepare a Table of Contents for each volume, with material, equipment, or system description identified, in three parts as follows:

   **Part 1:** Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment Suppliers, and service representative.
Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification section.

For each system, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:

- Significant design criteria
- List of equipment with As-Builts certified “As-Supplied”
- Parts list for each component
- Operating instructions
- Inspection, maintenance and adjustment instructions for equipment and systems
- Lubrication and maintenance schedules
- Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents
- Troubleshooting guides
- Schematic diagrams

Part 3: Material Safety Data Sheets

Part 4: Other Project documents and certificates, including the following:

- Certificates
- Photocopies of warranties

D. Closeout Procedures

1. Substantial Completion shall have been achieved when Work is complete, systems are successfully operating, and final testing has been successfully completed and Contractor considers the entire Work ready for its intended use; a full inventory of the spare parts and special tools purchased by the Owner are replenished and in the custody of the Owner; the Site has been restored to the satisfaction of the Owner; an inspection of the Work has been completed by the Engineer and the Owner; and an updated Punch List is provided. The Contractor shall have sole care, custody, and control of the Work until achievement of Substantial Completion.

2. Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) using the Notice of Substantial Completion form included in the Contract Documents and request that Engineer issue a certificate of Substantial Completion. Promptly after Contractor’s
notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

3. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion using the Certificate of Substantial Completion included in the Contract Documents with Punch List attached. Owner shall have 7 days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner’s objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised Punch List) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

4. The date of achieving Substantial Completion is the date set forth in the Certificate of Substantial Completion that is accepted and signed by the Owner.

5. During the period between Substantial Completion and the date for Final Completion, Contractor shall be given access to correct items on the Punch List and achieve Final Completion.

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

7. Final Completion shall have been achieved when Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, documents including maintenance and operating instructions, schedules, guarantees, warranties, bonds, certificates or other evidence of insurance, certificates of inspection, marked up record documents, and other required documents, and Engineer has indicated that the Work is complete in accordance with the Contract Documents including the following.
a. Final cleaning has been conducted and Contractor equipment and supplies including waste materials have been removed from the Site and legally disposed of.

b. Inspections required by Laws and Regulations are complete. Certificates and permits to occupy and operate have been issued if required.

c. Spare parts, maintenance and extra materials have been delivered in quantities specified to Project Site and stored as directed.

d. A Final Application for Payment has been submitted to the Engineer identifying total adjusted Contract Price, previous payments, and balance due along with required documentation including:

1) all documentation called for in the Contract Documents

2) consent of the surety, if any, to final payment

3) a list of all Claims against Owner that Contractor believes are unsettled

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

8. Is the final application for payment is acceptable, Engineer will give written notice to Owner and Contractor that the Work is acceptable using the Certificate of Completion form included in the Contract Documents. Owner will thereafter make final payment and acceptance per the Contract.

1.04 QUALITY REQUIREMENTS

A. Reference Standards and Regulatory Requirements

1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or Laws or Regulations of any governmental authority are used whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be
effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3. Acronyms and abbreviations used are defined in the applicable versions of the Encyclopedia of Associations published by Gale (part of Cengage Learning) generally available in large libraries and on the internet.

B. Qualifications
1. Meet or provide capability to meet the criteria specified in connection with the Work of the Contract Documents.

2. As a minimum, Contractor shall:
   a. have been regularly and actively engaged in similar Work as described in the Contract Documents, operating under the same business name and business organization structure, for the last 5 years on at least 5 projects;
   b. have successfully completed at least 3 projects involving construction of similar facilities in the same state as the Project covered by the Contract Documents;
   c. have a full-time project manager in responsible charge of the Work with at least 10 years’ experience as project manager on comparable projects; and
   d. carry at least the insurance coverage and amounts required in the Contract.

PART 2 – PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. General

1. Subject material and equipment furnished under these Contract Documents to a complete factory testing program as specified.

2. Shop Drawings and submittals: reviewed by Engineer before initiating testing program.

3. Perform checks and tests in accordance with manufacturer's recommendations and referenced standards.
4. Evaluate test results and advise Owner immediately of any discrepancy between test results and test limits or the failure of any device or system under test. Include test limits for acceptability applicable to each test on the certified test records.

5. Record test information, including the evaluation of testing results, on forms approved by Owner and Engineer.

B. Independent Testing Agency Certification

1. If specified, furnish certificates from an independent testing agency.

2. Independent testing agency to certify that material and equipment components have been examined and tested and are in conformance with the requirements specified in the Contract Documents.

3. Take Samples in accordance with the requirements specified in the Contract Documents, as selected by Owner or independent testing agency. Furnish and ship at no additional cost to Owner.

C. Factory Testing

1. Provide 14 days prior written notice of factory inspections and tests to Owner and Engineer.

2. If failure to give proper written notice results in material and equipment being assembled or covered before a factory inspection or test, make material and equipment ready for inspection or test and reassemble or recover at no additional cost to Owner.

3. Owner may inspect any portion of material and equipment furnished at any reasonable time during manufacture and may witness testing of any portion of material and equipment wherever located. Owner and Engineer to witness tests only.

4. Furnish, set up and operate test equipment and facilities.

5. If facilities for conducting required tests are unavailable to the manufacturer, conduct tests elsewhere or have them performed by an independent agency approved by Owner.

6. Protect material and equipment after testing and checking to provide that subsequent testing of other equipment or systems does not disturb, damage or otherwise interfere with functional capability of material and equipment.

7. Assume responsibility for protection of material and equipment and safety of all personnel during factory testing program.
8. Grounds for rejection: failure to withstand tests; failure to meet ratings; failure to meet applicable standards.

9. In the event of failure
   a. Submit revisions of documents requiring approval for changes required for rectification.
   b. Obtain Owner's and Engineer's approval before making such changes.
   c. Provide written details of any changes to be made not requiring approval.
   d. Notify Owner and Engineer in writing before retesting.
   e. Furnish new material and equipment which meets requirements of the Specifications if rejected material and equipment cannot be rectified to satisfaction of Owner and Engineer.
   f. Retest after rectification in presence of Owner or Engineer.

10. Assume responsibility for all costs, including, but not limited to: loss or damage to materials and equipment resulting from testing; retesting; rectification; new material and equipment to replace damaged or non-rectifiable material and equipment; removal, furnishing, transportation, unloading, and installation of replacement material and equipment; and witness of testing by Owner and Engineer including travel, lodging, meals, and payroll.

11. Submit certified test reports which define tests, list results, and are signed by Contractor's representative, and copies of raw data collected during tests in accordance with Paragraph 1.03.C above. Submission of certified test reports does not relieve Contractor of responsibility for material and equipment meeting requirements of the Contract Documents after installation.

2.02 PRODUCT REQUIREMENTS

A. General

1. Products include new material and equipment incorporated into the Work and may also include existing material and equipment required for reuse. This does not include machinery and equipment used for preparation, fabrication, conveying, installation and erection of the Work.

2. Do not use materials and equipment removed from existing Work Site, except as specifically permitted.
3. Provide complete with accessories, trim, finished, safety guards, and other devices and details need for a complete installation and for the intended use or effect.

4. Provide standard products which have been produced and used successfully on other similar projects for similar applications. Provide products which are likely to be available to Owner in the future for items required for maintenance and repair or replacement Work.

5. Furnish interchangeable components of the same manufacturer, for similar components.

6. Provide products that earn the Energy Star® and meet the Energy Star® specifications for energy efficiency.

B. Transportation and Handling

1. Transport and handle material and equipment in accordance with manufacturer's instructions.

2. Notify Engineer and Owner in writing upon acceptance of a shipment.

3. Promptly inspect shipments to assure that material and equipment comply with requirements, quantities are correct, and material and equipment are undamaged.

4. Furnish equipment and personnel to handle material and equipment by methods to prevent soiling, disfigurement, or damage.

5. Uncrate equipment and dispose of packing material properly.

C. Storage and Protection

1. Store and protect material and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive material and equipment in weather tight, climate controlled enclosures.

2. For exterior storage of fabricated material and equipment, place on sloped supports, above ground.

3. Provide for bonded off-Site storage and protection when Site does not permit on-Site storage or protection.

4. Cover material and equipment subject to deterioration with impervious sheet covering. Furnish ventilation to avoid condensation or potential degradation of material and equipment.
5. Store loose granular materials on solid flat surfaces in a well-drained area. Avoid mixing with foreign matter.

6. Furnish equipment and personnel to store material and equipment by methods to prevent soiling, disfigurement, or damage.

7. Arrange storage of material and equipment to permit access for inspection. Periodically inspect to assure material and equipment are undamaged and are maintained in acceptable conditions.

8. After receipt of material and equipment, assume responsibility for loss and damage including but not limited to breakage, corrosion, weather damage, and distortion.

PART 3 – EXECUTION

3.01 TEMPORARY CONSTRUCTION FACILITIES

A. Barriers

1. Furnish barriers to prevent unauthorized entry to and clear delineation of construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations as recommended by OSHA and as otherwise required for the protection of life and property during construction.

2. Construct barricades and protective facilities in accordance with local and state regulations. Furnish and install signs, lights, reflectors, and such protection facilities as may be required.

3. Furnish barricades required by governing authorities for public rights of way.

4. Provide protection for plant life designated to remain. Replace damaged plant life.

5. Protect non owned vehicular traffic, stored materials, Site and structures from damage.

6. If required, furnish commercial grade, minimum 8 foot high chain link fence around construction Site. Equip with vehicular gates with locks.

B. Protection of Work

1. Protect Work during working and non-working hours.

2. Provide special protection where specified in Specifications or Drawings and in accordance with manufacturer recommendations.
3. Furnish temporary and removable protection for installed equipment and material. Control activity in immediate Work area to minimize damage.

4. Protect exterior areas of Work from damage. Prohibit traffic from landscaped areas.

5. Buildings and Enclosures
   a. Furnish protective coverings at walls, projections, jambs, sills, and soffits of openings and protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
   b. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

6. Whenever gale or high winds are forecast, take measures to secure loose material, equipment or other items that could be blown and be damaged or cause damage. Do not leave such loose items unsecured at end of a working day. Particular attention shall be taken with scaffolding and items placed or stored on roofs or within a structure prior to being enclosed.

7. Provide for removal of snow and ice which may impede Work, damage the finishes or materials, be detrimental to workers, or impede trucking, delivery, or moving of materials at the Site, or prevent adequate drainage of the Site or adjoining areas.

C. Security
   1. Provide protection to stored items, the Work and Owner's operations from unauthorized entry, vandalism, or theft, and against fire, storms and other losses during working and non-working hours.
   2. Coordinate with Owner's security program.

D. Safety Facilities
   1. Provide first aid and other safety facilities required by Laws and Regulations during working and non-working hours.

E. Access Roads
   1. Construct and maintain temporary roads accessing public thoroughfares to serve construction area. Control dust and water.
   2. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
3. Provide for emergency access and maintain throughout the Work Site.

F. Parking

1. Construct temporary gravel surface parking areas to accommodate construction personnel. When Site space is inadequate, provide for off-Site parking.

2. Do not allow construction vehicle parking on existing pavement or sidewalks.

G. Field Offices – furnish as required.

H. Progress Cleaning and Waste Removal

1. Maintain areas free of waste materials, debris, and rubbish and maintain the Site in a clean and orderly condition.

2. Remove debris and rubbish from spaces and other closed or remote spaces before enclosing the space.

3. Collect and remove waste materials, debris, and rubbish from Site at least weekly and legally dispose off-Site.

3.02 TEMPORARY UTILITIES

A. Arrange for, pay for and maintain suitable utilities as required for duration of Project.

B. Furnish lighting for construction operations. Furnish lighting for exterior staging and storage areas and for security purposes. Maintain lighting and provide routine repairs.

C. Furnish and pay for heat devices and heat and cooling devices as required to maintain specified conditions for construction operations.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Furnish and maintain required sanitary facilities and enclosures. Do not use existing facilities.

F. Fire Protection

1. Provide temporary fire protection equipment and services during construction until the permanent system is serviceable per NFPA and local fire code and regulations, and fire marshal’s requirements.
2. Use Work procedures that minimize fire hazards to the extent practicable and materials that are fire resistant where possible. Collect and remove combustible debris and waste materials from the Site each day. Store fuels, solvents, and other volatile or flammable materials away from the construction and storage areas in well-marked, safe containers in accordance with Laws and Regulations.

3.03 TEMPORARY CONTROLS

A. Dust Control: Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere. Utilize the application of sprinkled water to reduce the emission of air-borne soil particulates from the Project Site.

B. Water Control and Dewatering

1. Comply with the requirements for submitting plans for pollution prevention, storm water management, erosion and sedimentation control.

2. Methods for Water Control and Dewatering may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells and combinations thereof.

3. Grade the Site to drain away from excavations to approved drainage collection facilities. Protect the Site from puddling, ponding and any other surface water.

4. Ensure collected surface drainage water meets permitted criteria for sediment content prior to discharge.

5. The Contractor shall be responsible for the proper design and execution of methods for controlling surface water and groundwater. The Contractor shall be responsible for any damage to properties, buildings or structures, utilities, pavements, and new Work that may result from the dewatering or surface water control operations.

a. The Contractor shall design temporary dewatering systems as required to lower and control water levels to at least 1 foot below the bottom of excavations to allow for construction in the dry and to maintain a stable subgrade; legally dispose of pumped water; construct, maintain, observe and, except where indicated or required to remain in place, remove dewatering equipment and system at the completion of construction.

b. The Contractor shall furnish the services of a professional engineer registered in the State of the Project to prepare and stamp the water control and dewatering system designs and submittals. The Contractor’s engineer shall have at least 5 years of relevant
experience in the design, installation and monitoring of dewatering systems of similar size and scope to the Project.

6. Dewatering may include lowering the water table, intercepting and collecting seepage which may penetrate the support of excavation, slopes or bottom of the excavations.

7. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps to control water and allow for installation of the pipe in a dry trench.

8. Special dewatering is defined as installing sump pumping, well points, deep wells, or eductor and ejector systems, or combinations thereof, to control groundwater and hydrostatic pressures to allow for installation of the Work.

9. Determine if additional subsurface information is required to complete design, the costs of which will be considered incidental to the Work.

10. Dewatering Operations and Procedures

   a. Provide electrically operated dewatering equipment, powered with independent generators adequately sized to operate the dewatering system and capable of running on commercial power. Provide standby equipment independent of commercial power and provide for dewatering within 24 hours upon primary pump or power failure. No work shall be performed by the Contractor below the pre-construction groundwater level during dewatering system failure.

   b. Construction and backfilling shall proceed in the dry, and flotation of completed portions of the work shall be prohibited.

   c. Provide suitable temporary pipes, flumes or channels for water that may flow along or across the Site of the Work.

   d. Provide dewatering equipment with noise attenuation systems capable of meeting the governing noise regulation requirements.

   e. Dewatering systems must be properly filtered to mitigate the pumping of silt and fine sand from the excavation.

   f. Locate dewatering facilities to prevent loss of ground or disturbance to the soils that support adjacent utilities/structures and the construction work to be done by others.

   g. For dewatering operations with relatively minor flows, direct pump discharges using filtration bag or system per Erosion and Sediment Control below, or pump into hay bale sedimentation traps lined with filter fabric. Filter water through the hay bales and filter fabric prior to seepage into storm drainage or any natural water course.
Discharge of effluent shall conform to all applicable statutory and regulatory requirements.

h. For dewatering operations with larger flows, provide pump discharges into a steel dewatering/sedimentation basin. Use steel baffle plates to slow water velocities, to increase the contact time, and allow adequate settlement of sediment prior to discharge into waterways, storm drainage or discharge point allowed by the construction dewatering permit.

i. Utilize silt sacks in catch basins when excess silt is suspended in the discharge water per Erosion and Sediment Control below.

j. If siltation basin is used, size to effectively filter for the volume and discharge rate of water anticipated without overflow.

k. Provide treatment necessary to prevent discharge of silty and/or contaminated ground water caused by the Contractor’s operations, or any contaminated ground water that may pass from excavated surfaces and/or through the excavation support system selected by the Contractor.

l. Dispose of water pumped or drained from the Work in accordance with permit requirements and in a manner to prevent undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities.

m. Obtain necessary regulatory approvals for the disposal of dewatering flows, including, among others, approval by the Environmental Protection Agency under the National Pollutant Discharge Elimination System (NPDES) program for construction dewatering activities. Submit the completed and approved construction dewatering permit to the Engineer immediately upon receipt.

n. Remove temporary dewatering and drainage systems when no longer needed. Restore all disturbed areas.

11. Special Dewatering

a. Special Dewatering methods may be necessary if Normal Dewatering methods are inadequate to ensure dry and stable excavation subgrade conditions.

b. Special Dewatering techniques may consist of a combination of sump pumps, one- or two-stage well point systems, deep wells, or eductor and ejector type systems. Design with suitable screens to prevent pumping of fines and to address specified Work site conditions.
C.  Erosion and Sediment Control

1.  Comply with the requirements for submitting plans for pollution prevention, storm water management, erosion and sedimentation control; compliance with state and Federal requirements.

2.  Submit erosion and sediment control plan to Engineer prior to the start of construction.

3.  Plan and execute construction using methods to control surface drainage from cuts and fills, from borrow and waste disposal areas and prevent erosion and sedimentation.

4.  Install erosion and sediment controls as may be shown on the Drawings and as required by Laws and Regulations. Install additional erosion and sedimentation control measures beyond those shown on the Drawings as necessary to stabilize the Site. Coordinate temporary erosion controls with permanent erosion controls to the extent practical. Provide and maintain devices to control erosion, siltation, and sedimentation that occur during construction operations. Undertake reasonable precautions and measures to avoid erosion of soil and to prevent silting of drainage ditches, storm sewers, rivers, streams, and lakes.

5.  Employ pollution prevention measures, erosion and sedimentation control before, during, and after soils are exposed. Implement measures prior to soil disturbance or soil storage to the extent possible to ensure that such measures are in place before activity occurs and employ additional measures as the Work progresses. Implement and maintain as necessary until the Site is permanently stabilized.

6.  Perform inspections of disturbed soil areas, material storage areas exposed to precipitation, and erosion control measures with Engineer a minimum of once every 14 days and also within 24 hours after any storm event greater than 0.5-inches of rainfall. Immediately correct deficiencies in the erosion control measures identified or indicated by failures or erosion by implementing additional measures or different techniques to correct and prevent subsequent erosion at no additional cost to Owner.

7.  In the event that silt or debris breaches erosion control, immediately remove and clean silt or debris from drainage ditches and storm sewers and revise erosion control measures as required by the Conservation Commission or the Engineer. Should silt or debris breach erosion controls and reach rivers, streams or lakes, immediately notify local, state or Federal representatives as required and implement required remediation methods at no additional cost to Owner.

8.  Limit duration of the exposure of soils on embankments, excavations, and graded areas to a minimum.
9. Provide temporary measures such as berms, dikes and drains to prevent water flow. Install erosion control measures in any ditch, swale or channel before water is allowed to flow in the waterway. Handle water pumped from trenches to minimize discharge of silty water to the maximum extent practicable.

10. Stabilize storm drain outfalls as shown on the Drawings before the discharge points become operational. Install inlet protection immediately upon construction of culverts.

11. Stabilize disturbed areas with temporary and permanent erosion control practices as soon as practicable, but no more than 14 days after construction activity on a particular portion of the Site has temporarily or permanently ceased. Exceptions to this time requirement include: a) where construction activities will resume on the particular portion of the Site within 21 days; and b) where snow cover delays initiation of stabilization measures.

12. Place stockpiled topsoil on the Site away from natural drainages, in piles with side slopes of 50 percent to 70 percent. Install siltation fence around the base of the pile to prevent eroding soil from washing into drainages. Cover topsoil piles which are to remain for a period of 21 days or more with temporary seed and mulch immediately following stockpiling.

13. Conduct pavement sweeping to remove sediment and soil debris accumulation on pavement resulting from construction activity.

14. Siltation/Silt Fence
   b. Wood posts: oak, 2 inches by 2 inches in section, and at least 4.5 feet in length.
   c. Erosion control fencing: heavy-duty filter fabric towed into the existing soil as shown on the Drawings.
   d. Construct as shown on Drawings or as directed by Engineer. Install parallel to contours where possible, prior to Site clearing and grading activities.

1) Dig a 6 inch by 6 inch minimum trench where the fence is to be installed. Position the fence in the trench with the fence posts set at 8 feet on center (maximum). Curve ends of fence uphill to prevent flow around ends.

2) Staple sedimentation control fabric and the industrial netting to each post. When joints are necessary, splice filter
fabric together only at support posts with 6-inch overlap and securely seal.

3) Bury lower edge of fabric at least 6 inches below ground surface to prevent underflow. Backfill trench and compact soil over filter fabric.

4) Installed height: minimum 2.5 feet and 36 inches maximum.

5) Inspect frequently; repair or replace any damaged sections.

15. Temporary Erosion Control Matting
   a. Rolled matting blanket consisting of curled wood excelsior, coconut fiber, straw or paper bound with a weave of twisted craft paper, cotton cord or plastic mesh.
   b. Provide staples for fastening matting to the ground. Staples: fabricated in a "U" shape from 11 gage or heavier stiff steel wire, 6 to 12 inches in length and 1 to 2 inches across.
   c. Surface Preparation and Installation
      1) Conform to grades and cross sections for slopes and ditches shown on the Drawings. Finish to a smooth and even condition with all debris, roots, stones, and lumps raked out and removed. Loosen soil surface to permit bedding of the matting.
      2) Unless otherwise directed, apply seed prior to placement. When directed, spread additional seed over matting, particularly at those locations disturbed by building slots. Press matting onto the ground with a light lawn roller or by other similar means.
      3) Bury edges of matting around the edges of catch basins and other structures.

16. Seeding
   a. Select seed variety and applied rates based upon the date of application per the following table. Equivalent seed mixture based on suitability for use in controlling erosion of the various soil types and slopes may be used as approved by the Engineer.
<table>
<thead>
<tr>
<th>Dates</th>
<th>Seed</th>
<th>Applied Rate (pounds per 1,000 feet²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1 to 7/1</td>
<td>Oats</td>
<td>1.8</td>
</tr>
<tr>
<td>8/15 to 9/15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/1 to 7/1</td>
<td>Annual Ryegrass</td>
<td>0.9</td>
</tr>
<tr>
<td>5/15 to 8/15</td>
<td>Sundangrass</td>
<td></td>
</tr>
<tr>
<td>9/15 to 10/15</td>
<td>Winter Ryegrass</td>
<td>2.6</td>
</tr>
</tbody>
</table>

1) Sow seed at the rates indicated, on the pure live seed basis.

2) Mulch areas where temporary seeding has been applied. Do not mulch seeded areas where matting will be immediately installed. If temporary seeding does not achieve adequate growth by November 1, apply an additional layer of mulch.

3) Mulch temporarily or permanently seeded areas, areas which cannot be seeded within the recommended seeding dates, and any soil stockpile areas, immediately following seeding. Straw or hay mulch, wood fiber mulch, and hydromulch are recommended.

17. Sod: grown from certified seed of adapted varieties to produce high quality sod free of any serious thatch, weeds, insects, diseases and other pest problem, be at least one year old and not older than three years, and cut with a 1/2 inch to 1 inch layer of soil.

   a. Lay sod strips on the prepared soil, perpendicular to the slope or direction of water flow, starting at the lowest elevation. Butt the edges and ends of the sod strips together and tamp or roll. Stagger joints.

   b. Staple sod strips at ends and at 3-foot intervals along the center of the strip.

   c. Irrigate sodded area immediately after installation.

18. Catch Basin Silt Sacks


   b. Test Method: ASTM D-4884 165.0 lbs./inch.

   c. Silt sack seams: certified average wide width strength.

   d. Meet the following ASTM D-4884 standards. Properties are Minimum Average Roll Values (MARV).
### Property Table

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Units</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile</td>
<td>ASTM D-4632</td>
<td>lbs.</td>
<td>315x300</td>
</tr>
<tr>
<td>Grab Elongation</td>
<td>ASTM D-4632</td>
<td>%</td>
<td>15x15</td>
</tr>
<tr>
<td>Puncture</td>
<td>ASTM D-4833</td>
<td>lbs.</td>
<td>125</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D-3786</td>
<td>psi</td>
<td>650</td>
</tr>
<tr>
<td>Trapezoid Tear</td>
<td>ASTM D-4533</td>
<td>lbs</td>
<td>120x150</td>
</tr>
<tr>
<td>UV Resistance</td>
<td>ASTM D-4355</td>
<td>%</td>
<td>90</td>
</tr>
<tr>
<td>Apparent Opening</td>
<td>ASTM D-4751</td>
<td>US Sieve</td>
<td>40</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>ASTM D-4491</td>
<td>gal/min/ft²</td>
<td>40</td>
</tr>
<tr>
<td>Permittivity</td>
<td>ASTM D-4491</td>
<td>sec⁻¹</td>
<td>0.55</td>
</tr>
</tbody>
</table>

1) Utilize silt sacks in catch basins as required when excess silt is suspended in discharge water.

19. **Filtration Bag or System for Discharge from Trench Dewatering**

   a. Meet the following standards. Properties are Minimum Average Roll Values (MARV).

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Units</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
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<tr>
<td>Permittivity</td>
<td>ASTM D-4491</td>
<td>sec⁻¹</td>
<td>0.55</td>
</tr>
</tbody>
</table>

   b. For discharge from trench dewatering, install filtration bag or system or dewatering siltation basin constructed of a hay bale barrier lined with filter fabric sized to handle the volume of dewatering without overflowing.

20. **Compost Filter Socks**

   a. Furnish and install biodegradable mesh “socks” filled with mature, clean compost per EPA National Pollutant Discharge Elimination System (NPDES) specifications.

      1) Install per EPA and manufacturers recommendations.

      2) Install parallel to contours where possible. Stake socks as needed to stabilize. Inspect frequently and repair as necessary.

21. Provide detention basins or water filtration systems for dewatering and coordinate locations with Engineer. See Dewatering in Paragraph 3.03.B. above.
22. Other Temporary Measures
   a. Provide and maintain temporary slope drains as required.
   b. Employ other temporary erosion control measures as directed by the Engineer or local Conservation Commission.

23. Maintenance
   a. Inspect erosion control practices immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Make appropriate repairs or replacement until Final Completion at no additional cost to the Owner.
   b. Remove silt from siltation fence and/or haybale when it has reached one-quarter of the bale and/or fence height, or prior to expected heavy runoff or siltation.
   c. Repair matting if any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, make satisfactory repairs immediately.
   d. Maintain areas mulched or matted until Final Completion, at no additional cost to the Owner.
   e. Maintain sediment basins by removing silt that reaches a depth of over one foot, at no additional cost to the Owner, until Final Completion.

24. Removal of Temporary Erosion Control
   a. Remove temporary materials and devices upon completion of the Work when permanent soil stabilization has been achieved. Re-use materials in good condition if approved by Engineer.
      1) If silt socks are used, remove in paved areas or cut open and disperse media in unpaved areas.
   b. Level and grade to preconstruction conditions and to the extent required to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.
   c. Remove siltation fences only when adequate grass growth has been established.
   d. Repair areas damaged by silt fences and hay bales to preconstruction conditions to the satisfaction of the local Conservation Commission and the Engineer.
   e. Remove unsuitable materials from Site and dispose of in a lawful manner.
D. Noise Control

1. Provide methods, means, and facilities to minimize noise from construction operations.

2. Provide noise attenuation systems capable of meeting the Department of Environmental Protection Division of Air Quality Control regulations governed by the following policy:

"A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:

- Increases the broadband sound level by more than 10 dB(A) above ambient, or
- Produces a "pure tone" condition when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

"These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment operating hours. The ambient may also be established by other means with the consent of the Department."

3. Construct sound enclosures or utilize other noise reduction techniques if the equipment does not meet the noise level requirements.

E. Pollution Control

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

   a. Water Pollution Control

   1) Assure that sediment, debris, petroleum, chemicals, or other contaminants will not enter existing drainage facilities and channels. Use construction methods that will prevent entrance of pollutants and wastes into existing streams, rivers, lakes, and flowing and dry watercourses.

   2) Obtain legal disposal sites and dispose of pollutants and wastes in a legal manner.

   3) Respond immediately to emergencies as directed when water quality of existing streams, rivers, lakes, and flowing and dry watercourses is threatened. Take corrective action to remove or contain pollutants until a permanent solution is determined.
b. Air Pollution Control

1) Equipment and vehicles that exhibit excessive exhausts emissions due to poor engine adjustments or inefficient operation will not be permitted to operate until corrective repairs or adjustments are made.

2) Burning of materials from clearing or grubbing operations, combustible construction materials, and rubbish will not be allowed.

F. Traffic Regulation

1. Control and maintain traffic within the Project area. Submit traffic control plans and coordinate with Owner and local agencies. Submit plan for traffic control to Owner for review 14 days in advance of any Work within public right-of-way, street closure or detour.

2. Provide and maintain traffic control and maintenance devices in accordance with Part 6, Temporary Traffic Control, of the "Manual on Uniform Traffic Control Devices for Streets and Highways", published by the U.S. Department of Transportation, Federal Highway Administration and other applicable codes and standards as specified. Operate devices 24 hours per day as required.

3. Provide for access by emergency vehicles, such as police, fire, and disaster units at all times. Contractor shall be liable for damages resulting from failure to provide such access.

4. During construction hours, traffic flow must be controlled by uniformed traffic police officers. The services of uniformed traffic police officers shall in no way relieve the Contractor of its responsibilities under the Contract.

5. Maintain minimum of one moving lane on roadways at all times.

a. Where detours are permitted, provide necessary barricades, flashers, flashing arrows and signs in accordance with referenced Manuals and Laws and Regulations.

b. Provide gravel borrow and bituminous concrete to maintain temporary passable travel lane ramps, temporary bridging, steel plates, temporary pavement, wood-framed walkways, caution, safety and other necessary signs directing the pedestrian and vehicular traffic towards unblocked and safe areas.
6. Provide safe access/egress to businesses and abutting property owners within the Project area. In areas where the construction activity is in progress, install directional signs in front of businesses indicating "OPEN FOR BUSINESS" or similar for guidance of customers.

   a. Certain construction operations such as utility work and roadway/sidewalk reconstruction may restrict access/egress on some roads and to businesses and abutting property owners. Under these circumstances, schedule operations during off-peak hours or late evenings with Owner approval so that a particular work activity can be completed in the shortest possible time.

   b. Provide 48 hours’ notice to businesses and abutting property owners when access/egress will not be available or restrictions will exist.

7. Exercise particular care to establish and maintain such methods and procedures that will not create hazards.

   a. Remove or properly cover traffic control, safety devices and/or signs having messages that are irrelevant to normal traffic conditions at the end of each Work period. Keep signs clean at all times and provide that legends are distinctive and unmarred.

   b. Place excavated material and construction equipment so that vehicular and pedestrian traffic is maintained at all times unless road closure permit is obtained. If the Contractor’s operations cause traffic hazards, implement appropriate safety measures immediately.

   c. In areas of high pedestrian and vehicular traffic volume, the remove waste materials and construction equipment from the Work Site on a daily basis. Do not park construction equipment overnight on the Site or the adjacent roads unless permitted by Owner.

   d. Provide night watchmen where special hazards exist.

8. Post signage clearly stating that any vehicle impeding the progress of construction will be towed at the vehicle owner’s expense. Towing charges incurred by Owner for Contractor’s failure to post such signs will be borne by the Contractor.

3.04 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

   A. Remove temporary utilities, equipment, and facilities before Final Application for Payment inspection.
B. Remove temporary underground installations and grade Site as indicated. Clean and repair damage caused by installation or use of temporary utilities, facilities, and controls.

C. Restore existing facilities and areas used during construction to original condition. Restore permanent facilities used during construction to specified condition.

### 3.05 OVERALL EXECUTION REQUIREMENTS

#### A. Coordination

1. Conduct preconstruction and pre-installation meetings before commencing certain Work that requires coordination or has special requirements or approvals in accordance with Paragraph 1.03A above.

2. Coordinate space requirements and installation of Work. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and repairs.

3. Coordinate Work of the various Specifications with interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

4. Coordinate related Work at the Site.

5. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

6. After Owner occupancy of premises, coordinate access to Site for correction of defective Work and/or incomplete Work to minimize disruption of Owner's activities.

7. Coordinate Work such that Work on each street is completed with minimum disruption to residents and businesses.

8. Regular working hours are 7:00 a.m. to 3:00 p.m., Monday through Friday.
B. Record Documents

1. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference and submitted at final completion per Paragraph 1.03.D above.

2. Store Record Documents separate from documents used for construction. Record information concurrent with construction progress.

3. Legibly mark each item to record description of actual equipment and material installed and actual construction on approved submittals, including the following.
   a. Manufacturer's name and equipment and material model and number
   b. Material and equipment substitutions or alternates utilized
   c. Approved changes
   d. Measured depths of foundations
   e. Measured horizontal and vertical locations of Underground Facilities and appurtenances, referenced to permanent surface improvements
   f. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work
   g. Field changes of dimension and detail
   h. Details not on original Contract Documents or Shop Drawings

4. Submit final record documents as specified in Paragraph 1.03.D above in accordance with subparagraph 1.03.C.8. above. Engineer’s review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered at final completion will be only be to determine generally that the content complies with the requirements of, and in the case of certificates of inspections, tests and approvals, that the results certified indicate compliance with, the Contract Documents.

C. Cutting and Patching
1. Employ skilled and experienced personnel to perform cutting and patching.

2. Submit written request in advance of cutting or alteration which affects:
   a. structural integrity of any element of Project;
   b. integrity of weather exposed or moisture resistant elements;
   c. efficiency, maintenance, or safety element;
   d. safety, traffic, or hazard barriers;
   e. visual qualities of sight exposed elements; and
   f. work of Owner or separate contractor.

3. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
   a. fit materials together, to integrate with other work;
   b. uncover Work to install ill-timed Work;
   c. remove and replace defective or non-conforming Work;
   d. remove Samples of installed Work for testing when requested; and
   e. provide openings in element of Work for penetration of mechanical and electrical work.

4. Execute Work by methods to avoid damage to other work and which will provide appropriate surfaces to receive patching and finishing.

5. Provide adequate temporary support for Work to be cut.

6. Restore Work with new materials in accordance with requirements of Contract Documents. Use materials identical with original materials where recognized that satisfactory results can be produced.

7. Provide protection from elements for areas which may be exposed by uncovering work.

8. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained adjoining Work in a manner, which will eliminate evidence of patching.

9. Identify any Hazardous Waste, Hazardous Environmental Condition, or hazardous substance exposed during the Work to Owner for decision or remedy.
10. Cut work by methods least likely to damage Work to be retained and work adjoining. Cut Work with sawing and grinding tools, not with hammering, chopping, or burning tools. Cut masonry and concrete materials with masonry saw or core drill. Do not use pneumatic tools without prior approval. Core drill openings through concrete Work. Adhere to mandatory cutback requirements when saw cutting concrete and roadway openings.

11. Do not cut and patch structural Work in a manner resulting in reduction of load-carrying capacity or load/deflection ratio.

12. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Maintain supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage and seal voids. For interior work at penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material, to full thickness of the penetrated element.

13. Do not cut and patch operational or safety-related components that reduce capacities to perform in manner intended. Do not cut and patch Work that reduces visual qualities. Remove and replace unsatisfactory cutting patching as directed by Engineer or Owner.

D. Electrolytic Corrosion Prevention

1. Prevent galvanic action, bimetallic corrosion, anodic or cathodic action, and electrolysis at all electrical grounds and for all galvanic scale (electromotive series or table of oxidation potentials). Do not allow contact of dissimilar metals further apart than 0.35 on the galvanic scale (electromotive series or table of oxidation potentials). The electrode potential of common metals is listed below.

<table>
<thead>
<tr>
<th>Electrode Potential Volts (Relative to Hydrogen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium                                     +2.37</td>
</tr>
<tr>
<td>Aluminum                                      +1.70</td>
</tr>
<tr>
<td>Zinc+                                         +0.76</td>
</tr>
<tr>
<td>Chromium                                      +0.56</td>
</tr>
<tr>
<td>Iron and Steel                                +0.44</td>
</tr>
<tr>
<td>Cadmium                                       +0.40</td>
</tr>
<tr>
<td>Nickel                                        +0.25</td>
</tr>
<tr>
<td>Tin                                           +0.14</td>
</tr>
<tr>
<td>Lead                                          +0.13</td>
</tr>
<tr>
<td>Copper                                        -0.34</td>
</tr>
</tbody>
</table>
2. Unless otherwise indicated, provide dielectric insulators between ferrous and nonferrous pipe and equipment.

E. Quality Assurance and Control of Installation

1. Monitor quality control of Subcontractors, Suppliers, manufacturers, material, equipment, services, Site conditions, and workmanship, to produce Work of specified quality. Conduct field quality control and testing specified.

2. Comply fully with manufacturers' installation instructions, including each step in sequence. If manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

3. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

4. Perform Work using persons qualified to produce workmanship of specified quality.

5. Install field Samples and mockups at the Site as required in Specifications for review. Acceptable Samples and mockups represent a quality level for the Work. Where field Sample or mockup is specified to be removed, clear area after field Sample or mockup has been accepted by Engineer or after Work is complete when mockup is to serve as a control reference.

6. Protect adjacent construction.

F. Manufacturers' Field Services

1. If required in the Specifications, arrange and pay for material or equipment Suppliers or manufacturers to provide qualified staff personnel (field representative) to perform the following services and services specified. Submit reports of activities, actions taken and test results to Engineer within 10 days of completion in accordance Paragraph 1.03.C above.

   a. Observe Site conditions, conditions of surfaces and installation, quality of workmanship.

   b. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

   c. Assist with field assembly as required.

   d. Furnish, setup, and operate required test equipment and facilities.
e. Perform and record results of manufacturer recommended inspections and tests, and tests specified for material and equipment.

f. Be responsible for protection of material and equipment and safety of all personnel during testing.

g. Perform any other services normally provided by field representative's company.

h. Instruct operating personnel in proper use of material and equipment.

G. Independent Testing

1. Employ and pay for specified services of an independent to perform inspection and testing as may be specified.

2. Reports will be submitted by the independent firm to Owner, in duplicate indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.

3. Inspection, testing, and source quality control may occur on or off the Project Site.

4. Cooperate with independent firm. Furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.

5. Notify Owner and independent firm 24 hours before expected time for operations requiring services.

6. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

7. Retesting required because of nonconformance to specified requirements will be performed by the same independent firm if instructed by Owner. Payment for retesting will be charged to Contractor by deducting inspection or testing charges from the Contract Price.

8. Testing or inspecting does not relieve Contractor from performing Work in accordance with requirements of the Contract Documents.

3.06 STARTUP, TESTING, AND COMMISSIONING

A. Spare Parts

1. Provide spare parts required for construction, startup, testing and commissioning of the Work prior to achievement of Substantial Completion, including spare parts for flushing and consumable supplies.
such as bolts, nuts, gaskets, filters, insulating tape, etc., normally consumed in the construction, commissioning and testing.

2. If spare parts are purchased by Owner, Contractor shall have the right to use the spare parts purchased by Owner provided that such spare parts are replaced prior to Substantial Completion at Contractor’s expense. Replacement spare parts, replaced by Contractor, shall be new, unused and identical as the original spare part used.

B. Consumables

1. Provide initial fills of consumables including equipment lubricants, resins, chemicals, desiccants, and fuels. Provide subsequent fills if required during Warranty Period if acts or omissions of Contractor cause such consumables to require replacement.

2. Coordinate with Owner for consumables required.

C. Checkout and Starting Systems

1. Coordinate schedule for startup and operation of various equipment and systems with Owner.

2. Notify Owner 7 days before startup of each major piece of equipment or system, including a staffing request for Owner’s operations and maintenance personnel required to adequately and safely support each specific start-up and operation activity.

3. Verify that each system or piece of equipment item has been assembled, constructed, or completed in accordance with the Contract and capable of functioning as intended.

4. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, magnetic center alignment, belt tension, control sequence, or other conditions which may cause damage.

5. Verify that each piece of equipment or system has successfully completed construction testing and cold commissioning, including hydrostatic testing, loop checks, relay checks, calibration, and continuity checks and that all tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

6. Verify wiring and support components for equipment are complete and tested.

7. Execute start up under supervision of responsible manufacturers’ representative or Contractor's personnel in accordance with manufacturers'
instructions utilizing Owner’s qualified operations and maintenance staff trained by Contractor.

8. When specified in individual Specification Sections, require manufacturer to provide field representative to be present at Site to inspect, check and approve equipment or system installation before start up, and to supervise placing equipment or system in operation.

D. Starting, Adjusting, and Balancing

1. Supply necessary equipment, material, construction power, and consumables (except for those provided by Owner) needed to startup and fully test the Work and replenish the same until Substantial Completion is achieved. Contractor may utilize Owner’s operating spare parts, such use requiring timely replacement at Contractor’s expense.

2. Coordinate as required for conduct of independent testing.

3. Perform specified and required adjusting and balancing concurrently to the maximum extent possible on individual equipment and systems and prior to startup and commissioning/performance testing.

E. Startup and Commissioning/Performance Testing

1. Conduct startup and commissioning/performance tests and perform pressure and leakage tests per the Specifications to demonstrate the Work meets the requirements of the Contract Documents, satisfies the Owner’s requirements.

2. Prepare and submit a written startup and commissioning/performance testing procedures no later than 60 days prior to start of testing for review and final test procedures no later than 30 days prior to start of testing. Submit a staffing request for Owner’s operations and maintenance personnel.

3. Calibrate test equipment and instrumentation on Site or provide acceptable certificate of calibration conducted within 30 days of testing.

4. Complete functional testing prior to initiating the startup and commissioning/performance testing as specified.
5. Complete specified startup and commissioning/performance tests prior to Substantial Completion. Owner and Engineer will witness Performance Testing. Notify Owner and Engineer in writing at least 7 days prior to starting any startup and commissioning/performance testing. Coordinate for witnessing of tests by required regulatory representatives.

6. Submit written test reports per subparagraph 1.03.C.7.b and Paragraph 1.03.D above.

F. Demonstration and Training

1. Provide formal demonstration and training of Owner’s personnel as specified in individual Specification sections.

3.07 ATTACHMENTS

A. Contact List

B. Transmittal form

END OF SECTION
ATTACHMENT A

PROJECT CONTACT LIST

OWNER

City of Newton, MA
Water/Sewer, Department of Public Works
1000 Commonwealth Avenue
Newton Centre, MA 02459
Attention: Ted Jerdee, Utilities Superintendent
Telephone: (617) 796-1640
Email: tjerdee@newtonma.gov

ENGINEER

Woodard & Curran, Inc.
980 Washington Street, Suite 325
Dedham, MA 02026
Telephone: (781) 251-0200

Steve Clark, Project Engineer
Telephone: (401) 651-6647
Email: sclark@woodardcurran.com

Gary Alders, Project Manager
Telephone: (508) 280-7683
Email: galders@woodardcurran.com
This page intentionally left blank
<table>
<thead>
<tr>
<th>Transmittal No.:</th>
<th>Date:</th>
</tr>
</thead>
</table>

### OVERALL GENERAL REQUIREMENTS

**City of Newton, MA**

**ATTACHMENT B**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Vendor/Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The material and equipment, and requirements for construction/installation contained in Submittal No.(s) have been reviewed and we certify that they are correct and in strict conformance with the requirements specified (no exceptions or deviations).

The material and equipment, and requirements for construction/installation contained in Submittal No.(s) have been reviewed and we certify that they are correct and in strict conformance with the requirements specified except for the following deviations:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Vendor/Manufacturer</th>
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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 ELECTRICAL REQUIREMENTS

A. The Contracting Requirements in Division 00 and the General Requirements in Division 01 apply to the Work of this Section(s).

B. Examine all Drawings and Specifications for requirements that affect the Work of this Section.

C. Coordinate the Work of this Section(s) with related Work of other trades and cooperate with such trades to assure the steady progress of the Work under the Contract Documents.

D. Electrical Work is specified in the following Specification sections:

   26 05 00 – Common Work Results for Electrical
   26 05 19 – Low-Voltage Electrical Power Conductors and Cables
   26 05 26 – Grounding and Bonding for Electrical Systems
   26 05 34 – Raceways, Boxes, and Supporting Devices
   26 05 43 – Underground Ducts and Raceways for Electrical Systems
   26 27 00 – Low-Voltage Distribution Equipment
   26 27 26 – Wiring Devices
   26 29 13 – Enclosed Controllers and Motor Starters

and on the following Drawings:

   E-001 – Typical Antenna Installation Detail
   E-002 – Antenna Installation Site Specific Materials Lists (Sheet 1 of 2)
   E-003 – Antenna Installation Site Specific Materials Lists (Sheet 2 of 2)
   E-004 – Wetwell Level Control Equipment Installation Details
   E-100 – Quinobequin Wastewater Pump Station Electrical Installation Plan
E-200 – Elliot Wastewater Pump Station Electrical Installation Plan
E-300 – Edgewater & Grayson Wastewater Pump Stations Electrical Installation Plans
E-301 – Hamlet & Islington Wastewater Pump Stations Electrical Installation Plans
E-302 – Longfellow & Oldham Wastewater Pump Stations Electrical Installation Plans
E-303 – Prairie Wastewater Pump Station & Waban Wastewater Lift Station Electrical Installation Plans
E-304 – Existing Wastewater Pump Stations Additional Equipment Installation Details
E-600 – Langley Road & Engine 10 Water Booster Stations Electrical Installation Plans
E-601 – Manet Water Booster Station Electrical Installation Plan
E-701 – Oak Hill Water Storage Tank Electrical Installation Plan
E-702 – Stanton Water Storage Tank Electrical Installation Plan
E-703 – Waban Hill Covered Water Storage Tank & Flowed Meadow Dewatering Station Electrical Installation Plan

1.02 SUMMARY

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install all electrical Work in accordance with the Drawings and as specified herein.

B. In general, electrical Work shall include but not be limited to the following:

1. Power distribution equipment.
2. Power outlets and equipment connections.
3. Wiring Devices.
4. Motor Controls not provided by other divisions.
5. Control wiring not provided by other divisions.
6. Complete grounding system.
7. All support material and hardware for raceway and electrical equipment.

8. Branch circuit wiring.

9. Underground electrical systems, including excavation, backfill, surface restoration; and provide manholes, handholes, conduit, and conduit spacers/supports.

10. Work shall include installation and termination of all control and signal wiring for instrumentation and process control equipment as indicated in the Contract Documents. Work shall include installation and mounting of new control panel hardware furnished under Division 40 in accordance with the Drawings.


12. Start up, acceptance testing test reports and instruction of systems operation to the Owner.

13. Mounting and connection of panels and instruments furnished by Division 40.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. Codes and Standards:

1. Electrical equipment, materials, installation and workmanship shall comply with all state and local building codes, safety and fire law regulations at the location of the Work and shall conform to the latest edition of the applicable codes and standards of the organizations listed:


   b. Massachusetts Electrical Code (MEC).

   c. Underwriters' Laboratories (UL).

   d. Institute of Electrical and Electronics Engineers (IEEE C2).

   e. American National Standards Institute, Inc. (ANSI).


   g. National Electrical Manufacturers Association (NEMA).

   h. Insulated Power Cable Engineers Association (IPCEA).

   i. Association of Edison Illuminating Companies (AEIC).
j. Occupational Safety Health Act (OSHA).

k. Americans with Disabilities Act (ADA).

2. Where the Contract requires the Work or any part of the same, to be above the standards required by applicable laws, ordinances, rules and regulations and other statutory provisions pertaining to the Work, such Work shall be performed and completed in accordance with the Contract requirements.

3. Should any changes in the specifications and Drawings be necessary to conform to the requirements of any of the above mentioned codes or standards, the Contractor shall so notify the Engineer.

B. Drawings required by governing authorities: Prepare any detailed diagrams or Drawings which may be required by the governing authorities.

C. Permits, Certificates, Inspections, Fees and Utility Costs:

1. The Contractor shall obtain and make payments for all permits, licenses, and certificates which are required for the associated Work.

2. Following completion of the Work, the Contractor shall obtain certificates of approval from the responsible agencies concerned with the Work.

3. Arrange for timely inspections required for Work under this section.

4. All utility company and municipal back charges shall be the responsibility of the Owner. Cost of electricity shall be borne by the Contractor until substantial completion as determined by the Owner.

1.04 COORDINATION OF WORK

A. The electrical work shall be coordinated with the work of other trades to prevent interferences and so that the progress in construction of the building will in no way be retarded.

B. Refer to other sections of these specifications and Drawings for related work which may affect the work of this section.

C. Coordinate with all local utility companies and make all installations for their services in accordance with all utility company requirements.

D. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.
E. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

1.05 DRAWINGS

A. All electrical equipment such as junction and pull boxes, panelboards, switches, controls and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible and properly labeled.

B. The Contractor shall examine all contracts and reference Drawings, and verify and properly coordinate the placement of outlets. Contractor shall also check all Drawings including mechanical Drawings and shop drawings for apparatus for which he must rough-in and to which he must connect.

1.06 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Follow the procedures specified in the General Requirements and in addition, the Contractor shall prepare and submit a complete submittal list to the Engineer. The submittal list shall include all submittal items covered in the Division 26 specification sections.

C. Shop Drawings shall be submitted to the Engineer for approval. Shop Drawings shall identify the specific equipment and material being supplied; the quantity being supplied; and all accessories, dimensions, descriptions, mounting and connection details, wiring diagrams, elementary control diagrams, equipment interface diagrams and any other information necessary to determine compliance with the plans and specifications. Fabrication and installation shall be in accordance with the approved Shop Drawings.

D. As-built copies of all Shop Drawings shall be submitted to the Engineer.

E. Permits and Easements. Submit copies of reports, permits, and easements necessary for installation, use, and operation.

F. Test Reports. Submit copies of reports of tests, inspections, and meter readings as specified.

1.07 RECORD DRAWINGS

A. The Contractor shall maintain a complete and separate set of prints of Contract Drawings and specifications at job Site for duration of the contract. The Contractor shall record Work completed and all changes from original Contract. Drawings shall clearly and accurately include Work installed as a modification or as an addition to the original design.
B. At completion of Work and prior to final request for payment, the Contractor shall submit a complete set of reproducible Record Drawings showing all systems as actually installed.

1.08 JOB CONDITIONS

A. Existing Conditions:

1. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.

2. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

3. Verify that the electrical installation may be made in complete accordance with all pertinent codes and regulations and the original design.

B. Coordination:

1. Coordinate the installation of electrical items with the schedules for Work of other trades to prevent unnecessary delays in the total Work.

2. Coordinate with all local utility companies and make all installations for their services in accordance with all utility company requirements.

3. Any changes shall be done at the Contractor expense.

4. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.

5. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

C. Accuracy of Data:

1. The Drawings are diagrammatic and functional only, and are not intended to show exact circuit layouts, number of fittings, components and place in satisfactory operational power, lighting, and other electrical systems shown. Install additional circuits, components and material wherever needed to conform to the specific requirements of the equipment whether or not indicated or specified.
2. Information and components called for in the specification but not shown on plans or vice versa shall apply and shall be provided as though required expressly by both.

3. The locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Field measurements shall take precedence over scaled dimensions from Drawings. Exact locations shall be as accepted by Engineer during construction. Obtain in the field all information relevant to the placing of electrical Work and, in case of any interference with other Work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the Work in an acceptable manner.

4. In case of difference between building codes, specifications, state laws, industry standards and the Contract Documents, the most stringent shall govern. Should the Contractor perform any Work that does not comply with the requirements of the applicable building codes, state laws, and industry standards, he shall bear all cost arising in correcting these deficiencies.

5. Verify size and ratings of motors and other electrically operated devices supplied by others.

6. Check with Engineer before installation of Work for outlets not specified as to location or for Work that interferes with other trades.

1.09 FLASHING, CUTTING, FIREPROOFING AND WATERPROOFING

A. Flashing around all electrical items penetrating roof or exterior walls shall be the responsibility of the Contractor.

B. All cutting of surfaces, including core drilling of walls and slabs, shall be done by the Contractor.

C. Patching shall be done by the Contractor.

D. The Contractor shall fireproof, waterproof and seal all openings in slabs and walls.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protection. Use all means necessary to protect electrical system materials before, during and after installation and to protect the installed Work and materials of all other trades.

B. Replacements. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall
be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

C. Protect the Work of other trades. Restore any damage caused to other trades to the condition existing prior to damage at no additional cost to the Owner.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

1.11 WORK PERFORMANCE

A. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.

3. Before initiating any work, a job specific work plan must be developed by the Contractor and the Owner. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.

4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner.

1.12 SPECIAL WARRANTY

A. Compile and assemble the warranties specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.

B. Provide complete warranty information for each item. Information to include:

1. Product or equipment list.
2. Date of beginning of warranty or bond.
3. Duration of warranty or bond.
4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.13  DEFINITIONS

A. As used in this specification, “provide” means “furnish and install”, “furnish” means “to purchase and deliver to the project Site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturer’s instructions”, and “install” means “to unload at the delivery point at the Site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project”.

B. Finished Areas. In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.

C. Interior. For the purposes of this specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.

1.14  TEMPORARY POWER

A. The Contractor shall furnish, install, maintain, and remove the temporary electrical power and lighting systems, including lamps, and pay for all labor, materials, and equipment required therefore. All such temporary electrical Work shall meet the requirements of the National Electrical Code, the local utility company, and OSHA.

B. The Contractor shall make all necessary arrangements with the local utility company as to where the temporary electric service can be obtained.

C. The Contractor shall secure and pay for all required permits and back charges for Work performed by others, and other expenses incidental to the installation of the temporary electric service.

1.15  POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
3. Safety precautions.

4. The procedure in the event of equipment failure.

5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.16 MANUFACTURER’S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.17 FIELD FABRICATED NAMEPLATES

A. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the Drawings. Each nameplate inscription shall identify the name of the equipment, function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, black with white letters. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style. All electrical equipment shall be labeled with the following:

1. Panel Name

2. Fed from “Panel Name” & “CKT #”

3. Amps

4. Volts

5. Phase

1.18 ARC FLASH LABEL

A. Provide arc flash labels for all electrical equipment with operating voltages greater than 50 volt per NEC 110.16.

1.19 WARNING SIGNS
A. Exterior warning and caution signs shall be weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20 gauge, galvanized steel backing, with colors, legend, and size appropriate to the location.

B. Interior warning and caution signs shall be aluminum signs with preprinted baked enamel finish and punched for fasteners. Colors, legend, and size appropriate to location.

1.20 WIRE AND CABLE Markers

A. Underground line marking tape shall be permanent, bright colored, continuous printed, metal backed, plastic tape compounded for direct burial service not less than 6 inches wide. Printed legend indicative of general type of underground line below.

B. Wire labels for wires smaller than No. 4. shall be vinyl or vinyl cloth, self-adhesive, wraparound, wire markers with preprinted numbers and letters. Wire sizes No. 4 and larger and multi conductor cables shall be marked with one-piece, nylon locking marker ties equal to Panduit PLM Series.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Materials and equipment shall be listed by UL unless it can be demonstrated that no UL standards exist for a specific item or class of equipment.

B. All other materials, not specifically described but required for a complete and operable electrical installation, shall be new, first quality of their respective kinds, specification grade or better, and as selected by the Contractor subject to the acceptance by the Engineer.

C. All materials and equipment furnished and installed on this project shall meet the most stringent efficiency standards of the local utility to qualify for the maximum rebate.

2.02 MATERIAL AND CONSTRUCTION REQUIREMENTS

A. Unless otherwise shown or specified, all enclosures, motors, wiring and other materials and all construction methods shall conform to the following:

1. Indoor, Above Ground, Dry Areas - NEMA 12, General Purpose, with gasketing for applications where atmospheric conditions are normal. Enclosures shall be sheet steel, treated to resist corrosion, prime painted and finished with a gray baked-on enamel. Control stations shall have NEMA 13, oil tight and dust-tight enclosures.
2. Outdoors, Moist Areas and Indoor Below Grade Areas - NEMA 4, watertight. Enclosures shall be cast aluminum or stainless steel. Where indicated on electrical plans provide NEMA 4X enclosures of stainless steel or reinforced non-metallic (Krydon) construction. All installations shall utilize only stainless steel fasteners/hardware.

3. Indoor-Outdoor, Subject to Submersion in Liquid - NEMA 6, submersible, liquid tight construction. Enclosures shall be cast aluminum.

4. Hazardous Areas - NEMA 7 & 9, explosion-proof construction for Class 1, Division 1, Group D areas. Enclosures shall be cast aluminum.

5. Corrosive Atmospheres - All Work located in corrosive atmospheres, such as atmospheres in the filter area and the chemical feed pump areas shall be of such construction that the corrosive agent cannot enter into and damage the electrical Work. All materials in these areas shall be non-corrodible or finished with an inert coating. Stainless steel, or reinforced PVC electrical enclosures and PVC coated rigid conduit and fittings are required. In addition, provide gas tight seals in all conduits passing from or into corrosive areas (similar to Crouse Hinds Type EYS), to minimize migration of corrosive fumes to other building areas.

2.03 INTERCHANGEABILITY

A. In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays and other items is essential. All similar items shall be of the same manufacturer, type, model and dimensions.

B. For ease of maintenance and parts replacement, to the maximum extent possible, use equipment of a single manufacturer.

C. The Engineer reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.

PART 3 - EXECUTION

3.01 COORDINATION

A. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

B. Field verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and regulations, the Contract Documents, and the referenced standards.
C. The Work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this Work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

D. In the event any discrepancies are discovered, immediately notify the Owner’s Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3.02 INSTALLATION

A. Install all equipment and fixtures in complete accordance with the manufacturer’s recommendations and all pertinent codes and regulations.

B. Thoroughly inspect all items of equipment and any items dented, scratched, or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and acceptance.

C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.

E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

F. The final routing of raceways shall be determined by structural conditions, interferences with other trades and by terminal locations on apparatus. The Engineer reserves the right of a reasonable amount of shifting at no extra cost up until time of roughing in the Work.

G. Where circuits are shown as “home-runs” all necessary fittings and boxes shall be provided for a complete raceway installation.

H. In general, wiring and raceway systems for security alarm, fire alarm, telephone and intercommunications systems are not indicated on the Drawings but shall be furnished and installed under this section.

I. Each lighting and each receptacle circuit shall have its own neutral, dedicated to that circuit. A common neutral for more than one signal phase circuit is not allowed.

J. Surface mounted panel boxed, junction boxes, conduits, etc., shall be supported by spacers to provide a clearance between wall and equipment.

K. Upon completion of all installation, lamping, and testing, thoroughly inspect all exposed portions of the electrical installation and completely remove all exposed labels, soils, markings and foreign material.
3.03 MARKING AND LABELING:

A. All panelboards, indoor transformers, cabinets, control panels and other specified equipment shall be labeled with engraved laminated plastic plates with engraved letters. Punch tapes with mastic backings are not acceptable.

B. All starters, disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates and engraved letters. Where individual switches are circuit breakers in power or distribution panelboards do not have cardholders, they shall be marked with ½” high labels.

C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.

D. All panelboards directories shall be filled out with typewritten identification of each circuit.

3.04 WIRE AND CABLE MARKERS

A. Tag control circuit conductors at both ends and at junction box splices using wire and cable markers with identification numbers as designated on equipment wiring diagrams. Provide typed listing to identify conductors by number and use.

B. Identify spare conductors, individually, at both ends and at junction box splices with number between 1 and 999. Do not duplicate numbers.

C. Identify wire numbers on terminal block marking strips.

D. Provide permanent plastic name tag indicating load for each feeder for all junction boxes, handholes and manholes. Label all process motor wires to yard equipment in handholes and manholes.

3.05 TESTS & SETTINGS

A. Provide the services of an independent Testing Agency to perform the specified tests for the following systems:

1. Ground resistance. The Testing Company shall perform all testing in accordance with National Electrical Testing Association (NETA) standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by the respective Agency. Test results shall indicate recommended action for a sub-par test results. Results shall list recommended test values that should be obtained for new installation.
B. Provide necessary material, equipment, labor and technical supervision to perform and complete the Electrical Acceptance Tests as required.

C. Acceptance tests as herein specified are defined as those tests and inspections required to determine that the equipment involved is acceptable as delivered to the job Site, that the equipment may be energized for final operational tests and is in accordance with the Specifications.

D. Final acceptance of the equipment and/or workmanship will depend upon performance characteristics as determined by the subject tests, in addition to complete operation tests, on all electrical equipment to show that it will perform the functions for which it was designed.

E. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.

F. Upon completion of the remedial Work, the Testing Agency shall repeat all of the tests on components previously found deficient on the first test or any additional test if they be required. It shall be the responsibility and obligation of the Contractor to have all remedial Work accomplished as may be required by second and/or additional tests.

3.06 CLEANING

A. When all Work is completed and has been tested and accepted by the Owner’s Representative, the Contractor shall clean all light fixtures, equipment, and exposed surfaces that have been directly affected by this Work.

END OF SECTION
SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the plans and as specified herein.

B. This section includes wires, cables, and connectors for power, lighting, signal, control, communications and related systems rated 600 volts and less.

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. Related Sections:

1. Division 26: Section, “Common Work Results for Electrical”.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC), and Massachusetts Electrical Code".

   a. UL Standard 83 Thermoplastic Insulated Wires and Cables.
   b. UL Standard 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
   c. UL Standard 854 Service Entrance Cable.

   a. WC-5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
b. WC-7 Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

c. WC-8 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

4. Institute of Electrical and Electronic Engineers (IEEE) Compliance.
   a. Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors.

1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for electrical wires, cables, and connectors.
2. Product data for Megger insulation testing instrument.
3. Report sheets for Megger testing.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.

B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements:
2. Provide color-coding for phase identification as specified herein.

3. Provide factory applied nylon or polyvinyl chloride (PVC) external jackets on wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than three equivalent 90 degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

B. Service & Distribution Wiring:

1. 98 percent conductivity copper.

2. 600 volt insulation, type XHHW.

3. U.L. listed for underground use in wet locations at 75° C.

4. Use XHHW for #4 and larger and THHN/THWN or XHHW for #6 and smaller.

C. Building Wiring:

1. 98 percent conductivity copper.

2. 600 volt insulation, type, THWN/THHN, or XHHW.

3. Stranded conductor: #14 AWG and larger.

4. Minimum branch circuit: #12 AWG.

5. Minimum #10 AWG for 120 volt circuits more than 100 feet long.

6. Minimum #10 AWG for 277 volt circuits more than 230 feet long.

D. Control Wiring:

1. Control wiring for digital/discrete signal wiring, shall be 600V, minimum #14AWG, THHN/THWN, copper stranded, unless specifically indicated otherwise.

2. Instrument cable for analog signal wiring (4-20mA DC) shall be shielded, 2-conductor, 300 volt rated, minimum #18 AWG, Belden No. 8760, Alpha Wire, or approved equal. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below.

a. Tinned copper, XLPE insulated stranded conductors, No. 18 AWG minimum, twisted pair with overall shield, stranded tinned No. 18 AWG copper drain wire and overall PVC jacket. Rated for 600 volts minimum and conforming to UL 1581. Cables shall be rated for tray cable “TC” use where installed within a cable tray.

1) Beldon Company.

2) Okonite Company.

3) Dekoron Wire and Cable Company.


a. Tinned copper, XLPE insulated stranded conductors, No. 16 AWG minimum, twisted pairs with shield over each pair, stranded tinned No. 18 AWG copper drain wire, and overall PVC outer jacket. Rated for 600 volts minimum and conforming to UL 1581 or UL 13. Cables shall be rated for tray cable “TC” use where installed within a cable tray.

1) Beldon Company.

2) Okonite Company.

3) Dekoron Wire and Cable Company.

E. VFD Cable:

1. VFD load-side power cable shall be shielded type specifically listed for use with Variable Frequency Drives.

2. VFD cable shall be UL listed with 600V black XLPE insulation.

3. Cable shall be equipped with 100% foil shield.

4. Cables shall be stranded type with number and sizes of conductors as indicated on the Drawings.

5. Cable shall be equal to Belden Series 295XX, or Engineer approved equal.

F. Ethernet Cable:
1. Cabling shall be UL listed for the application and shall comply with EIA TIA/EIA-568-B and NFPA 70. Provide a labeling system for cabling as required by EIA TIA/EIA-606-A and UL 969.

2. When running cables in ceiling return air plenums, use Teflon Air Plenum cable, unless used inside conduit or tubing sleeve.

3. Provide conduit or tubing sleeves when passing through walls and floors.

4. Provide bushings at each end of conduit runs.

5. Cables shall be derated appropriately in accordance with NEC when combined in a common conduit run.

6. Areas used as air plenums: run fire-resistant teflon cable approved for use in air plenums.

7. Ethernet cable shall be CAT6 four pair, 24 AWG annealed copper, UTP cables with PVC jackets at all locations indicated on the Drawings.

8. All cables shall be "BLUE" in color.

9. All cables shall be homerun from to locations indicated in minimum 3/4"C.

10. All cables shall be terminated and tested at both ends of the cable run.

G. Splices:

1. No. 10 and smaller with 600-volt pressure type insulated connector of wire-nut type, or equal; soldered and crimped type not allowed. Ideal type “wire nut” Buchanan type “B-Cap” and Minnesota Mining (3M) type “Scotchlok”.

2. No. 8 and larger with solderless lugs or solderless connectors of Lock-tite or similar type properly taped with plastic insulating tape, Minnesota Mining Co. #33, or equal, then two half-lap servings of friction tape, Manson, or equal.’

3. Wire connector systems for use with underground conductors shall be UL listed specifically for such use.

4. Service entrance conductors shall be installed without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Control and metering conductors shall be installed without splices.
5. All splices shall be made only by specific permission of the Engineer and then only in manholes or pull boxes and shall be sealed watertight with a heat-shrunk insulation.

6. Tighten electrical connectors and terminals in accordance with manufacturer’s published torque tightening values. Where manufacturer’s torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

7. Use UL listed splice for all underground wires, ducts buried, in conduit and in ducts. Connectors and splices shall be waterproof.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION:

A. All wire and cables shall be installed in conduit of size and type indicated on the drawing and specifications.

B. Install electrical cables, wires, and connectors in compliance with NEC.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

E. Conceal all cable in finished spaces.

F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

G. Conductors shall be sized such that voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.

H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

I. All feeder and branch circuit wiring shall be color coded at all termination and splice locations. System neutrals shall be designated in addition to phase conductors. Equipment grounds shall be green.
J. The number of conductors shown on the Drawings is not necessarily the correct number required. As many conductors as are required in each case shall be installed. In general, grounding conductors are not scheduled.

K. In general, wiring for the following systems shall be installed in separate conduits. Do not mix categories in a single raceway.

1. 120 volt power wiring.
2. 120 volt control wiring, including, digital input and output signals.
3. 24 volt DC control wiring, including, digital input and output signals.
4. 24 volt DC analog control wiring (4-20mA).
5. Communications wiring.
6. Special & Emergency Systems

L. Conductors 600 volts and below shall be color coded in accordance with the following:

<table>
<thead>
<tr>
<th>CONDUCTOR</th>
<th>120/208 COLOR</th>
<th>480/277 COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
<td>Orange</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
<td>White/Gray</td>
</tr>
<tr>
<td>Equipment Grounds</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

3.02 FIELD QUALITY CONTROL:

A. The Contractor shall test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.
B. The Contractor shall Megger Test, the insulation resistance between phases and from each phase to ground for each of the following feeder and motor branch circuits:

1. Secondary Service Entrance
2. Distribution Equipment
3. Generator and ATS
4. Transformers
5. Variable Frequency Drives.
6. Motors.

C. The Megger Testing shall be witnessed by the Engineer/Architect. The Engineer/Architect shall be notified at least 48 hours in advance of testing.

D. Measure the insulation resistance with a digital "Megger" insulation testing instrument in accordance with manufacturer’s recommendations. All test instruments are to be provided by the Contractor.

E. If any insulation resistance measures less than 50 megohms, the cable shall be considered faulty with the cable failing the insulation test. In moist environments, bag the ends of the cable to prevent a faulty Megger test.

F. Any cable which fails the insulation tests or which fails when tested under full load conditions shall be replaced with new cable for the full length and retested at no additional cost to Owner.

G. The below grade service or feeder splice shall be water immersion Megger tested in the presence of the Engineer. Each splice shall be immersed in a grounded water immersion bath for 24 continuous hours prior to and during the test. Criteria for failure shall be as described for cable above.

END OF SECTION
SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install grounding materials in accordance with the plans and as specified herein.

B. This section includes solid grounding of electrical systems and equipment.

C. Related Requirements

1. Division 26: Section, "Common Work Results for Electrical".

2. Division 26: Section, "Wiring Devices".

1.02 QUALITY ASSURANCE

A. Reference Standards.

1. "National Electrical Code" (NEC), as applicable to electrical grounding and bonding, Art. 250. Use of conduit system for ground conductor shall not be allowed.


4. Institute of Electrical and Electronic Engineers (IEEE) IEEE 81 and 142.

a. 1, "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounded System (Part 1)."

b. 141, "IEEE Recommended Practice for Electric Power Distribution for Industrial Plants."

c. 142, "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems."
1.03 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.
   1. Product data for each type of product specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide each electrical grounding system with assembly of materials required for complete installation including wires/cables, connectors, lugs, clamps, ground rods, bonding jumpers and accessories.

B. Provide electrical grounding conductors for grounding connections matched to power supply wiring materials and sized according to NEC.

C. Provide electrical connectors, lugs, clamps, bonding jumpers and accessories as recommended by the respective manufacturer for the particular application, unless other indicated.

D. Ground rods; Solid copper clad, 3/4-inch diameter by 10 feet long.

E. Insulated conductors: Green in color.

F. Ground Bus. Bare annealed copper bars of rectangular cross section, ¼-inch x 3-inch x length as required, with 98 percent conductivity, rigidly attached to structure, or as indicated on the Drawings.

G. Bonding Strap Conductor/Connectors. Soft copper, 0.05 inch thick and 2-inches wide, except as indicated.

H. Pressure Connectors. High conductivity plated units.

I. Bolted Clamps. Heavy-duty units listed for the application.

J. Exothermic Welded Connections. Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.
PART 3 - EXECUTION

3.01 GROUNDING AND BONDING:

A. Ground main service entrance ground bus or lug to neutral of incoming service, to enclosure, to building steel, to ground rods/grounding ring, to rebar in concrete footing, and to main cold water pipe. Install grounding bushings on service conduits. Use exothermic style ground connections to the ground rods and building steel.

B. Provide and install 600 volt insulated bonding conductors throughout the distribution system with connection to bonding (or grounding) terminal on each panel and panelboard with connections to other equipment where specifically indicated and noted.

C. Bonding conductors shall be continuous where possible. Where splices are required, provide T & B, or equal, compression connectors of approved pattern. Insulate connectors to equivalent thickness of conductors.

D. Provide grounding system for grounded circuit conductors of dry type transformer secondaries as indicated and required. Use exothermic style ground connections to building steel. Enclose grounding conductors in schedule 40 PVC conduit.

E. Provide equipment grounding conductors in all conduits containing power, control, or instrumentation conductors on the load side of the service equipment or on the load side of a separately derived system.

F. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except that larger sizes indicated or shown on the Contract Documents shall take precedence. Use of metallic conduit systems for equipment grounding as recognized by the NEC shall not be permitted under this specification.

G. Install grounding bushings on conduits at both primary and secondary entrances to transformers. Ground transformer enclosures to bushings.

H. Install bonding jumper for flexible metal conduit unless fittings are approved for grounding or otherwise comply with NEC.

1. Size jumper to match over-current device.
2. Green insulation.
3. Connect to grounding bushing at each end.
I. Ensure that entire electrical system is electrically continuous and permanently and effectively grounded, including all electrical equipment and motors.

1. Locate ground rods with a minimum of two rod length from each other and at least the same distance from any other grounding electrode. Connect ground conductors to ground rods by means of exothermic welds except at test wells and as otherwise indicated. Drive rods until tops are 24 inches below finished floor or final grade except as otherwise indicated.

J. Route grounding electrode conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

K. Ensure that grounding electrode conductor connections to interior piping, structural members, and the like are accessible for periodic inspection during the life of the structure.

3.02 BONDING FOR OTHER TRADES:

A. Signal raceways, water piping, heating piping and metallic air ducts shall be bonded together and to the grounding conductor with No. 8 soft drawn bare solid conductors. Connections to pipes shall be made with cast clamps of like material as the pipes to which attached, to ducting terminated in a secure manner by best practical means, bonding across any flexible or insulated connections.

B. All bonding conductors shall be installed in a neat and workmanlike manner properly shaped for contour of surface involved and properly supported. At locations remote from the main service entrance panelboards, bond to the largest raceway nearby.

3.03 FIELD QUALITY CONTROL:

A. Independent Testing Organization. Arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

B. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the three-point fall of potential method in accordance with Section 9.03 of IEEE 81. Simple moisture addition is not acceptable.
C. Ground/resistance maximum values shall be as follows:

1. Equipment rated 500 kva and less. 10 ohms.
2. Equipment rated 500 kVA to 1000 kVA. 5 ohms.
3. Equipment rated over 1000 kVA. 3 ohms.
4. Unfenced substations and pad mounted equipment. 5 ohms.
5. Fence Grounds. 10 ohms.

D. The grounding tests results shall be submitted to the Engineer for review and approval. Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values.

END OF SECTION
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SECTION 26 05 34

RACEWAYS, BOXES AND SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install raceways, boxes and supporting devices in accordance with the plans and as specified herein.

B. Types of products specified in this section include:

1. Conduit, Raceways & Fittings
2. Supporting Devices.
3. Boxes and fittings.

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. Related Sections:

1. Division 26: Section, “Common Work Results for Electrical”.
2. Division 26: Section, “Low-Voltage Electrical Power Conductors and Cables”.

1.03 QUALITY ASSURANCE

A. Reference Standards.

1. Underwriter’s Laboratories, Inc. (UL) Listing and Labeling. Items provided under this section shall be listed and labeled by UL.
1.04 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and material certifications as required.

B. In accordance with Conditions of Contract and Division 1 specification sections:
   1. Product data for cabinets and enclosures with classification higher than NEMA 1.
   2. Shop drawings for floor boxes and boxes, enclosures and cabinets that are to be shop fabricated (non-stock items).

PART 2 - PRODUCTS

2.01 CONDUIT, RACEWAYS & FITTINGS

A. Provide conduit with ¾-inch diameter minimum, except where specifically shown smaller on the Contract Drawings.

B. Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

C. Refer to Table 3.01A for approved conduit installation guidelines.

1. Electrical Metallic Tubing (EMT):
   a. EMT shall be rigid metallic conduit of the thinwall type in straight lengths, elbows, or bends and must conform to NEMA C80.3 and the requirements of UL 797.
   b. Couplings and connectors shall be steel compression fittings. Where EMT enters outlet boxes, cabinets, or other enclosures, connectors must be the insulated-throat type, with a locknut. Fittings must meet the requirements of NEMA FB 1.

2. Rigid Galvanized Steel Conduit:
   a. Rigid steel conduit (RGS), including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and NEMA C80.1. Steel fittings shall be galvanized by the hot-dip process.
   b. Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.
c. Gaskets shall be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

d. Covers shall have captive screws and be accessible after the Work has been completed.

3. PVC-Coated Rigid Metal Conduit:
   a. Rigid galvanized metal conduit coated with 40 mils thick polyvinylchloride coating.
   b. Fittings, elbows, supporting devices and accessories shall include factory applied 20 mils thick polyvinylchloride coating and be manufactured by the same as that of the conduit.
   c. Use tools as recommended by the manufacturer so as not to damage PVC coating. Where coating is damaged, touch-up with PVC paint in the field after installation.

4. Rigid Plastic Conduit:
   a. PVC Schedule 40: Conduit shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90 degree C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.
   b. PVC Schedule 80: Heavy wall PVC conduit that shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90 degree C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.

5. Flexible Metallic Conduit:
   a. Flexible metallic (FM) conduit shall meet the requirements of UL1.
   b. Liquidtight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.
c. Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

6. Wireways:
   a. Wireways and auxiliary gutters for use in exposed, dry locations shall be a prefabricated channel-shaped sheet metal trough with hinged or removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.
   
   b. Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets shall be constructed from sheet steel of commercial quality not less than 16-gage. Sheet metal component parts shall be cleaned, phosphatized, and coated with a corrosion-resistant gray paint.
   
   c. Straight sections of wireways and auxiliary gutters shall be solid or have knockouts as indicated in both sides and bottom, 3 inches on center.
   
   d. Straight sections shall be not more than 5-feet long, with covers held closed with screws.

7. Conduit Seals:
   a. Provide factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide a cast in place water stop wall sleeve with a mechanical pipe seal between the conduit and the sleeve. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
   
   b. Provide E.Y.S. seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environments or a Class 2, Division 1 or 2 environment, and chemical rooms.

2.02 SUPPORTING DEVICES

A. Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot dip galvanized unless material is inherently corrosion resistant.
B. Refer to Table 2.02A for approved supporting device installation guidelines.

1. Conduit Supports:
   a. Single run hangers: Galvanized steel conduit straps or clamps, or cast metal beam clamps. Perforated straps and spring steel clips and clamps will not be permitted.
   b. Group run hangers: Minimum 12-gauge galvanized performed U-channel rack with conduit fittings; 25 percent spare capacity.
   c. Hanger rods: Threaded steel, 3/8-inch diameter, or as identified on the Drawings.
   d. Vertical run supports: Minimum 12-gauge galvanized performed U-channel struts with conduit fittings.

2. Equipment and Lighting Supports:
   a. U-channel: 12-gauge galvanized performed U-channel struts with fixture and conduit fittings, as applicable, unless indicated otherwise on the Drawings.

3. Corrosive Area Supports:
   a. Clamp Hangers, Pipe Straps, and Clamp Back Spacers for use with PVC-coated rigid metal conduit shall have 40mil gray PVC exterior coating.
   b. Clamp Hangers, Pipe Straps, etc. for use with PVC nonmetallic conduit shall be of nonmetallic PVC material.
   c. Hanger Rods: 20mil gray PVC exterior coated rod with threaded ends only 3/8” and 1/2” sizes as required.
   d. Strut Support: 20mil gray PVC exterior coating strut. Standard channel, slotted channel, and back to back channel are acceptable.
### TABLE 2.02A – Supporting Devices

<table>
<thead>
<tr>
<th>Location/Equipment</th>
<th>Acceptable Support Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical &amp; Control Rooms</td>
<td>Galvanized Steel U-Channel</td>
</tr>
<tr>
<td>Utility &amp; Mechanical Rooms</td>
<td>Galvanized Steel U-Channel</td>
</tr>
<tr>
<td>Exterior</td>
<td>Galvanized Steel U-Channel</td>
</tr>
<tr>
<td>Preliminary Treatment Building Headworks Rm</td>
<td>PVC Coated Steel U-Channel</td>
</tr>
<tr>
<td>Preliminary Treatment Building Basement</td>
<td>PVC Coated Steel U-Channel</td>
</tr>
<tr>
<td>Sludge Handling &amp; Disposal Building</td>
<td>PVC Coated Steel U-Channel</td>
</tr>
</tbody>
</table>

### 2.03 BOXES AND FITTINGS

A. Boxes must have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A.

B. In general, boxes that are exposed to weather, process areas, normally wet locations, and locations exposed in mechanical spaces shall be cast-metal. Boxes in all other finished areas shall be sheet metal. Boxes installed in corrosive areas, such as the chemical feed room, shall be nonmetallic.

C. Refer to Table 2.03A for approved enclosure types.

1. **Sheet Metal Outlet Boxes:**
   a. Sheet Metal Outlet Boxes: Standard type galvanized steel, minimum four inch square or octagon by 1-1/2 inch deep.
   b. Luminaire and Equipment Supporting boxes: Rated for weight of equipment supported; include 2 inch male fixture studs where required.
   c. Single Wall Type: Minimum size, four inch square by 1-1/2 inch or 2-1/8 inch deep, except as noted. Provide dry wall device covers raised 3/4 inch minimum to insure flush finish mounting.
   d. Ganged Wall Type: Minimum depth three inches except as noted, ganged as required under common plate to contain devices shown. On 277 volt circuits ganged boxes for switches shall contain only one circuit or equip box with permanent barriers per NEC Art 404-8.

2. **Cast Outlet Boxes:**
   a. Type FS shallow and type FD deep, cast ferroalloy.
   b. Provide number of threaded hubs as required.
c. Use in all exterior, damp and locations exposed in mechanical spaces.

d. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing. Provide correct box to accept weatherproof covers as specified.

3. Sheet Metal Pull & Junction Boxes:

   a. Sheet metal boxes shall be standard type galvanized steel and must conform to UL 50.

   b. Box dimensions shall be minimum four inch square or octagon by 2/1/2 inch deep.

   c. Sizes up to 12x12x6 inch: Provide screw-type or hinged covers.

   d. Sizes greater than 12x12x6 inch: Provide hinged covers.

   e. Boxes shall be sized to accommodate all incoming raceways.

4. Nonmetallic Outlet, Device, and Wiring Boxes:

   a. Conform to NEMA OS 2, "Nonmetallic Outlet Boxes, Device Boxes, Covers, and box Supports," and UL 514C, "Nonmetallic Outlet Boxes, Flush Device Boxes and Covers." Boxes shall be molded polyvinyl chloride (PVC), or fiberglass units of type, shape, size, and depth to suit location and application.

   b. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching material suitable for the application and location installed.

   **TABLE 2.03A – Electrical Enclosure Types**

<table>
<thead>
<tr>
<th>Location/Equipment</th>
<th>Acceptable Enclosure Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical &amp; Control Rooms</td>
<td>NEMA 1G</td>
</tr>
<tr>
<td>Utility &amp; Mechanical Rooms</td>
<td>NEMA 12</td>
</tr>
<tr>
<td>Exterior</td>
<td>NEMA 4X</td>
</tr>
<tr>
<td>Preliminary Treatment Building</td>
<td>NEMA 7/4X</td>
</tr>
<tr>
<td>Headworks Rm</td>
<td></td>
</tr>
<tr>
<td>Preliminary Treatment Building</td>
<td>NEMA 4X</td>
</tr>
<tr>
<td>Basement</td>
<td></td>
</tr>
<tr>
<td>Sludge Handling &amp; Disposal Building</td>
<td>NEMA 4X</td>
</tr>
</tbody>
</table>
PART 3 – EXECUTION

3.01 CONDUIT

A. Uses Permitted:

1. Use liquid tight flexible metal conduit for the final 24 inches of connections to motors or control items subject to movement or vibration.

2. Use RGS for all exterior aboveground installations unless otherwise noted.

3. Use PVC coated rigid steel conduit, or as scheduled below, for installation in corrosive areas, and other areas as identified on the Contract Drawings.

4. Exposed raceways in Manufacturing Area’s, Utility Rooms, Mechanical Rooms, Warehouse Area’s, etc., shall be Rigid Galvanized Steel below 15 ft.

5. Conduit and raceway runs in finished areas concealed in or behind walls, above ceilings, or exposed on walls and ceilings 15 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

6. Use Schedule 40 PVC conduit for exterior direct buried installations. Use Schedule 40 PVC conduit for exterior concrete encased installations. Use Schedule 80 PVC conduit for underground installations under driveways. The transition from underground and from concrete encasement to riser shall be PVC coated rigid steel conduit to a minimum of 12” above finished floor and/or finished grade elevation. All elbows shall be prefabricated Rigid Steel to prevent wire burn through. Reference specification 26 05 43 “Underground Ducts and Raceways for Electrical Systems” for further requirements.

7. Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal. Provide seals for the interior of conduits that penetrate exterior or water bearing walls, consisting of gland type sealing bushings or RTV closed cell silicone foam.
8. Refer to Table 3.01A below for approved conduit types:

**TABLE 3.01A – Conduit Types**

<table>
<thead>
<tr>
<th>Location/Equipment</th>
<th>Approved Conduit Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical &amp; Control Rooms</td>
<td>Electrical Metallic Tubing</td>
</tr>
<tr>
<td>Utility &amp; Mechanical Rooms</td>
<td>Rigid Galvanized Steel</td>
</tr>
<tr>
<td>Exterior</td>
<td>Rigid Galvanized Steel</td>
</tr>
<tr>
<td>Preliminary Treatment Building</td>
<td>PVC Coated Rigid Galvanized Steel</td>
</tr>
<tr>
<td>Headworks Rm</td>
<td></td>
</tr>
<tr>
<td>Preliminary Treatment Building</td>
<td>PVC Coated Rigid Galvanized Steel</td>
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<tr>
<td>Basement</td>
<td></td>
</tr>
<tr>
<td>Sludge Handling &amp; Disposal Building</td>
<td>PVC Coated Rigid Galvanized Steel</td>
</tr>
</tbody>
</table>

B. Power, lighting, control, emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems as indicated on the Contract Drawings and as specified herein.

C. Any run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope stalled.

D. Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

E. Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves. Conduit shall be securely clamped and supported at least every 10 feet vertically and 8 feet horizontally. Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

F. Install exposed conduits, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or sidewalls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
G. Do not run conduits exposed on the exterior surface of buildings. Conduits penetrating exterior walls below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration. The exterior of the conduit shall be sealed with a mechanical pipe seal. The interior conduit seal shall be a gland type sealing bushing or RTV closed cell silicone foam. Ensure that conduits do not retain water against these seals.

H. Raceways penetrating fire rated walls, floors, and partitions shall be sealed with a fire rated sealant.

I. All conduits shall be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the raceway system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1 1/4 inches and 8 feet for conduits 1 1/4 inches and larger. Support riser conduits at each floor level with clamp hangers. All underground conduits shall be securely anchored to prevent movement during placement of concrete or backfill. Use precast separators and heavy gauge wire ties or other approved fasteners.

J. Provide E.Y.S. seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environments or a Class 2, Division 1 or 2 environment, and chemical rooms.

K. Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports. Exposed ends of conduit without conductors shall be sealed with watertight caps or plugs.

L. Bonding wires shall be used in flexible conduit for all circuits. Flexible conduit shall not be considered a ground conductor.

M. Liquid tight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

N. Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment.

O. A polypropylene pull rope with a tensile strength not less than 130 pounds shall be installed in empty conduit.
P. Electrical conduit may be embedded in concrete according to the provisions of Article 6.3 of ACI 318 "Building Code Requirements for Reinforced Concrete", provided the following conditions are met:

1. Outside diameter of conduit shall not exceed 1/3 of concrete thickness. Maximum conduit outside diameter shall not exceed 3 inches when embedded in slab.

2. Conduit shall not be placed closer than three diameters on center. Route conduit to minimize crossing of different conduit runs.

3. Conduit shall not be embedded in structural concrete slabs less than four inches thick.

4. A 1 1/2 inch minimum concrete cover shall be provided for conduits in structural concrete slabs.

Q. Installation of Underground Conduit:

1. Minimum of 3/4 inch conduit in or under concrete slab on grade.

2. Where conduits are installed in concrete slabs, on the ground, underground, or exposed to the weather, make all joints liquid tight and gas tight.

3. Bury all underground conduit, except under concrete slabs placed on fill, to a depth of at least 30 inches below finished grade unless otherwise indicated on the Drawings.

4. Slope ducts to drain away from buildings into manholes and/or handholes. Adjust final slopes to coordinate with existing site utilities.

5. Install on undisturbed soil where possible. Concrete encase conduits as shown on Drawings. Use pit run gravel and sand, placed 8 inch lifts and compacted for backfill.


R. Installation of Rigid Metal Conduit:

1. Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight. Conduit shall be protected against damage and the entrance of water or foreign material during construction.
2. Ninety-degree bends of conduit with a diameter larger than 1 inch shall be made with factory-made elbows. Conduit elbows larger than 2 ½ inches shall be long radius. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

3. At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.

4. Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound (cold galvanizing paint) shall be used on all conduit threads or any locations where the original hot galvanized surface has been compromised.

5. Conduit stubbed-up through concrete floors for connections to free-standing equipment except motor-control centers, cubicles, and other such items of equipment shall be provided with a minimum of a 12” riser above the floor slab is of sufficient thickness; if not, a floor box shall be provided and set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.02 SUPPORTING DEVICES

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installations.

C. Conform to manufacturer’s recommendations for selection and installation of supports.

D. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

E. Support parallel runs of horizontal raceways together on trapeze type hangers.
F. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

G. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

H. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

I. Install sleeves in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed fire-stopping sealant in gaps between sleeves and enclosed conduits and cables.

3.03 BOXES AND FITTINGS

A. Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pull box installed at a convenient intermediate location.

B. Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

C. Bonding jumpers shall be used around concentric or eccentric knockouts.

D. Installation of Outlet Boxes:

1. Use nonmetallic boxes in corrosive areas such as chemical feed area and as designated on the plans.

2. Use explosion proof boxes in Hazardous areas as identified on the Drawings.

3. Use cast metal boxes in all other locations. Each box with associated covers and fittings shall have a NEMA rating for each location installed.

E. Installation of Pull and Junction Boxes:
1. Use general purpose boxes (NEMA 1) in finished areas with framed construction.

2. Use dust-tight and oil-tight boxes (NEMA 12) in other dry interior areas.

3. Use explosion proof boxes (NEMA 7) in hazardous areas as designated on the plans.

4. Use watertight boxes (NEMA 4) for exterior and wet locations on outdoor structure where moisture is present.

5. Use corrosion resistant watertight boxes (NEMA 4X) for wet locations and corrosion filled areas, such as the chemical feed area, and as identified on the Drawings.

END OF SECTION
SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install underground duct banks, manholes and handholes including all necessary excavation, backfill and surface restoration.

B. Provide underground conduit duct banks with manholes and pullboxes for power, and lighting circuits as shown on the Drawings.

C. Coordination: Duct bank routing when shown on the Drawings is diagrammatic. Coordinate installation with piping and other underground systems and structures and locate clear of interferences. Coordinate manhole and handhole installation with piping, sheet piling and other underground systems and structures and locate clear of interferences.

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. Division 26, Section “Common Work Results for Electrical.”

C. Division 26, Section “Raceways, Boxes, & Supporting Devices.”

D. Division 26, Section “Low-Voltage Electrical Power Conductors and Cables.”

E. Division 26, Section “Grounding and Bonding for Electrical Systems.”

1.03 QUALITY ASSURANCE

A. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:

1. National Electrical Manufacturers Association (NEMA).


3. The Institute of Electrical and Electronic Engineers (IEEE).
4. Insulated Cable Engineers Association (ICEA).
8. ANSI A14.3, Safety Requirements for Fixed Ladders.
9. OSHA.

1.04 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Layouts showing the proposed routing of duct banks and the locations of manholes, handholes and areas of reinforcement.
2. Profiles of duct banks showing crossings with piping and other underground systems.
3. Typical cross sections.
4. Installation procedures.
5. Manufacturer's technical information for manholes, handholes and accessories proposed for use.
6. Drawings showing interior and exterior manhole and handhole dimensions and details of openings, jointing, inserts, reinforcing, size and locations of openings, and accessory locations.
7. Certificate of concrete and steel used in underground pre-cast concrete utility structures, according to ASTM C858.
8. Product Data for nonmetallic conduit and manhole accessories.

B. Record Drawings

1. Layouts showing the actual routing of duct banks including the dimensions and depth of the top of duct bank below grade. Record drawings for duct banks should also include cross sections of the duct bank indicating the circuit, use, conduit size, orientation and number of conduits.
2. Locations of manholes, handholes and areas of reinforcement.
1.05 DEFINITIONS

A. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.

B. Duct bank: 2 or more conduits or other raceway installed underground in the same trench or concrete envelope.

C. Handhole: An underground junction box in a duct or duct bank with cover accessible from grade.

D. Manhole: an underground utility structure, large enough for a person to enter, with facilities for installing and maintaining cables. Where required manholes shall comply with the Utility Companies requirements.

1.06 PROJECT CONDITIONS AND COORDINATION

A. Coordination with other Underground Utilities:

1. Locate all existing underground utilities through the use of an underground utility piping location services company. Locate the existing underground utilities and piping before any excavation is to begin.

2. Coordinate conduit routing, duct bank and manholes with other new and existing underground utilities. Revise locations and elevations as required to suit field conditions and ensure that conduits, duct runs, manholes and handholes do not interfere with existing and new underground utilities and piping.

PART 2 – PRODUCTS

2.01 DUCT BANK CONDUIT

A. Duct: Schedule 40 and Schedule 80 PVC conduit and fittings in accordance with Division 26 Section “Raceways, Boxes and Supporting Devices.”

B. Rigid Steel Conduit: Rigid steel conduit and fittings in accordance with Division 26 Section “Raceways, Boxes and Supporting Devices.”

C. All shielded instrumentation and communications cable shall be installed in ferrous metal, steel conduit throughout the entire run of conduit from end to end.

2.02 MANHOLES

A. Manholes shall conform to the requirements as shown and detailed on the Drawings.
B. Material and Construction:
   1. Pre-cast reinforced concrete.
   2. Minimum interior dimensions as indicated on the Drawings or required by the Utility Company.
   3. Duct entrances sized and located to suit duct banks. Duct-bank penetration shall be watertight.
   5. Nominal inside dimensions as shown.
   6. Base Section: Shall include sump and grate and ground rod openings.
   7. Sump Covers; ASTM A48; Class 30B galvanized iron.

C. Frames and Covers:
   1. Material: Cast iron conforming to ASTM A 48, Class 30A.
   2. Covers: 42” minimum diameter, watertight, sealed type marked "ELECTRICAL" in raised two inch letters.
   3. Frame shall be grouted on the manhole.
   4. Manufacturer: Provide frames and covers of one of the following:
      b. Flockhart Foundry Company.
      c. Campbell Foundry Company.
      d. Approved equal.

D. Pulling Irons:
   1. Material: Galvanized steel.
   2. Cast in the wall opposite to the centerline of each incoming duct bank and 12 inches below centerline of bottom line of ducts.
   3. Product and Manufacturer: Provide one of the following:
b. Cat. No. 8119 by A.B. Chance Company.

c. Approved equal.

E. Cable Racks:

1. Cable racks shall adequately support cables with space allowed for future cables. Provide as indicated to support mounting channels and racks. Cast-in Place anchors with minimum rated pullout working capacity of 2000 pounds. Pennsylvania Insert Corp. 5/8-11-INSERT, with 5/8-11 hex head cap screw made from 316 stainless steel.

2. Each rack shall be a vertical assembly of 24 inch cable racks extending from within 6 inches of the manhole roof slab to within 6 inches of the manhole floor.


4. Cable Racks: Heavy duty non-metallic racks. 8, 14, 20 inches as indicated.

5. Product and Manufacturer: Provide one of the following:

   a. Underground Devices, Inc. model RA 08, RA14, RA20 or approved.

   b. Approved equal.

F. Insulators:


2. Product and Manufacturer: Provide one of the following:


   b. Cat. No. 2120 by Hubbard and Company.

   c. Approved equal.

G. Manhole Steps:


2. Steps spaced evenly at approximately twelve to sixteen inch centers and shall project evenly from manhole walls.
3. Manufacturer: Provide manhole steps of one of the following:
   a. Flockhart Foundry Company.
   b. Neenah Foundry Company.
   c. Approved equal.

2.03 HANDHOLES

A. The pull/splice box underground enclosures shall be constructed of polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement may be provided by means of steel, fiberglass, or a combination of the two. Handholes for installation in roadways shall concrete reinforced H20 traffic rated.

B. Enclosure:
   1. The enclosure must be manufactured with an open or closed bottom and a removable cover. The enclosures shall be green or concrete gray in color.
   2. The enclosures shall be designed to be installed flush to grade with the cover fitting flush to the box.
   3. The enclosures shall be suitable for installation in either direct or buried native soil, embedded in concrete, or embedded in asphalt surfacing. (A concrete collar is required for installation in asphalt.)
   4. The enclosures shall be of a stackable design for greater installation flexibility.
   5. All covers are to be equipped with a minimum of two stainless steel lockdown mechanisms. All covers shall have a logo recessed into the cover and it shall read electric.
   6. All enclosure covers will have some type of recessed access point to allow removal of the cover with a hook. The access points will be placed in such a location to allow for the greatest amount of leverage and safety possible.
   7. Enclosures shall be designed and suitable for installation and use through a temperature range of -40ºC (-40ºF) to 60ºC (140ºF).
   8. A certified copy of all test reports must be signed and stamped by a registered professional engineer and submitted prior to shipment of products.

C. Material Requirements:
1. Permanent deflection of any surface shall not exceed 10 percent of the maximum allowable static design load deflection.

2. The covers shall be skid resistant and have a maximum coefficient of friction of 0.50 on the top surface of the cover. Coatings will not be allowed.

3. Any point on the covers must be able to withstand a 70 foot-pound impact administered with a 12 pound weight having a “C” tup (ASTM D-2444) without puncturing or splitting. The test shall be performed with the cover resting on a flat, rigid surface such as concrete or a 1” steel plate.

4. Covers shall have molded lettering, ELECTRIC or COMM as applicable.

5. Fastening devices used to secure the cover to the box shall be capable of withstanding a minimum torque of 15 foot-pounds and a minimum straight pullout strength of 750 pounds.

6. The material is tested according to the requirements of ASTM D543, Section 7, Procedure 1, for chemical resistance. The manufacturer is responsible for proof of compliance with the latest version of the ASTM standards.

7. Other required acceptance standards are:
   c. ASTM D570, Section 5, 6.1, 6.5: Water Absorption.
   d. ASTM D790: Flexural Properties
   e. ASTM D635: Flammability Test.

D. Manufacturers: Provide handholes as manufactured by
   1. Strongwell Quazite or approved equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Concrete shall be measured, mixed and placed, and compacted as required in Division 3.
B. Provide not less than 3 inches of concrete between the outside of a duct and the earth. Provide not less than 2 inches of concrete between adjacent ducts. Refer to Drawings for spacing requirements. Provide side forms for each duct bank.

C. All duct line concrete pours shall be continuous between manholes or handholes and between manholes or handholes and structures.

D. Where duct lines pass through concrete walls, concrete envelopes shall be extended through the finished flush with inside surfaces. Watertight construction joints of an approved type shall be provided.

E. Duct banks shall be reinforced when laid on backfill covering new pipelines, roads, parking lots or any are subject to vehiccular traffic. Beneath these areas, install reinforcing bars as shown on the Drawings, extending 10 ft beyond area needing protection.

F. Duct lines shall be laid in trenches on mats of gravel not less than 6 inches thick and well graded.

G. All electrical duct banks shall be colored red for safety purposes.

H. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3 in per 100 ft.

I. Make raceway entrances to buildings and vaults with hot dipped rigid galvanized steel conduit not less than 10 ft long. Conduits which are not concrete encased for runs below floor slabs in slab-on-grade construction shall be hot dipped rigid galvanized steel conduit. Conduits which are concrete encased for runs below floor slabs in slab-on-grade construction shall be encased under the slab to their respective equipment.

J. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

3.02 INSTALLATION

A. Provide excavation and backfilling required for duct bank manhole and handhole installation.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 3-inch minimum separation between the outer surfaces of the ducts.
D. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to insure filling of all spaces between ducts.

E. Make bends with sweeps of not less than 48-inch radius or 5 degree angle couplings.

F. Make a transition from non-metallic to PVC coated rigid steel conduit where duct banks enter structures or turn upward for continuation above grade. Terminate the ducts in insulated grounding bushings. Continue ducts inside buildings with steel, metallic conduit.

G. Where ducts enter manholes and handholes, terminate the ducts in suitable end bells.

H. Provide expansion/deflection fittings in accordance with the requirements specified in Division 26, Section “Raceways, Boxes and Supporting Devices.”

I. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material or other materials which can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.

J. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3 inches per 100 feet.

K. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand or gravel have been left in the duct.

L. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system. Terminate ground conductor at last manhole or handhole for outlying structures.

M. Install a warning ribbon approximately 12 inches below finished grade over all underground duct banks. The identifying ribbon shall be a PVC tape, 3-inches wide, yellow color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters.
N. Plug and seal all empty spare ducts entering buildings and structures. Seal all ducts in use entering buildings and structures. Seal shall be watertight, O-Z/Gedney Type Dux Duct Sealing Compound or equal.


P. Install manholes and handholes where shown on Drawings. Verify final locations in field.

Q. Complete installation of manholes and handholes so that structures are watertight. Provide expansion/deflection fitting for each conduit entry into the manholes.

R. Provide sump opening in manhole floor.

S. Provide grading rings or brick stacks for manholes when required to adjust manhole cover to proper grade. Stacks shall be minimum of 12 inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack shall be such as is necessary to bring the manhole frame to the proper grade.

T. Cable Racks:
   1. Provide cable hooks to support each cable on each rack along the cable run within the manholes.
   2. Individually support each cable at each hook on porcelain insulators.
   3. In the manhole securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape. Tie cables with non-metallic 3/4-inch strapping tape as manufactured by 3M or tie down with nylon straps.

U. Conduits shall extend 3 inches above concrete slab surface, unless otherwise indicated. All conduits shall be bushed to protect cables and provide means for grounding.

V. Duct Bank Conduit Spacers: Non-metallic, snap together intermediate and bottom pieces, sized for conduit diameter and code spacing. Carlon “Span-Loc” or approved. Separators shall be compatible with the conduit utilized. The joints of the conduits shall be staggered by rows and layers so as to provide a duct line having the maximum strength. During construction, partially completed duct lines, shall be protected from the entrance of debris such as mud, sand, and dirt by means of suitable conduits plugs. As each section of a duct line is completed, a testing mandrel not less than 12 inches long with a diameter ¼ inch less than the size of the conduit, shall be drawn through each conduit, after which a brush
having the diameter of the duct, and having stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand and/or gravel; conduit plugs shall then be immediately installed. Provide a plastic pull rope, having a minimum of 3 additional feet at each end, in all spare ducts.

3.03 DUCT BANK INSTALLATION

A. All bends shall have a radius greater than 36 inches or 12 times conduit inside diameter whichever is greater.

B. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.

C. Install no more than equivalent of three 90-degree bends between pull points.

D. Provide suitable fittings to accommodate expansion and deflection where required.

E. Use suitable separators and chairs installed not greater than 4 feet on centers. Conduit separation shall be per code, and not less than 3 inches.

F. Securely anchor duct to prevent movement during concrete placement. Use re-bar holders at spacers and secure with #4 re-bar driven into earth minimum of 1 foot.

G. Connect to manhole wall using No. 6 re-bar dowels. Dowels shall be located at each corner, and 12 inches on center. Insert dowels minimum 3 inches into manhole and 3 feet into duct bank.

H. Tops of concrete-encased ducts shall be:
   1. Not less than 24in and not less than shown on the Drawings, below finished grade.
   2. Not less than 30in and not less than shown on the Drawings, below roads and other paved surfaces.

I. Tops of direct burial ducts and conduits shall be:
   1. Not less than 24in and not less than shown on the Drawings, below finished grade.
   2. Not less than 30in and not less than shown on the Drawings, below roads and other paved surfaces.

3.04 PRE-CAST MANHOLE INSTALLATION

A. Install and seal pre-cast sections in accordance with manufacturer’s instructions.
B. Install manholes plumb.
C. Attach cable racks to inserts after manhole installation is complete.
D. Provide 12 inches minimum gravel bedding under manholes, and 12 inches gravel fill around manholes.
E. Conduit/Ductwork penetration shall be grouted and sealed. Penetration shall be watertight.

3.05 CABLE PULLING

A. The inspection, handling, storage, temperature conditioning prior to installation, bending and training limits, pulling limits, and calculation parameters for installation of all cables must comply with the manufacturer’s recommendations. For ease of installation and prevention of cable damage, the Contractor shall utilize quadrant blocks located properly along the cable run. Failure to comply with any of the above shall make this Contractor responsible for any cable failures that occur within the manufacturer’s warranty period.

B. Cable lubricant shall be soapstone, graphite or talc for rubber or plastic jacketed cables.

C. Lubricants for assisting in the pulling or jacketed cables shall be those specifically recommended by the cable manufacturer.

D. Cable pulling tensions shall not exceed the maximum pulling tensions recommended by the cable manufacturer.

E. All medium voltage cables shall be individually fire/arc proofed.

3.06 CABLE TERMINATING

A. Terminations of insulated power and lighting cables shall be protected from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials. Terminations shall be made using materials and method as indicated or specified herein or as designed by the written instruction of the cable manufacturer and termination kit manufacturer.

3.07 GROUNDING

A. Duct banks shall be grounded with a bare stranded copper ground wire that is run within the duct bank and is bonded and grounded at both ends. Conduit shall not be used as the ground conductor.

B. Manholes shall be grounded with ground rods. A bare stranded copper ground wire from the ground wire loop shall be used to bond together and ground the
manhole cover frame, ladder support bracket, concrete inserts, cable racks, duct bank ground conductors, and the shields of any medium voltage cables that are spliced in the manhole.

C. Grounding: Install a ground rod for each manhole. Bond all exposed metal manhole accessories and the concrete reinforcing rods with bare copper wire and connect to the ground rod and to the duct bank ground cable. Provide foam sealant for rod penetration in manhole floor for water tight seal.

D. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system, manholes and handholes. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system.

END OF SECTION
SECTION 26 27 00

LOW-VOLTAGE DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install Distribution Equipment in accordance with the plans and as specified herein.

B. This section includes lighting and power panelboards, transformers and associated auxiliary equipment rated 600 volts or less.

1.02 QUALITY ASSURANCE

A. Reference Standards.


1.03 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for each type panelboard, accessory item, component, and transformer specified.

2. Shop drawings from manufacturers of panelboards and transformers including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, voltage rating and AIC ratings.

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. Panelboards shall have mains and circuits as indicated on the Drawings and designed for three phase, four wire, solid neutral, 60-hertz service rated for 480/277 volt, or three phase, four wire rated for 120/08V service as indicated. Where main circuit breakers are indicated on the Drawings, provide main circuit breaker type interiors. Back-fed branch circuit breakers shall not be utilized for main circuit breakers.

B. Panelboards shall be flush or surface mounted, etc., as indicated by panel schedule; code gauge galvanized steel boxes and enameled steel fronts sized for minimum 6” minimum side, top and bottom gutters, or greater as required by NEC.

C. Each panel shall have door in door trim with full length piano hinge to allow for easy access to wireways.

D. Each panel shall have door provided with cylinder lock and latch allowing for common key access to each panel. Each panel shall have fully typed out directory indicating outlets, fixtures, devices and locations served by the intended circuit. Panelboards for use as service disconnecting means shall additionally conform to UL 869.

E. Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto. Panelboards shall have fully capacity neutral bus, ground bus and bolt-on circuit breakers.

F. Circuit breakers shall be molded-case, thermal-magnetic, quick-make, quick-break, bolt-in type. Interrupting rating of circuit breakers shall be as indicated. Provide with suitable handle locks where indicated. Where interrupting rating is not indicated, panels for 120/208 volts service shall have breakers with 10,000 ampere RMS minimum interrupting rating at 240 volts, main circuit breakers where indicated shall have 25,000 ampere RMS minimum interrupting rating at 240 volts. Panels for 480/277 volt service shall have breakers with 14,000 ampere RMS minimum interrupting rating at 480 volts.

G. Distribution panelboards shall be circuit breaker type and shall have mains and circuits as indicated on the Drawings and all designed for three phase, four wire, solid neutral with bonding bar, 60-hertz service rated for 208/120 volt or 480/277 volt service as indicated. Circuit breaker interrupting ratings shall be a minimum of 25,000 amperes, RMS or as indicated on the Contract Drawings. Distribution panelboards shall be of same manufacturer as breaker panelboards and shall have UL label.
H. Acceptable Manufacturers:

1. Square D. Co.
2. General Electric Co.

2.04 DRY TYPE TRANSFORMERS

A. Transformers with steel enclosures ventilated as required and provided with suitable terminal compartments and terminals designed to receive copper conductors. Ventilated transformers located against walls shall be located sufficient distance from wall for proper ventilation. Coordinate with manufacturers recommendations.

B. Sound levels for transformers shall not exceed NEMA established sound levels for specialty dry type transformers.

C. Insulation shall be rated not to exceed 115 C rise over 40 degrees ambient. Transformer insulation system shall be in accordance with ANSI/NEMA Standard St-20.

D. Transformers for three phase circuits shall be three phase type rated for 480 volts delta primary and 208/120 volt, three phase, four wire wye secondary, except as noted.

E. Transformers shall have 2-1/2% taps for above and below voltage on primary side.

PART 3 - EXECUTION

3.01 PANELBOARDS

A. Install panelboards and accessory items in accordance with NEMA PB 1.1,"General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

B. Mounting Heights. Top of trim 6'-2" above finished floor, except as indicated.

C. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing. Number branch circuit devices accordingly to correspond to circuit directory.
D. After substantial completion, conduct load balancing measurements and circuit changes. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

E. Make equipment grounding connections for panelboards as indicated.

F. Provide ground continuity to main electrical ground bus indicated.

G. Electrical Tests: Include the following items performed in accordance with manufacturer's instructions:
   1. Ground resistance test on system and equipment ground connections.
   2. Test main and subfeed overcurrent protective devices.

3.02 TRANSFORMERS

A. Transformers shall be suitable for wall and platform mounting for ratings 45kVA and below. Provide mounting supports and platforms as required and indicated. Submit detailed shop drawings of supports on all transformers.

B. Provide isolation mounts for all transformers to minimize noise transmission. Transformer connections shall have a minimum of eighteen (18) inches of flexible conduit.

C. Secondary midpoint of wye connected transformers shall be grounded as required by NEC for separately derived source.

3.03 CLEANING

A. Upon completion of installation, inspect all panelboards and transformers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION
SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install wiring devices in accordance with the plans and as specified herein.

B. This section includes the following:

1. Flush Wiring Devices.
2. Control Relays.
4. Control Stations.
5. Thermostats.
6. Door Intrusion Switches.
7. Stand Alone Smoke and Heat Detectors.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. Related Sections:

1. Division 26: Section, “Common Work Results for Electrical.”
3. Division 26: Section, “Grounding and Bonding for Electrical Systems.”
4. Division 26: Section, “Raceways, Boxes & Supporting Devices.”
1.03 QUALITY ASSURANCE

A. Reference Standards:

1. National Electrical Code (NEC)
2. Massachusetts Electrical Code (MEC)
3. Underwriter's Laboratories, Inc. (UL)

1.04 SUBMITTALS

A. Furnish manufacturer’s product data, test reports, and materials certifications in accordance with Division 1, Submittals.

PART 2 - PRODUCTS

2.01 FLUSH WIRING DEVICES

A. Wall Switches:

1. Wall Switches shall be specifications grade, toggle operated, quiet type alternating current (ac) switches, NEMA heavy duty class, rated at 20 ampere, 120/277 v. Provide matching two pole, 3-way or 4-way switches as indicated. Comply with UL 20 and NEMA Standards.

2. Where two or more switches are to be installed at the same location, they must be mounted in one-piece ganged switch boxes, with appropriate gang cover plate.

3. Provide waterproof switches where indicated. All switches installed in the Chemical Feed Room shall be waterproof tumbler operated switches.

4. Explosion Proof Switches: Explosion Proof/Dust-Ignition Proof Wall Switches shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Switches shall be tumbler operated equal to Appleton EDS Series, Crouse Hinds, or approved equal. Switches shall be factory sealed specifically designed to a U.L. standard so that any arcing devices are within a chamber which contains any explosions. Switches shall be approved for installation without any additional external sealing fittings. Switches shall be specifically designed to accept conduit sizes indicated on the Contract Drawings.
B. Receptacles:

1. Convenience receptacles for interior use shall be specification grade, industrial heavy duty type, 20-ampere, 125-volt ac, 2-pole, 3-wire, back wiring, metal plaster ears, single, duplex (as indicated) grounded, conforming to NEMA FB 11, NEMA WD 1 and to the 5-20R configuration in NEMA WD 6. Provide waterproof in-use covers where indicated and required.

2. Ground Fault Interrupter (GFI) Receptacles shall be specification grade. Provide 20 ampere, "feed through" type ground fault circuit interrupter, with integral heavy duty NEMA 5 20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2 3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1. Provide waterproof in-use covers where indicated and required.

3. Locking receptacles shall conform to NEMA WD 6. One (1) plug shall be furnished with each locking receptacle.

4. Receptacles shall meet the requirements for retention of plugs, overload, temperature, and assembly security in accordance with NEMA WD 1.

5. Special purpose outlets: NEMA heavy duty class, grounding type with matching plug. Coordinate NEMA type with equipment manufacturer.

6. Explosion Proof Receptacles: Explosion Proof/Dust-Ignition Proof Receptacles shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Receptacles installed in hazardous locations shall be factory sealed as provide by Appleton Contendor U-Line Series, Crouse Hinds, or approved equal. Receptacles shall be 20 amp rated designed with dead front construction. To operate, a matching plug shall be utilized. When the plug is inserted and rotated, the receptacle shall be activated. Receptacles shall be approved for installation without any additional external sealing fittings. Receptacle enclosures shall be constructed of copper-free aluminum and malleable iron. Provide each receptacle with matching 20 amp plug. Plugs shall be constructed of thermoplastic polyester specifically designed for use where moisture and corrosion may be present. Plugs shall be designed for use with general purpose receptacles in non-classified locations. Provide each receptacle with two (2) spare matching plugs.
C. Device Plates:

1. Wall plates for flush wall switches and receptacles shall be the appropriate type and size and shall match the wiring devices for which they are intended. Dimensions for openings in wall plates shall be in accordance with NEMA WD 1.

2. Process area: Plates in process areas for receptacles, telephone, etc., shall be Galvanized steel, smooth rolled outer edge sized to fit box.

3. Plates in general areas for receptacles, telephone, etc., shall be stainless steel.

D. Weatherproof Device Plates:

1. Provide weatherproof device plates where indicated and required.

2. Interior and Exterior Wet Locations: Device plates for interior and exterior wet locations shall be die-cast aluminum, gasket, with corrosion resistant screws to match plate cover finish. Provide weatherproof receptacles with vertical “in-use” covers for complete weatherproofing when plug is inserted.

3. Chemical Feed Room: Device plates for installation in the Chemical Feed Room shall be gasket nonmetallic polyvinyl chloride (PVC), or fiberglass units, for complete weatherproofing and protection against corrosive chemicals. Provide receptacles with vertical “in-use” covers for complete weatherproofing when plug is inserted.

2.02 CONTROL RELAYS

A. Control Relays: Allen Bradley Bulletin 700-H Series, Square D or equal.

B. 120V coil as required or as indicated.

C. Number of poles as indicated or required.

D. Electrically Held, except as noted.

E. Enclosure shall be NEMA-1, except as noted.

2.03 MOTOR CONTROL RELAYS/CONTACTORS

A. 120V and 277V coils as required or as indicated

B. Number of poles as indicated or required.
C. Horsepower rated for connected motor.

D. Electrically Held, except as noted.

E. Enclosure shall be NEMA-1, except as noted.

F. 600V Rated.

2.04 CONTROL STATIONS

A. All control stations shall be industrial, heavy duty type, with oil-tight construction and clearly marked legend plates. Enclosures shall be provided based upon location in accordance with NEMA requirements and as required for the area classifications as indicated and NEMA rating to meet environmental conditions of installed location.

B. Enclosures shall be common or grouped mounted for devices in the same location. Devices shall include front mounted nameplates identifying function.

C. Subject to compliance with requirements, provide control stations by one of the following:


4. Approved equal.

D. Selector Switches:

1. Selector Switches shall be non-illuminated, standard knob operated rated for use at 120VAC. The knob operator insert shall be white in color. Units shall be rotary type with round or oval handles and positioning device to securely hold switch in selected position. Where shown on the Drawings selector switches shall be key type.

2. Provide compatible nameplate for each selector switch identifying intended functions: (i.e. "HAND/OFF/AUTO," "LOCAL/OFF/REMOTE," “JOG/OFF/AUTO,” etc.) as indicated on the Contract Drawings.

3. Units shall be 30.5mm selector switches.
E. Pushbuttons:

1. Switches shall be non-illuminated momentary or maintained type rated for use at 120 VAC. Switches shall green in color for "START" pushbuttons, and shall be red in color for "STOP" pushbuttons.

2. Provide compatible nameplate for each pushbutton identifying intended functions (I.E. "STOP", "START", ETC.).

3. Emergency stop operators shall be mushroom style, 2-position push-pull type, with number of contacts as indicated on the Contract Drawings. Stations shall be provided with push-pull padlocking attachment and legend plate reading: "Push to Stop, Pull to Start."

4. Units shall be 30.5mm pushbuttons.

2.05 THERMOSTATS

A. Thermostats:

1. Electric thermostats shall be line voltage type, suitable for the application and location installed. Sensors shall be provided with a two-wire connection to the controller that is polarity and wire type insensitive. Provide with manual adjustment dials, which provide a maximum and minimum range of approximately -10-100F. Unit shall have form C dry contact for low temperature alarm monitoring via the facilities SCADA control panel. Electric thermostats shall be equal to Dayton, Model 2E815, or approved equal.

2.06 DOOR INTRUSION SWITCHES

A. Door intrusion switches shall be non-contact interlock position switches with a switching voltage of 120 VAC, 0.2A. Switch shall be UL listed and have a nominal break range of 1.2 inches, minimum lead lengths of 12”, conduit connection of ¼” NPT, and a hermetically sealed N.O. contact configuration. Enclosure shall be Nylon 6/6 and NEMA rating of 4X. Intrusion switches shall have a load rating of 84W. Intrusion switch shall be as manufactured by GE, Allen Bradley or approved equal.

2.07 STAND ALONE SMOKE DETECTORS

A. Stand Alone Smoke Detectors shall be powered by 120vac with available battery backup. An LED power on indicator shall be provided for verification that the unit is active.

B. Unit shall be provided with test switch which shall electronically activate the chamber to simulate smoke and check for proper operation. Unit shall be provided
with electronic horn with a level of 85 decibels at 10 feet. Unit shall meet the requirements of U.L Standard 217.

C. Unit shall be provided with Form C dry-contact for alarming to the facility SCADA system.

2.08 STAND ALONE HEAT DETECTORS

A. Stand Alone Heat Detectors shall be powered by 120vac with available battery backup. An LED power on indicator shall be provided for verification that the unit is active.

B. Unit shall be provided with test switch which shall electronically activate the detector and check for proper operation. Unit shall be provided with electronic horn with a level of 85 decibels at 10 feet. Unit shall meet the requirements of U.L Standard 217.

C. Unit shall be provided with Form C dry-contact for alarming to the facility SCADA system.

PART 3 - EXECUTION

3.01 WIRING DEVICES

A. Wall Switches and Receptacles:

1. Wall switches and receptacles shall be so installed that when device plates are applied, the plates will be aligned vertically to within 1/16-inch.

2. Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper.

B. Device Plates:

1. Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

2. Device plates and receptacle cover plates for receptacles other than 15-ampere, 125-volt, single-phase, duplex, convenience outlets shall be suitably engraved, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle; for example: RP1-12, 208 VOLTS, 60 Hertz, 3-PHASE, 30 AMPERES. If engraving is not practical, an engraved laminated phenolic identification plate may be applied.
3. Device plates shall be identified on the inside by circuit number and panelboard.

C. Control Stations:

1. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

2. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other surface exists.

3. Install in conformance with National Electrical Code.

END OF SECTION
SECTION 26 29 13

ENCLOSED CONTROLLERS AND MOTOR STARTERS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes ac magnetic motor starters rated 600 V and less that are supplied as enclosed units.

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. Division 26, Section “Common Work Results for Electrical”.

C. Division 26, Section “Low-Voltage Electrical Power Conductors and Cables”.

D. Division 26, Section “Grounding and Bonding for Electrical Systems”.

E. Division 26, Section “Low-Voltage Distribution Equipment”.

1.03 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 over-current protective devices in combination controllers.
   e. Features, characteristics, ratings, and factory settings of individual over-current protective devices in combination controllers.
   f. Listing of the motor starters to be furnished with their location and equipment to be controlled and identified.

C. 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.

1.04 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Maintain, within 100 miles (160 km) of Project Site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

C. 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 NEMA Standard ICS2-321 AC General Purpose Class A Controller for Squirrel Cage Induction Motors, 600 volts and less.

F. UL #508, Industrial Control Equipment.

G. Comply with NFPA 70.

H. 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.

1.05 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.

1.06 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 installation of roof curbs, equipment supports, and roof penetrations.

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.

1.07 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 five installed, but not less than one set of three of each type and rating.

2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manual and Magnetic Enclosed Controllers:
   a. Square D Co
   b. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
   d. General Electrical Distribution & Control.
   e. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.

2.02 ENCLOSED MAGNETIC MOTOR STARTERS:

A. Description: NEMA ICS 2, Class A, full voltage, across the line, non-reversing, magnetic coil operated, horsepower rated, NEMA sized, with thermal overload bimetallic protection, unless otherwise indicated. Starter shall consist of one contactor, one overload relay, and a magnetic only circuit breaker.
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. Include two primary fuses for 480-volt systems, one secondary fuse and the other secondary leg grounded. For other voltage systems include one secondary fuse and the other secondary leg grounded.

C. Combination Controller: Factory-assembled combination controller and disconnect switch.


2. Disconnecting means shall be provided with an external operating handle mounted in the flange of the enclosure which has a means to lock the handle in the off position. Mechanism shall prevent enclosure door from opening when handle is in the on position.

D. Overload Relay: Ambient-compensated melting alloy, bimetallic type, interchangeable heaters with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Manually reset from outside the enclosure by means of an insulated button with normally open auxiliary contact for remote alarm purposes and separate heater elements sized for the full load ampere and service factor of the actual motors furnished. They shall have a visible trip indicator, a reset mechanism that resets on the upstroke only and a manual weld check which checks the overload contacts for welding. 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. Contactor contacts shall be silver alloy, double break, and shall be inspectable on NEMA Sizes 00 through 4 without the use of tools. Size 5 and larger shall be inspectable with standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.

F. Contactor coils shall be the encapsulated type, and shall be replaceable on NEMA Sizes 00 through 4 without the use of tools. Size 5 and larger shall be replaceable with standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.

G. Controls: Combination starters shall be provided with hand-off-auto selector switch, start push button, stop push button, red on indicating light (across coil) and green off indicating light. Operating controls, pilot and control devices shall be provided for each starter for proper operation. Pilot and control devices shall be mounted on the enclosure door. The auto position shall enable the motor to perform start/stop operations from remote dry contact from external control panel. Auxiliary contacts to remotely signal temperature control panel run and overload conditions. Provisions to accept remote dry contact from stop station for shutdown of the motor.
H. The short circuit withstand rating of the combination starter is to be 65K RMS amperes symmetrical.

2.03 ENCLOSURES:

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA Type 4.
   2. Corrosive Locations: NEMA Type 4X, stainless steel.
   3. Wet or Damp Locations: NEMA Type 4.
   4. Indoor Dry Locations: NEMA Type 1.
   5. Indoor Dusty Locations: NEMA Type 12.

2.04 ACCESSORIES:

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.


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. Hand-Off –Automatic three position selector switch.

E. Control Relays: Auxiliary and adjustable time-delay relays.

2.05 FACTORY FINISHES:

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION:
A. Examine areas and 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.

3.02 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.

3.03 INSTALLATION:

A. 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 as required.

B. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

C. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports reasonably close to motor where no wall or other surface exists.

D. Certified factory start-up shall be provided for each solid state reduced voltage soft starter provided. Service engineers shall be employed by the manufacturer or be certified by the manufacturer and provide start-up services including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

3.04 IDENTIFICATION:

A. Identify enclosed controller components and control wiring according to Division 26 Section “Basic Electrical Requirements”.

3.05 CONTROL WIRING INSTALLATION:

A. Install wiring between enclosed controllers according to Division 26 Section "Wire 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.

3.06 CONNECTIONS:

A. Conduit installation requirements are specified in other Division 26 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.

3.07 FIELD QUALITY CONTROL:

A. 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.

B. 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.

3.08 ADJUSTING:

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.09 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. Verify that enclosed controllers are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION
SECTION 40 90 00

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide instrumentation and control for process systems in accordance with this Section, the Work described in Section 01 10 00, and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 26 – Electrical
2. Section 40 91 00 – Primary Process Measurement Devices
3. Section 40 94 33 – SCADA Computers and Software
4. Section 40 94 43 – Programmable Logic Controllers
5. Section 40 95 13 – Process Control Panels and Hardware

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

2. National Electrical Code, (NEC)
3. National Electrical Manufacturer's Association Standards, (NEMA)
5. Operational Safety and Health Administration Regulations, (OSHA)
6. Underwriters' Laboratory, Inc., (UL)
7. American National Standards Institute, Inc. (ANSI)
8. Factory Mutual (FM)
9. The Instrumentation, Systems and Automation Society (ISA)

10. State and Local code requirements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Prior to submittal to the Engineer, Shop Drawings and submittal information will be thoroughly checked by the Contractor to ensure compliance with Contract Documents. The Contractor is Responsible for verifying that equipment, instruments, and materials submitted fit within available space and maintain specified physical clearances, and that equipment is compatible with the operation of the overall system. Submittal to the Engineer of Shop Drawings and submittal information implies that the Contractor has reviewed the information and requirements have been satisfied.

C. Submittals and Shop Drawings shall consist of the following elements:

1. Project name, location, and project number

2. Contractor name and address

3. Table of contents or index, including equipment, instruments or materials being submitted, utilizing identification consistent with Contract Documents (equipment designation, instrument tag number, control panel name, etc.), as well as proposed, manufacturer, style/model, and part number.

4. For instrumentation submittals, refer to Section 40 91 00, Primary Process Measurement Devices, for specific requirements.

5. For SCADA computer and software submittals, refer to Section 40 94 33, SCADA Computers and Software, for specific requirements.

6. For PLC hardware, refer to Section 40 94 43, Programmable Logic Controllers, for specific requirements.

7. For SCADA control panel shop drawing submittals, refer to Section 40 95 13, Process Control Panels and Hardware, for specific requirements.

D. The submittal information for each section will be contained in a single submission. Incomplete or partial submissions are not accepted.
E. Operations and Maintenance (O&M) Materials

1. Include descriptions of equipment, the nature and intended modes of operation, testing procedures of units in the System, and safety measures to be taken in operation. Necessary procedures and methods for effective operation of the System shall be included.

2. Include record Drawings and instructions necessary for the planned maintenance of equipment in the system. The O&M Manuals will incorporate maintenance procedures and schedules, and they will coordinate and be cross-referenced to detailed operation procedures provided by the manufacturers.

3. Organize in three-ring binders, provided with labeled dividers, including a table of contents clearly describing the information included and order.

4. Include a list of local service departments of authorized distributors for equipment, instruments, services and appurtenances installed under this Contract. These service departments should stock the manufacturer’s standard parts and equipment; provide local service options, etc.

5. For instrumentation O&Ms, refer to Section 40 91 00, Primary Process Measurement Devices, for specific requirements.

6. For SCADA computer and software O&Ms, refer to Section 40 94 33, SCADA Computers and Software, for specific requirements.

7. For PLC hardware, refer to Section 40 94 43, Programmable Logic Controllers, for specific requirements.

8. For SCADA control panel O&Ms, refer to Section 40 95 13, Process Control Panels and Hardware, for specific requirements.

F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications

1. The Contractor must have completed Work of similar or greater complexity on at least 3 previous Projects within the last 5 years. Successful completion is defined as a finished Project completed on time, without any outstanding claims or litigation involving the Contractor. Provide, for a period of not less than 12 months from Final Acceptance of the Project, all labor, tools, materials, and equipment necessary to address
issues or defects in any system that result from faulty workmanship, installation, equipment, instruments or materials, and any resulting damage from said defects or faults, at the convenience of the Owner.

2. The Contractor will furnish SCADA control panels fabricated per the Drawings (as shown on the I sheets), by a UL 508A approved Panel Shop regularly engaged in furnishing, installing and wiring similar equipment for use in water and wastewater treatment facilities and that has been in satisfactory operation for at least 5 years.

C. Instruments, SCADA control panels and materials provided under this Contract must comply with the Specifications, be supplied from manufacturers regularly engaged in the production of such products, be standard products (not special order or custom-made) wherever possible, and be the manufacturer’s latest design.

D. Instruments, SCADA control panels, and materials supplied under this Contract are subject to approval by the Engineer and demonstrate equal appearance, quality, and performance to that specified herein. The Contractor is Responsible for verifying the availability of equipment, instruments and materials proposed for use in the execution of this Contract prior to submission to Engineer for approval. If production of equipment, instrument, or material is discontinued, the Contractor will submit an alternate of comparable quality to the Engineer for approval prior to execution of Work, and at no additional cost to Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Coordinate equipment, instrument, and material delivery to coincide with the Project schedule. If the delivery schedule of any equipment, instrument, or material affects the overall Project schedule, notify the Engineer in writing immediately. Include in the written notification documentation from the equipment Supplier indicating the revised delivery schedule and reason for the change.

C. When applicable, coordinate delivery of equipment, instruments, or materials to be delivered directly to another trade or vendor for installation in a system or control panel provided under another Specification section.

D. Exercise care while loading, unloading and transporting equipment, instruments and materials to avoid damage. Check all equipment, instruments, and materials for damage or defects within 7 days of delivery to the Project Site.

E. Equipment, instruments, and materials required to be stored on Site prior to installation will be stored in such a manner to avoid damage or exposure to water, dust, or construction debris.
F. Repair or replace, at no additional cost to the Owner, equipment, instruments and materials that are defective or damaged during installation, to the satisfaction of the Engineer.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WORK NOT INCLUDED

A. PLC programming, HMI/OIT screen development, and integration of new SCADA system shall be provided by others.

1.10 RELATED DOCUMENTS

A. Refer to Division 26, Electrical for wiring standards and practices.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Instruments, SCADA control panels, equipment, and other materials provided under this Contract that come with a manufacturer’s warranty will have the warranty transferred to the Owner upon Final Acceptance.

B. After installation, provided instruments and SCADA control panels will be powered up, tested, and witnessed by the Engineer for proper termination and operation.

C. After installation, the Contractor will calibrate instruments that require calibration in accordance with the manufacturer’s recommended procedure unless indicated otherwise on the instrument data sheet found Section 40 91 00.

END OF SECTION
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SECTION 40 91 00

PRIMARY PROCESS MEASUREMENT DEVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide primary process measurement devices in accordance with this section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 26 – Electrical
2. Section 40 90 00 – Instrumentation and Control for Process Systems
3. Section 40 95 13 – Process Control Panels and Hardware

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

2. National Electrical Code, (NEC)
3. National Electrical Manufacturer's Association Standards, (NEMA)
5. Operational Safety and Health Administration Regulations, (OSHA)
6. Underwriters' Laboratory, Inc., (UL)
7. American National Standards Institute, Inc. (ANSI)
8. Factory Mutual (FM)
9. The Instrumentation, Systems and Automation Society (ISA)
10. State and Local code requirements.
1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Submit detailed information for each instrument or control device in accordance with Section 40 90 00.

C. In addition to the requirements of Section 40 90 00, the submittals will include:
   1. Instrument data sheet for each instrument.
   2. Product (item) name and Tag number as shown on the Drawings.
   3. Manufacturers complete model number.
   4. Location of device.
   5. Input - output characteristics.
   6. Range, size, and graduations.
   7. Physical size with dimensions, enclosure NEMA classification, and mounting details.
   9. Calibration certificates provided by manufacturer.
   10. Installation and operation manuals.

D. Define exceptions or deviations to the Specifications or Drawings. Contractor will submit sufficient details to the Engineer for evaluation.

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Instruments and appurtenances provided under this Contract must comply with the Specifications, be supplied from manufacturers regularly engaged in the production of such products, be standard products (not special order or custom-made) wherever possible, and be the manufacturer’s latest design.
C. Instruments and appurtenances supplied under this Contract are subject to approval by the Engineer and will demonstrate equal appearance, quality, and performance to that specified herein. The Contractor is Responsible for verifying the availability of equipment, instruments and materials proposed for use in the execution of this Contract prior to submission to Engineer for approval. If production of equipment, instrument, or material is discontinued, the Contractor must submit an alternate of comparable quality to the Engineer for approval prior to execution of Work, and at no additional cost to Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver, store, and handle products in accordance with manufacturer's recommendations and in accordance with Section 40 90 00, Instrumentation and Control General Requirements.

1.08 OPERATIONS AND MAINTENANCE (O&M) MATERIALS

A. Operations and maintenance (O&M) information will be provided in accordance with Section 40 90 00, Instrumentation and Controls General Requirements.

B. In addition to the requirements in Section 40 90 00, the instrumentation section of the O&M manuals will consist of the following:

1. Instrument list or ISA data sheets, including tag numbers

2. All submittal information listed in paragraph 1.05 above

1.09 WORK NOT INCLUDED

A. PLC programming, HMI screen development, and integration of new SCADA system will be provided by others.

1.10 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary General Conditions and other Specification Sections, which apply to the Work of this Section.

B. Refer to Division 26, Electrical for wiring standards and practices.

PART 2 – PRODUCTS

2.01 INSTRUMENTATION – GENERAL

A. Instrumentation supplied must be the manufacturer's latest design and produce or be activated by signals that are established standards for the water and wastewater industries.
B. Instrumentation requiring power supplied from a source other than the control panel to which it is connected must operate on 120VAC, single phase, 60 HZ current, unless specifically indicated otherwise. This power will be supplied from the closest local electrical distribution panel with a breaker for each circuit.

C. Electronic instrumentation must be solid-state. Analog control signals shall be linear and be industry standard currents of 4 to 20 mA DC (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current), or the like. No zero based signals are allowed.

D. Outputs of equipment that are not of the standard signals as outlined, will have the output immediately raised and/or converted to compatible standards signals for remote transmission. No zero-based signals are allowed.

E. Instruments will be provided with stainless steel mounting hardware and/or galvanized steel floor stands, wall brackets, or instrument racks as appropriate for each location.

F. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Contract Electrical Drawings, to comply with the National Electrical Code.

G. Indicators and recorder readouts must be linear in the process units.

H. Transmitters will be provided with either integral indicators or conduit mounted indicators in process units, accurate to ± 2 percent.

I. Electronic equipment must be the manufacturer's latest design. Circuit boards and associated components must have suitable conformal coating to prevent contamination by dust, moisture, and fungus. Solid-state components must be conservatively rated for their purpose to assure optimum long-term performance and dependability over normally anticipated atmospheric conditions of temperature, pressure and humidity. The field-mounted equipment and system components will be designed for installation in dusty, humid, and slightly corrosive service conditions.

J. Instruments furnished will be heavy-duty type, designed for continuous industrial service. The system will contain products of a single manufacturer, insofar as possible, and will consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

K. Lightning/Surge Suppression - Provide individual surge protection means for each field instrument mounted outside the building from the control panel to which they are connected. Instruments mounted inside the same building as the control panel to which they are connected shall not require surge protection.
L. Instruments shall be provided as indicated on the Instrument Index and in the Instrument Data Sheets, included as an attachment at the end of this Section. These documents include the instrument tag names, physical requirements, control requirement, and basis of design manufacturer and model number information.

2.02 LEVEL INSTRUMENTATION

A. Submersible Level Transducer – Refer to Instrument Data Sheet 2.02A
B. Mechanical Tilt Level Switch – Refer to Instrument Data Sheet 2.02B
C. Vertical Level Switch – Refer to Instrument Data Sheet 2.02C

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION AND MOUNTING

A. Provide labor, tools, material, and equipment required to mount instruments in the locations shown on the Drawings, in accordance with manufacturer-recommended mounting practices. The location of equipment, transmitters, alarms, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Group or Engineer during construction. Obtain in the field information relevant to the placing of process control Work and in case of any interference with other Work, proceed as requested by the Engineer.

B. Make necessary mechanical changes to install new instrumentation equipment provided under this Contract. This Work includes fittings, fabrications, supports, guides, restraints, bolting, gaskets, and accessories. All Work shall be done in a workmanlike manner.

C. The instrumentation Drawings indicate the intent of the interconnections between the individual instruments. Any exceptions should be noted and communicated to the Engineer and/or Group in writing.

D. Work will be executed in full accordance with codes and local rulings. Should any Work be performed contrary to said rulings, ordinances, and Regulations, the Contractor will bear full responsibility for such violations and assume all costs arising there from.

E. Instrument cabinets located outdoors or in unheated locations must be provided with heating and/or cooling devices as necessary to maintain all instruments and/or electronics installed in those cabinets within their design temperature limits.
F. Brackets and hangers required for equipment mounting will be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

G. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than one (1) ground point be employed for each shield.

H. The Contractor shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets, and devices. The Contractor is Responsible to ensure that field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for necessary system grounding to ensure a satisfactory functioning installation.

3.02 INSPECTION AND TESTING

A. Submit detailed Test, Procedure, and Startup instructions for each instrument.

B. Provide the services of a qualified service representative for the instrumentation provided under this Contract, for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative will be available for not less than two (2) days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period.

C. Test and calibrate in place the instrumentation to demonstrate that it meets the accuracy requirements for the conditions specified herein. Provide labor, equipment, and incidentals required for the tests, including electric power, water, instrument air, etc. required for tests. The Engineer will witness field tests and conduct field inspections. The Contractor will give the Engineer a minimum of ten (10) working days’ notice of the dates and times scheduled for tests. Rectify any deficiencies found and retest Work affected by such deficiencies at the Contractor’s expense. Record data from each field test will be recorded and documented in a formal field test report.

3.03 ATTACHMENTS

A. Instrument Index (1 page)

B. Instrument Data Sheets (3 pages)

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.
3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

1. After installation, the Contractor will calibrate instruments that require calibration in accordance with the manufacturer’s recommended procedure unless indicated otherwise on the instrument data sheet found in this Section.

3.06 CLOSEOUT ACTIVITIES

END OF SECTION
## INSTRUMENT INDEX

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Instrument Tag</th>
<th>Data Sheet</th>
<th>Instrument Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-100</td>
<td>LT-101A</td>
<td>2.02A</td>
<td>Quinobequin Wetwell 1 Level Transmitter</td>
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<td>Instrument Description</td>
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## SUBMERSIBLE LEVEL TRANSDUCER – INSTRUMENT DATA SHEET 2.02A

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<th>PAGE: 11 of 16</th>
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<td>DESCRIPTION:</td>
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### SERVICE:

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<th>Type:</th>
<th>Cage Style</th>
<th>Body Material:</th>
<th>316SS</th>
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<tr>
<td>Mounting:</td>
<td>Immersion</td>
<td>Diaphragm Material:</td>
<td>316SS</td>
</tr>
<tr>
<td>Span Range Min/Max:</td>
<td>0 – 23.07 ft. See Note 4</td>
<td>Cable Jacket Material:</td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Press/Temp Rating:</td>
<td>3x FSPR / 0 - 140°F</td>
<td>Cable Length:</td>
<td>40', See Note 2</td>
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<tr>
<td>Accuracy:</td>
<td>0.5% Full scale</td>
<td>Power Supply:</td>
<td>24VDC, loop-powered</td>
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<tr>
<td>Area Classification:</td>
<td>C1 D1</td>
<td>Transmitter/Local Ind.:</td>
<td>N/A</td>
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<td>Sealed/Vent Tube:</td>
<td>Vent Tube</td>
<td>Stilling Well:</td>
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### CALIBRATION

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<th>Process (0% / 100%):</th>
<th>0 – 23 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (4mA/20mA):</td>
<td>4 – 20 mA</td>
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</table>

### PROCESS DATA

<table>
<thead>
<tr>
<th>Proc Fluid / State:</th>
<th>Sanitary Wastewater / Liquid</th>
<th>Level (Min/Oper/Max):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity:</td>
<td>Water-like</td>
<td>Level Units: ft</td>
</tr>
<tr>
<td>Density:</td>
<td>Water-like</td>
<td>Pressure (Min/Oper/Max): psi</td>
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<tr>
<td>Conductivity:</td>
<td>Water-like</td>
<td>Pressure Units: psi</td>
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<td>Viscosity:</td>
<td>Water-like</td>
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<td>Tank Material:</td>
<td>Water-like</td>
<td>Temperature Units: °F</td>
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<td>Tank No.:</td>
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### ACCESSORIES

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<tr>
<th>Ind. Scale/Range:</th>
<th>Option-1: SS, engraved</th>
<th>Option-2:</th>
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</thead>
<tbody>
<tr>
<td>Device Tag:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### MANUFACTURER OR APPROVED EQUAL

- **Manufacturer 1:** Blue Ribbon Bird Cage BC001 Series (basis of design)
- **Manufacturer 2:** Mercoid PBLTX Series
- **Manufacturer 3:** Ametek 675 Series

### COMMENT

1. Provide strain relief and weight & chain assembly as shown on the contract drawings.
2. Cable length to be verified in the field prior to ordering.
3. Refer to Instrument Index for quantity and tag numbers.
4. Wetwell depth to be verified in the field prior to ordering.

### NOTES

1. Provide strain relief and weight & chain assembly as shown on the contract drawings.
2. Cable length to be verified in the field prior to ordering.
3. Refer to Instrument Index for quantity and tag numbers.
4. Wetwell depth to be verified in the field prior to ordering.
5.
## MECHANICAL TILT FLOAT SWITCHES

<table>
<thead>
<tr>
<th>TAG NO:</th>
<th>See Note 1</th>
<th>PAGE: 13 of 16</th>
</tr>
</thead>
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<td>P&amp;ID #:</td>
<td>NA</td>
<td>PRINTED: 3/17/2015-20/2015</td>
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## PROJECT NUMBER: 221942.00

### DESCRIPTION:
Newton, MA – SCADA Upgrades Phase 1

### REV

### REVISION DESCRIPTION
Client Review

### BY
JHG

### DATE
11/11/2014

### SERVICE:

<table>
<thead>
<tr>
<th>Type:</th>
<th>Mechanical Tilt</th>
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<tbody>
<tr>
<td>Mounting Style:</td>
<td>Tether</td>
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<tr>
<td>Float/Disp. Material:</td>
<td>Polypropylene / ABS / EPDM</td>
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<tr>
<td>Press/Temp Rating:</td>
<td>None / 32 - 158°F</td>
</tr>
<tr>
<td>1st Switch Level:</td>
<td>Determined in field</td>
</tr>
<tr>
<td>2nd Switch Level:</td>
<td>Determined in field</td>
</tr>
</tbody>
</table>

### CALIBRATION

| 3rd Switch Level: | NA |
| 1st Switch Level: | NA |
| 2nd Switch Level: | NA |

### PROCESS DATA

| Proc Fluid / State: | Sanitary Wastewater / Liquid |
| Specific Gravity: | Water-like |
| Percent Solids: | Water-like |
| Conductivity: | Water-like |
| Di-Electric Const.: | Water-like |
| Viscosity: | Water-like |
| Tank Material.: | - |
| Tank No.: | - |
| Tank Agitated: | - |

### ACCESSORIES

| Loc. Indicators/Style: | NA |
| Instrument Tag: | Yes, SS engraved, See Note 1 |

### MANUFACTURER OR APPROVED EQUIPMENT

| Manufacturer 1: | Conery B8 Series (basis of design) |
| Manufacturer 2: | Warrick Series M |
| Manufacturer 3: | Madison M45 Series |

### COMMENTS

1. Refer to Instrument Index for quantity and tag numbers.
2. Confirm cable length required prior to ordering.
3. Provide chain and weight mounting equipment for floats; confirm length of chain necessary prior to ordering.

### NOTES

1. Refer to Instrument Index for quantity and tag numbers.
2. Confirm cable length required prior to ordering.
3. Provide chain and weight mounting equipment for floats; confirm length of chain necessary prior to ordering.
<table>
<thead>
<tr>
<th>VERTICAL LEVEL SWITCHES</th>
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<th>See Note 2</th>
<th>PAGE:</th>
<th>15 of 16</th>
</tr>
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<td></td>
<td></td>
<td></td>
<td>BY</td>
<td>SC</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>DATE</td>
<td>11/14/2014</td>
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</table>

**SERVICE:**

**GENERAL**

- **Type:** Magnetic Reed w/slosh shield
- **Power Supply:** 115 VAC
- **Mounting:** Wall Mount
- **Area Classification:** NEMA 4X
- **Press/Temp Rating:** -
- **Switch Type:** SPST / NO or NC (selectable)
- **Rod Length/Material:** PVDF / Polypropylene
- **Sw. Contact Rating:** 20VA @ 120VAC
- **Float/Disp. Material:** PVDF / Polypropylene
- **Conduit Connection:** NA
- **Float/Displacer Size:** -
- **Cable Length:** 6 ft
- **Actuation Length:** 9/16”
- **Cable Jacket Mat’l:** Polypropylene

**CALIBRATION**

- **Switch Level:** Finished Floor Level

**PROCESS DATA**

- **Proc Fluid / State:** Sanitary Wastewater / Liquid
- **Specific Gravity:** Water-like
- **Level (Min/Oper/Max):**
- **Level Units:** ft
- **Percent Solids:** Water-like
- **Pressure (Min/Oper/Max):**
- **Pressure Units:** psig
- **Conductivity:** Water-like
- **Temperature (Min/Oper/Max):**
- **Temperature Units:** °F
- **Di-Electric Const.:** Water-like
- **Viscosity:** Water-like

**ACCESSORIES**

- **Instrument Tag:** Yes, SS engraved
- **Option-1:** N/A
- **Option-2:** N/A
- **Option-3:** N/A

**MANUFACTURER OR APPROVED EQUAL**

- **Manufacturer 1:** Madison MSB8800 (basis of design)
- **Manufacturer 2:** Gems Sensors LS-3 Series
- **Manufacturer 3:** Flowline Switch-Tek LV20 Series

**NOTES**

1. Provide NEMA 4X junction box to terminate switch leads, and required mounting hardware.
2. Refer to Instrument Index for quantity and tag numbers.
3.
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SECTION 40 94 33

SCADA COMPUTERS AND SOFTWARE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment and incidentals, as shown, specified and required to furnish, install, and test the new SCADA computer system (including HMI).

B. Items to be provided under this Section shall include, but not limited to, the following:

1. SCADA Computers
2. SCADA Printers
3. SCADA Software
   a. PLC Programming Software
   b. Human Machine Interface (HMI) Software
   c. Remote Alarm Notification Software
   d. Automated Reporting Software
4. Remote Access Hardware and Software

1.02 SUBMITTALS

A. Submit in accordance with Section 40 90 00 INSTRUMENTATION & CONTROLS FOR PROCESS SYSTEMS and Division 01 General Requirements.

B. In addition to the requirements of Section 40 90 00, the submittals shall include but are not limited to:

1. Manufacturer’s literature, illustrations, specifications, drawings, data, and descriptive literature on all pieces of equipment
2. Deviations from Drawings and Specifications
3. Engineering data including dimensions, materials, size, and weight
4. Fabrication, assembly, installation and wiring diagrams

C. Operation and Maintenance Data. Submit complete manuals including but not limited to:
1. Copies of all Shop Drawings, reports, maintenance data, and schedules, description of operation, and spare parts information.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment in accordance with Section 40 90 00, Instrumentation and Controls General Requirements.

PART 2 – PRODUCTS

2.01 SCADA COMPUTERS

A. Provide two (2) Dell Precision T3610 Workstation computers (or Engineer Approved Equal) with the following specifications:

1. Processor: Intel Xeon Quad Core Processor E5-1603 (Quad Core, 2.8Ghz, 10MB)

2. System Configuration
   a. Chassis Configuration: Minitower
   b. Memory: 4GB DDR3 Non-ECC SDRAM, 1600 MHz
   c. Keyboard: USB Keyboard, no Hotkeys
   d. Monitor: 21” Widescreen Flat Panel LCD
   e. Mouse: USB Optical Mouse with Scroll
   f. Hard Drive: Two (2) 500GB, 3.5” SATA 7,200RPM Hard Drives
   g. Video: 1GB NVIDIA video card
   h. Audio: Integrated Audio
   i. Speakers: LCD Speaker Bar
   j. Optical Drive: 16X DVD+-RW
   k. Ports (minimum)
      1) 8 x USB 2.0
      2) 1 x VGA
      3) 1 x Serial
   l. Slots
      1) 2 x Full-height PCI
      2) 2 x Full-height PCI x16
   m. Operating System: Microsoft Windows 7 Professional 64-bit
   n. Microsoft Office Microsoft® Office Home and Business 2013
o. Network Adapter
   1) (1) On-board 10/100/1000 NIC
   2) (1) PCIe NIC for SCADA redundancy
p. Modem: Internal Universal PCI Bus Interface TAPI compliant voice
   1) Modem w/Windows 7 driver
q. RAID: SATA RAID 0/1/5/10 Controller
r. Resource DVD
   1) Resource DVD – contains diagnostics and drivers for Windows 7 Systems
s. Restoration DVD for all provided software
t. Warranty Service: 3 Year Basic Limited Warranty and 3 year NBD On-site Service

3. UPS: APC Power-Saving Back-UPS Pro 1300

2.02 SCADA PRINTERS
A. Provide one (1) current model color deskjet printer for report printing. Provide all software necessary to operate printer in a Windows 7 Professional environment.

2.03 SOFTWARE
A. PLC Programming Software
   1. PLC programming software shall be compatible with the PLCs installed as part of this Contract, and shall be procured from the same manufacturer.
   2. Provide the following software to configure and program the PLCs included in this Contract:
      a. Allen-Bradley RSLogix 500 Standard Edition Programming Software, or Engineer approved equivalent
B. HMI Software
   1. Provide the following HMI software or Engineer Approved Equal for SCADA system visualization:
      a. GE iFIX Plus SCADA Unlimited Development, current version (1 license)
      b. GE iFIX Plus SCADA Unlimited Runtime, current version (1 license)
      c. GE iFIX IGS Drivers for Development and Runtime
d. GE GlobalCare Complete (1 year), for iFIX Licenses and IGS Drivers

C. Remote Alarm Notification Software

1. Provide the following software or Engineer Approved Equal to remotely notify operations personnel of a SCADA alarm:
   a. WIN-911 Professional with TAPI External Modem and Premium Voice Package (part no. WIN-911/PRO-BT-PV)

D. Automated Reporting Software

1. Provide the following software to configure and produce automated reports from the data monitored and collected by the SCADA system:
   a. XLReporter Professional Edition v11.4, with extended support or Engineer Approved Equal.

2.04 REMOTE ACCESS HARDWARE AND SOFTWARE

A. Furnish the following hardware and software for remote SCADA support:

1. Allen Bradley Stratix 5900 Services Router, or Engineer approved equivalent.

2. Teamviewer Remote Access Software (current version), or approved equivalent.

2.05 BACKUP AUTO-DIALER

A. Furnish the following backup auto-dialer:

1. Sensaphone 800 auto-dialer or approved equivalent.

PART 3 – EXECUTION

3.01 SOFTWARE REGISTRATION

A. All hardware and software requiring registration shall be registered to the Owner. Owner’s contact information shall be as follows:

City of Newton, MA
Water/Sewer, Department of Public Works
1000 Commonwealth Avenue
Newton Centre, MA 02459
Attention: Ted Jerdee, Utilities Superintendent
Telephone: (617) 796-1640
Email: tjerdee@newtonma.gov
3.02 SOFTWARE TRAINING

A. The software shall have an interactive on-line tutorial to teach the basic operations of the system, including graphics and tag development. The tutorial shall demonstrate the configuration operations using interactive on-screen instructions.

3.03 WARRANTY AND CUSTOMER SUPPORT

A. The software shall come with a one year extended warranty. It shall include software version upgrades, telephone technical support and online web based download area and Knowledge Base. The support shall be handled by a factory trained engineer or technician. Support shall be available twenty-four (24) hours, seven (7) days a week. The SCADA software warranty shall be valid for a full year from the date of Substantial Completion for the project.

END OF SECTION
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SECTION 40 94 43

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.01 PROPRIETARY NOTIFICATION

A. The Owner has determined that it is in the Public interest to include in the Specifications for the Project, the requirement that the Programmable Logic Controller (PLC) as described in this Section, be a proprietary item, specifically Allen Bradley as manufactured by Rockwell Automation or approved equal. The reason for this determination is that the Town has standardize replacement parts for PLCs utilizing equipment manufactured by the same manufacturer, thus ensuring the quality and interchangeability of parts to simplify and reduce the cost of maintenance and repairs.

Should the Contractor request a substituted system, the Owner must evaluate and determine whether the requested substitution is equal based upon the following:

1. It is at least equal in quality, durability, appearance, strength and design.

2. It will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased.

3. It conforms substantially, even with deviations, to the detailed requirements, for the items included in this and related sections.

4. Should a substituted system be approved by the Owner, the Contractor shall be responsible for all costs of redesign, including efforts associated with review and approval of the substituted system, necessary to incorporate the substituted system into the existing facility and remaining aspects of the Project.

1.02 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment and appurtenances to furnish, install, test and make ready for operation; programmable logic controllers and operator interface terminals as specified herein and on the Drawings. This Section covers the following:

1. Programmable Logic Controllers (PLC)

2. Operator Interface Terminals (OIT)

B. Definitions

1. PLC: Programmable Logic Controller
2. RIO: Remote Input/Output Rack
3. OIT: Operator Interface Terminal
4. HMI: Human Machine Interface
5. RTU: Remote Terminal Unit
6. I/O: Input Output
7. SCADA: Supervisory Control and Data Acquisition

1.03 QUALITY ASSURANCE

A. PLCs and OITs provided under this Contract shall comply with the Specifications, shall be supplied from manufacturers regularly engaged in the production of such products, shall be standard products (not special order or custom-made) wherever possible, and shall be of the manufacturer’s latest design.

B. This specification has been developed to establish minimum requirements for the solid-state programmable controllers and OITs designed to provide high reliability in industrial applications. All PLCs, OITs, and associated software provided under this Contract shall meet the requirements of this Specification, unless approved by the Engineer. If production of equipment is discontinued, the Contractor shall submit an alternate of comparable quality to the Engineer for approval prior to execution of Work, and at no additional cost to Owner.

1.04 SUBMITTALS

A. Submit in accordance with Section 40 90 00, Instrumentation and Controls General Requirements and Division 01 requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Coordinate equipment, instrument, and material delivery to coincide with the Project schedule. If the delivery schedule of any equipment, instrument, or material shall affect the overall Project schedule, notify the Engineer in writing immediately. Include in the written notification documentation from the equipment Supplier indicating the revised delivery schedule and reason for the change.

B. When applicable, coordinate delivery equipment, instruments, or materials to be delivered directly to another trade or vendor for installation in a system or control panel provided under another Specification Section.

C. Exercise care while loading, unloading and transporting equipment, instruments and materials to avoid damage. Check all equipment, instruments, and materials for damage or defects within seven (7) days of delivery to the Project Site.
D. Equipment, instruments, and materials required to be stored on Site prior to installation shall be stored in such a manner to avoid damage or exposure to water, dust, or construction debris.

E. Repair or replace, at no additional cost to the Owner, all equipment, instruments and materials that are defective or damaged during installation, to the satisfaction of the Engineer.

F. Provide in accordance with Division 01 General Requirements.

1.06 OPERATIONS AND MAINTENANCE DATA

A. Provide in accordance with Division 01 General Requirements.

B. Provide specific operations and maintenance data in accordance with Section 40 90 00, Instrumentation and Controls General Requirements.

C. Provide the following additional data and information.

1. Configuration and programming manuals for each type of PLC provided.

2. Configuration and programming manuals for each type of OIT provided.

1.07 SPARE PARTS

A. Provide the following spare parts for the Project:

1. One of each type of PLC power supply used

2. One of each type of PLC processor used

3. One of each type of I/O module used

4. One of each type of communication module used

5. One of each type of memory module used

PART 2 – PRODUCTS

2.01 GENERAL

A. PLC hardware and programming software shall be by the same manufacturer.

B. All PLCs and OITs shall be housed in a new control panel as specified per Section 40 95 13, Process Control Panels and Hardware. Power provided to the control panel shall be 120VAC, 60 Hz, single phase.

C. Minimum PLC input/output (I/O) requirements are indicated on the Equipment & Instrumentation list as well as the Drawings. Provide at minimum an additional 40% active spare I/O wired to terminal blocks.
D. PLC rack or mounting space provided shall accommodate at minimum 40% spare slots for future expansion.

**2.02 PROGRAMMABLE LOGIC CONTROLLERS**

A. The PLCs shall be microprocessor based devices and shall be furnished with power supplies, processors, process input and output modules, communication cards as required, rack mounted in the control panel.

1. Power supplies shall be sized to accommodate all analog signals including all spares. The power supply shall accommodate the card's entire I/O capacity (i.e. if 5 analog outputs is required, the power supply shall be sized to handle the full 8 analog outputs of an 8 point card).

B. The PLC shall be capable of stand-alone operation in the event of a SCADA network or SCADA computer failure.

C. The PLC system shall use a modular, field expandable design.

D. The PLC shall be capable of Ethernet/IP communications, either through an onboard Ethernet port or through an Ethernet/IP communications module.

E. Modules are defined herein as devices that plug into a chassis or connect to an adjacent module and are keyed to allow installation in only one direction. The design must prohibit upside down insertion or connection of the modules. Modules provided shall be compatible with processor type specified.

F. All hardware of the programmable controller shall operate at an ambient temperature of 0 – 60° C (32 – 140° F), with an ambient temperature rating for storage of (-40) – 85° C ((-40) – 185°F).

G. The programmable controller hardware shall function continuously in the relative humidity range of 5 – 95%, non-condensing.

H. The programmable controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

I. The Programmable controller system shall be UL 508 listed.

J. All chassis-based PLCs and associated modules shall be the following:

1. Processor shall be Allen-Bradley SLC 5/05 1747-L551, or as specified on the Contract Drawings.

2. Discrete input modules used shall be Allen-Bradley 1746-IA16, or as specified on the Contract Drawings.

3. Discrete output modules used shall be Allen-Bradley 1746-OW16, or as specified on the Contract Drawings.
4. Analog input modules used shall be Allen-Bradley 1746-NI8, or as specified on the Contract Drawings.

5. Analog output modules used shall be Allen-Bradley 1746-NO4I, or as specified on the Contract Drawings.

K. All module-expandable PLCs and associated modules shall be the following:

1. Processor shall be MicroLogix 1100 series, 1400 series, or 1500 series, as specified on the Contract Drawings

2. For the MicroLogix 1100 and 1400 series, the associated I/O modules shall be the following:
   a. Discrete input modules used shall be Allen-Bradley 1762-IQ8 and 1762-IQ16, or as specified on the Contract Drawings.
   b. Discrete output modules used shall be Allen-Bradley 1762-OW8 and 1762-OW16, or as specified on the Contract Drawings.
   c. Analog input modules used shall be Allen-Bradley 1762-IF4, or as specified on the Contract Drawings.
   d. Analog output modules used shall be Allen-Bradley 1762-OF4, or as specified on the Contract Drawings.

3. For the MicroLogix 1500 series, the associated I/O modules shall be the following:
   a. Discrete input modules used shall be Allen-Bradley 1769-IA16, or as specified on the Contract Drawings.
   b. Discrete output modules used shall be Allen-Bradley 1769-OW16, or as specified on the Contract Drawings.
   c. Analog input modules used shall be Allen-Bradley 1769-IF8, or as specified on the Contract Drawings.
   d. Analog output modules used shall be Allen-Bradley 1769-OF4, or as specified on the Contract Drawings.

2.03 OPERATOR INTERFACE TERMINALS

A. The operator interface terminal shall be color graphic display that connects directly to the PLC's communication port or a communication module and allow viewing and changing of the PLC's parameters.

B. Shall be environmentally rated NEMA 4/4X

C. The OIT shall be powered by 24VDC.

D. The OIT shall be provided with an integrated real time clock with battery backup.
E. All remote station OITs shall have a minimum resolution of 320 x 240 TFT graphics with 16 bit color graphics.

F. The OIT shall be provided with touch screen operation.

G. Minimum display size shall be 6 inches with a viewable display area of 5.7 inches.

H. The OIT shall be provided with 26MB internal Project memory. Unit shall also include SD port. Contractor shall provide 1GB SD card for each operator terminal to store data.

I. The OIT shall provide real-time trending of process variables.

J. The OIT shall provide active and historical alarm screens with the ability to acknowledge and clear.

K. The OIT shall have the ability to go to a selectable screen based on specific alarm bits.

L. Provide all communications modules and cables for OIT - PLC communications. PLC interface shall be Ethernet/IP. RS-232 shall also be available for use.

M. Provide and coordinate all communications protocol drivers to establish reliable communications between PLC and OIT.

N. Provide OIT programming & configuration cables.

O. The OIT shall be provided with a licensed copy of programming software.

P. OITs shall be Automation Direct C-More EA7 Series as applicable with resolutions specified.

PART 3 – EXECUTION (NOT USED)
PART 1 – GENERAL

1.01 DESCRIPTION
A. The Contractor shall provide all wiring, labor, tools, materials, and equipment necessary to modify, install, and test control panels and enclosures as specified herein and on the Drawings.

B. Related Requirements
   1. Refer to Division 26, Electrical for wiring standards and practices.
   2. Section 40 90 00 – Instrumentation and Control for Process Systems
   3. Section 40 91 00 – Primary Process Measurement Devices
   4. Section 40 94 43 – Programmable Logic Controllers

1.02 WORK NOT INCLUDED
A. PLC programming, HMI/OIT screen development, and integration of new SCADA system shall be provided by others.

1.03 REFERENCES
A. Construction of panels and the installation and interconnection of all equipment and devices mounted within shall comply with applicable provisions of the following standards, codes and Regulations:
   2. National Electrical Code, (NEC)
   3. National Electrical Manufacturer's Association Standards, (NEMA)
   5. Operational Safety and Health Administration Regulations, (OSHA)
   6. Underwriters’ Laboratory, Inc., (UL)
   7. American National Standards Institute, Inc. (ANSI)
   8. Factory Mutual (FM)
9. The Instrumentation, Systems and Automation Society (ISA)

10. State and Local code requirements.

1.04 QUALITY ASSURANCE

A. Control Panel Fabricator (hereafter referred to as 'Panel Shop') shall hold a valid UL-508A certification for their panel fabrication facility, and shall have executed a minimum of three (3) Projects of similar scope in the municipal water and wastewater markets in the past five (5) years.

B. Surge protection shall be provided by recognized manufacturer with a minimum of five (5) years’ experience in the production of this equipment.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Submit detailed information for the process control panels and enclosures in accordance with Section 40 90 00.

C. In addition to the requirements of Section 40 90 00, the submittals shall include:

1. Prior to submittal to Engineer, Shop Drawings and submittal information shall be thoroughly checked by Contractor to insure compliance with Contract Documents. Contractor shall be Responsible for verifying that all equipment, instruments and materials submitted upon shall fit within available space and maintain specified physical clearances, and that all equipment is compatible with the operation of the overall system. Submittal to the Engineer of Shop Drawings and submittal information implies that the Contractor has reviewed the information and all requirements have been satisfied.

2. Bill of Materials for each control panel, including panel tag name or number, and component description, quantity, manufacturer name and model number for each component used in the fabrication of the control panel. The Bill of Materials shall be keyed to easily correlate the component shown in the Bill of Materials with the component shown on the control panel Equipment Layout Drawings.

3. Manufacturer’s descriptive literature (i.e. catalog information or cut sheet) for each component called out on the Bill of Materials, clearly designate the part number with highlights or arrows.

4. Equipment Layout Drawings for each control panel, indicating any deviations from the Contract Documents.
5. Panel communication diagrams for each control panel, indicating any deviations from the Contract Documents.

6. Power wiring diagrams for each control panel, indicating any deviations from the Contract Documents.

7. PLC I/O wiring diagrams, on a module-by-module basis, indicating any deviations from the Contract Documents.

8. Intrinsic barrier panel wiring details for each control panel.

D. If ‘shop drawing’-level control panel Drawings were included in the Drawings, Contractor shall have the option to submit a letter/memo (included with copy of Drawings to be used for fabrication) indicating that Panel Shop shall fabricate control panels as specified.

E. Substitutions of equipment or changes to panel design that deviate from the Drawings shall be submitted to Engineer for review prior to fabrication of control panels.

F. Procurement of materials and manufacture of the control panels shall not begin until related submittals have been reviewed by the Engineer.

G. As-Built Drawings

1. After fabrication of the control panels and factory acceptance testing is complete, Panel Shop shall provide Drawings of the control panels, representing the ‘as-built’ conditions. Submit panel Drawings in AutoCAD DWG and Adobe PDF file formats, on DVD-R media.

H. Operation and Maintenance (O&M) Information

1. Refer to Section 40 90 00, Instrumentation and Controls General Requirements for O&M material requirements. In addition to the requirements in Section 40 90 00, the control panel section of the O&M manuals shall include:

   a. Record Drawings of the control panels, updated to reflect the panels after checkout and startup.

   b. Installation and operation manuals for all major control panel components, including the network switches, PLCs, I/O modules, communication equipment, etc.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Coordinate equipment, instrument and material delivery to coincide with the Project schedule. If the delivery schedule of any equipment, instrument or material shall affect the overall Project schedule, notify the Engineer in writing immediately. Include in the written notification documentation from the equipment Supplier indicating the revised delivery schedule and reason for the change.

C. When applicable, coordinate delivery equipment, instruments or materials to be delivered directly to another trade or vendor for installation in a system or control panel provided under another Specification section.

D. Exercise care while loading, unloading and transporting equipment, instruments and materials to avoid damage. Check all equipment, instruments and materials for damage or defects within seven (7) days of delivery to the Project Site.

E. Equipment, instruments, and materials required to be stored on Site prior to installation shall be stored in such a manner to avoid damage or exposure to water, dust or construction debris.

F. Repair or replace, at no additional cost to the Owner, all equipment, instruments and materials that are defective or damaged during installation, to the satisfaction of the Engineer.

1.07 SPARE PARTS

A. Provide the following spare parts for the Project.

1. One of each type of analog loop surge protector

2. 10% spare of each type of fuse used (minimum of 1 spare of each type of fuse used)

3. One of each type of intrinsic safety barrier

4. One of each type of Ethernet switch

PART 2 – PRODUCTS

2.01 CONTROL PANEL COMPONENTS

A. The following table contains control panel components and recommended manufacturers for each component.
<table>
<thead>
<tr>
<th>Control Panel Components</th>
<th>Manufacturer (or approved equivalent)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosures</td>
<td>Hoffman</td>
<td>Shall be suitable for use in the environments that they will be located (NEMA, NFPA, etc.)</td>
</tr>
<tr>
<td></td>
<td>Hammond</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saginaw</td>
<td></td>
</tr>
<tr>
<td>Programmable Logic Controllers (PLCs)</td>
<td>Refer to Section 40 94 43</td>
<td>Match existing site standards</td>
</tr>
<tr>
<td>Operator Interface Terminals (OITs)</td>
<td>Refer to Section 40 94 43</td>
<td>Match existing site standards</td>
</tr>
<tr>
<td>Wireway</td>
<td>Panduit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hoffman</td>
<td></td>
</tr>
<tr>
<td>DIN Rail</td>
<td>Allen Bradley</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phoenix Contact</td>
<td></td>
</tr>
<tr>
<td>Radio Equipment</td>
<td></td>
<td>Match existing Site standards as necessary.</td>
</tr>
<tr>
<td>Terminal Blocks</td>
<td>Allen Bradley</td>
<td>Utilize two-tier terminal blocks wherever possible to conserve panel space.</td>
</tr>
<tr>
<td></td>
<td>Phoenix Contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entrelec</td>
<td></td>
</tr>
<tr>
<td>Terminal Block Fuse Holders</td>
<td>Allen Bradley</td>
<td>Specify fuse holders with blown fuse indicators.</td>
</tr>
<tr>
<td></td>
<td>Phoenix Contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entrelec</td>
<td></td>
</tr>
<tr>
<td>Circuit Breakers</td>
<td>Square D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allen Bradley</td>
<td></td>
</tr>
<tr>
<td>120VAC Surge Suppressors</td>
<td>Phoenix Contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Square D</td>
<td></td>
</tr>
<tr>
<td>Analog Surge Suppressors</td>
<td>Phoenix Contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Citel</td>
<td></td>
</tr>
<tr>
<td>Media Converters</td>
<td>N-Tron</td>
<td>Furnish with DIN rail mount converters as required on the network architecture</td>
</tr>
<tr>
<td></td>
<td>B&amp;B Electronics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L-Com</td>
<td></td>
</tr>
<tr>
<td>Fuses</td>
<td>Bussman</td>
<td>All glass fuses in control panels shall be fast acting style. Motor circuit protection fuses shall be time delay style.</td>
</tr>
<tr>
<td></td>
<td>Ferraz Shawmut</td>
<td></td>
</tr>
<tr>
<td>Control Relays</td>
<td>Allen Bradley</td>
<td>Include all required bases, hardware, etc.</td>
</tr>
<tr>
<td></td>
<td>Square D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Omron</td>
<td></td>
</tr>
<tr>
<td>Control Panel Components</td>
<td>Manufacturer (or approved equivalent)</td>
<td>Comments</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Power Supplies</td>
<td>Sola Phoenix Contact Allen Bradley</td>
<td>Furnish with power supplies sized as required for equipment contained within the enclosures and to supply field equipment connected to the enclosure.</td>
</tr>
<tr>
<td>Intrinsic Safety Barriers</td>
<td>Pepperl &amp; Fuchs MTL Phoenix Contact</td>
<td>Discrete barriers shall be 2-channel barriers. Analog barriers shall be two-wire barriers.</td>
</tr>
<tr>
<td>Ethernet Switches (Unmanaged)</td>
<td>Moxa B&amp;B Electronics</td>
<td>Switches shall be Furnished with direct-wired low voltage power source within the enclosure.</td>
</tr>
<tr>
<td>Ethernet Switches (Managed)</td>
<td>N-Tron B&amp;B Electronics Allen Bradley</td>
<td>All switches comprising the ring topology throughout the facility shall be Furnished from the same manufacturer.</td>
</tr>
<tr>
<td>Fiber Patch Panels</td>
<td>L-Com B&amp;B Electronics</td>
<td>Furnish with panel mount patch panels for incoming fiber optic cables as required</td>
</tr>
<tr>
<td>Emergency Power System</td>
<td>Sola Phoenix Contact Meanwell</td>
<td>Include UPS in each control panel sized to Furnish with at least 10 minutes of emergency power.</td>
</tr>
<tr>
<td>Panel Heaters</td>
<td>Hammond Hoffman</td>
<td>Furnish with panel heaters for outside control panels where temperature is a concern for electronic components.</td>
</tr>
<tr>
<td>Receptacles</td>
<td>Pass &amp; Seymour Hubbel Leviton</td>
<td>Furnish with receptacle for UPS and convenience receptacle in each PLC control panel</td>
</tr>
<tr>
<td>Pilot/Status Lights (Push to test)</td>
<td>Allen Bradley General Electric Square D</td>
<td>Color code as follows: Red-Fault, Green-Run</td>
</tr>
<tr>
<td>HOR, On/Off, L/R switches and push buttons</td>
<td>Allen Bradley General Electric Square D</td>
<td>Refer to Section 26 27 26, Wiring Devices and Miscellaneous Electrical Equipment. Furnish switches and push buttons with matching nameplate</td>
</tr>
</tbody>
</table>
PART 3 – EXECUTION

3.01 CONTROL PANEL FABRICATION

A. General

1. The control panels shall include programmable logic controller, required I/O modules with chassis (if applicable) and power supply, cables and all appurtenances as specified in this and all applicable sections. The enclosures shall include switches, lights, annunciators and all appurtenances as specified in this and all applicable sections. The panels and miscellaneous materials shall be furnished by one Supplier.

2. All electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to provide reliable performance over ambient atmosphere fluctuations between 0 - 140°F and 0 - 95% relative humidity, non-condensing. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

3. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70 and CCR, Title 8, Electrical and General Safety Orders.

4. All equipment, cabinets and devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The PLC system shall contain products of a single manufacturer, and shall consist of equipment models which are currently in production.

5. The following paragraphs describe general fabrication requirements of control panels, enclosures, consoles and cabinets. All control panel assemblies shall be UL listed, to comply with UL 508A standards.

6. Control panel enclosures shall be sized to provide at least 20% spare space, for future expansion, addition of panel components, etc. This shall minimize impact of the addition of unintended equipment during the checkout and startup phases.

7. PLC hardware provided shall accommodate a minimum 20% spare of each I/O type used in the panel, wired to terminals during the fabrication process. This shall minimize impact of unintended I/O requirements added during the checkout and startup phases of the Project.
B. Wiring

1. All interconnecting wiring shall be stranded and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius.

2. Power distribution wiring on the line side of fuses shall conform to Division 26 requirements.

3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of power distribution wiring and control wiring shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

4. All wiring shall terminate onto single-or-double tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct interlock wiring between equipment will not be allowed. The control panel shall be fabricated with minimum 20% spare terminals. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Terminal blocks shall be the compression screw type. Spring clamp style terminals shall not be accepted.
   a. Discrete inputs and outputs (DI and DO) shall have two (2) terminals per point with adjacent terminal assignments. All active and spare points shall be wired to terminal blocks.
   b. Analog inputs/outputs (AI and AO) shall have a minimum of three (3) terminals per shielded pair. Three (3) terminals shall be provided for direct connection of powered (four wire) loops. Four (4) terminals shall be provided for direct connection of loop powered (two wire) loops. Five (5) terminals shall be provided for connection of analog loops incorporating a local indicator or recorder. One (1) terminal is for shielded ground connections for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare points shall be wired to terminal blocks.
   c. Wire and tube markers shall conform to Division 26 requirements.
   d. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of the panel.
   e. Whenever possible, the terminals for field wiring shall be located to reduce the amount of routing through wireway necessary to carry the field wiring to the termination point.

5. All wiring (internal to the panel and field wiring) shall be provided with a 'service loop,' to allow for adjustment of the termination point in the
future. The service loop shall be no more than 4-5 inches, and shall be stored in the associated wireway.

6. All wiring to hand switches, etc., which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

7. All wiring shall be clearly tagged and color coded in accordance with the National Electric Code. All tag numbers and color coding shall correspond to the panel wiring diagrams prepared by the Engineer. All power wiring, control wiring, grounding and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:

a. Incoming 120 VAC Hot – Black
b. 120 VAC Hot Wiring (downstream of panel circuit breaker) – Red
c. 120 VAC Neutral – White
d. Ground – Green
e. DC Wiring – Blue
f. Intrinsically Safe Wiring - Light Blue
g. Foreign Voltage – Yellow

C. Control Panel Loss of Power

1. Each control panel containing a PLC shall have an input configured to alarm the operators upon loss of main control panel power. This alarm shall be displayed on the SCADA nodes to alert the operators that attention is required.

D. Control Panel Overcurrent Protection

1. All overcurrent protection devices (circuit breakers, fuses) shall be properly sized to protect the devices and the loads to which they are associated.

2. Circuit Breakers

a. Circuit breakers in the panel shall be sized to protect the associated equipment, and to provide the necessary power to operate.

3. Fuses

a. Glass fuses not associated with motor circuit protection shall be specified as fast-acting style. Fuses associated with motor circuit protection shall be specified as time delay style.

E. Lightning/Surge Suppression
1. Lightning/surge suppression shall be provided to protect the control panel and associated equipment from surges on the incoming power circuits, or those induced by lightning strikes and propagated along the signal or power lines connected to the control panels. Surge protection shall be provided by qualified manufacturer complying with requirements in Article 1.04. Surge protection shall be sized properly for its intended purpose.

2. 120VAC surge suppression
   a. The incoming 120VAC power source for the control panel shall be provided with surge suppression in the control panel. Surge suppressors shall be provided with an auxiliary contact, connected to the PLC, to indicate surge suppressor failure. Install surge suppression in strict accordance with manufacturer’s recommendations.

3. Analog signal surge suppression
   a. Analog signals connected to equipment or instrumentation that is located outside the building where the control panel is installed shall be supplied with DIN-rail mounted surge suppression in the control panel. Provide surge protection at both ends of the signal cable and mount surge protection as close to the equipment, instrument or termination point as possible. Provide with a minimum of 10kA surge current suppression.

4. Telephone Line and Ethernet surge suppression
   a. Copper-based telephone lines and Ethernet cabling connected to the control panel that leaves the building where the control panel is installed shall be provided with surge suppression in the control panel. Provide surge protection at both ends of the telephone or Ethernet cabling and mount surge protection as close to the termination point as possible.

F. Selector Switches, Pushbuttons and Pilot Lights
   1. All selector switches, pushbuttons and pilot lights required for the enclosures shall be provided in accordance with Section 26 27 26, Wiring Devices and Miscellaneous Electrical Equipment.

G. Uninterruptible Power Supplies
   1. Each control panel containing a PLC shall be provided with an uninterruptible power supply (UPS) sized to provide a minimum of ten (10) minutes of power in the event of main control power loss. The UPS
shall be provided with relay contact outputs, connected to the PLC, to indicate UPS fault and UPS low battery conditions.

H. Ethernet Switches
   1. Ethernet switches shall be configured to accept the number of connections shown on the Drawings.
   2. Ethernet switches shall be provided with a minimum of 20% spare RJ-45 ports available for future expansion.

I. Seal Fail and Motor Temperature Relays
   1. Pumps, mixers, etc. equipped with proprietary seal fail and motor temperature relays, shall require these relays to be mounted in the SCADA control panel. The seal fail and motor over temperature alarm contacts shall be connected to the PLC as discrete inputs.

J. Intrinsic Safety Barrier Panels
   1. Intrinsic safety barriers required for interfacing with equipment and instruments located in a classified area shall be mounted in a panel separate from the control panels.
   2. Panels housing intrinsic safety barriers shall be laid out to facilitate separation of hazardous and non-hazardous wiring. Wireway containing hazardous area wiring shall be clearly indicated as such.

K. Equipment Mounting/Arrangement
   1. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required by the manufacturer to protect equipment from vibration. Components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings and these Specifications.
   2. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc., required to maintain the NEMA rating of the panel.
   3. A minimum of 1-1/2 inches shall be provided between panel wireway and terminal blocks, to insure that wiring can be accessed easily.
4. Maintain manufacturer recommended spacing around panel-mounted equipment, for heating and ventilation concerns.

5. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components.

L. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates which identify the panel and individual devices as required. Each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the Drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamacoid with engraved inscriptions. The letters shall be black against a white background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable. Nameplates shall be affixed to the panels using #4-40 threaded stainless steel button head hex screws.

3.02 CONTROL PANEL QUALITY ASSURANCE

A. Panel Shop shall, upon fabrication of the control panels, apply power to each panel, to ensure that panels are wired correctly and all devices contained within the panels ‘power up’ properly. Panel Shop shall provide written confirmation to the Engineer that ‘power up’ test was completed.

B. Panel Shop shall complete a point-to-point wiring checkout for all wiring contained in the control panels, and correct any errors or omissions found during that process. Panel Shop shall provide written confirmation to the Engineer that checkout was completed.

C. Panel Shop shall provide advance notice to the Engineer that control panel fabrication is complete, and shall make the control panels available in their facility for completion of the Factory Acceptance Test by the Engineer or System Integrator. Panel Shop shall not ship control panels prior to execution of the Factory Acceptance Test, unless indicated in writing by the Engineer.

3.03 INSTALLATION AND MOUNTING

A. Contractor shall provide all labor, tools, material and equipment required to mount SCADA panels in the locations shown on the Drawings, in accordance to manufacturer-recommended mounting practices. The location of control panel shown on the Drawings is approximate only. Exact location shall be as approved by the Owner or Engineer during construction. Obtain in the field all information
relevant to the placing of process control Work and in case of any interference with other Work, proceed as requested by the Engineer.

B. All control panels shall be powered up upon installation and all field wiring shall be tested for proper termination. All analog signals shall be simulated for a full scale 4-20ma test.

3.04 STARTUP AND TESTING

A. Contractor shall provide all labor, tools, materials and equipment necessary to assist in the startup and testing of the SCADA system with the Integrator after installation of control panels and instruments, and termination of field wiring to panels is complete. Start up and testing shall be witnessed by the Owner or Owner’s representative.

END OF SECTION
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