

# TOWN OF SALEM, NEW HAMPSHIRE

## REQUEST FOR BIDS

### ARLINGTON POND PUMPING STATION VFD INSTALLATION

November 21, 2016



Town of Salem, New Hampshire  
33 Geremonty Drive  
Salem, NH 03079

**A. REQUEST FOR PROPOSALS/BIDS**

The Town of Salem, New Hampshire is requesting proposals/bids for **VFD Installation** at the Arlington Pond Pumping Station, located at 22 Wheeler Dam Road in Salem.

All bidders are required to visit the site to determine existing conditions and obtain all pertinent dimensions, etc. that would affect the work. Bids submitted shall include a written certification that a site visit was made and that the Bidder is fully familiar with all existing conditions.

The Town of Salem will accept proposals/bids at **Town of Salem Town Hall, 33 Geremonty Drive, Salem, NH 03079 until 2:00 p.m. on Thursday, December 22, 2016, at which time they will be opened publicly and read aloud.** The bid proposal that allows the project to be performed within the Town's available budget and will result in the work being performed in a schedule and manner that is in the best interest of the Town shall be the basis of selection for award of the work. The Town reserves the right to reject any and all bids, and the cost of preparing a bid submittal is the sole responsibility of the Bidder.

**B. INFORMATION FOR BIDDERS:**

Completion time for the proposed Substantial and Final Completion dates of the proposed work shall be specified by the Bidder in the submittal. In no case shall the proposed substantial completion date be later than April 30, 2017.

The Bidder shall identify any and all proposed deviations from the specification requirements of **Section H. Technical Specifications** with a description of that deviation and justification for such deviations in his proposal. Failure to include justification for deviations proposed will indicate non-compliance and shall be rejected without further consideration.

The successful bidder shall furnish a 100% Performance Bond in a form acceptable to the Town of Salem upon execution of the Construction Contract.

Technical questions on the project and arrangements to inspect the existing Electrical and Controls system in the Arlington Pond Pump Station shall be directed to Frank Giordano, Town of Salem, at (603) 890-2179.

No bidder may withdraw a Bid within 60 days after the actual date of opening thereof.

Copies of the Contract Documents may be obtained only from the Town of Salem, 33 Geremonty Drive, Salem, NH 03079 upon payment of a fee of **\$25.00** per set which will not be refunded. Partial sets will not be distributed.

## C. BID:

Proposal of

(hereinafter called "BIDDER"), organized and existing under the laws of the State of \_\_\_\_\_, doing business as \_\_\_\_\_

(Corporation, Partnership, Individual)

To the TOWN OF SALEM \_\_\_\_\_ (hereinafter called "OWNER").

In compliance with the Information for Bidders, BIDDER hereby proposed to perform all WORK described in the Bid Package for the installation of VFDs at the Arlington Pond Pumping Station within the time set forth herein at the price stated below.

## BASE BID PRICE:

Dollars (\$ \_\_\_\_\_)

LUMP SUM

BIDDER shall provide information below indicating any item of work that could be considered to be above and beyond the work covered in the LUMP SUM prices cited above:

\_\_\_\_\_  
\_\_\_\_\_

PROPOSED START DATE: \_\_\_\_\_

PROPOSED SUBSTANTIAL COMPLETION DATE: \_\_\_\_\_

PROPOSED FINAL COMPLETION DATE: \_\_\_\_\_

Respectfully submitted:

Signature \_\_\_\_\_

Address \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

Being duly sworn, deposes and says that he is

of \_\_\_\_\_

(Name of Organization)

and that the answers to the foregoing questions and all statements contained therein are true and correct.

Sworn to before me this \_\_\_\_\_

day of \_\_\_\_\_

, 2016

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_  
(Seal - If BID is by Corporation)

ATTEST: \_\_\_\_\_

Underwood Engineers, Inc., Portsmouth, NH  
UEI #2119

**D. CONTRACT/AGREEMENT:**

**THIS AGREEMENT**, made this \_\_\_\_\_ day of \_\_\_\_\_, 20 16 by  
and between TOWN OF SALEM, hereinafter called "**OWNER**"  
(Name of Owner)  
and \_\_\_\_\_ doing business as (an individual,) or (a  
partnership,) or (a corporation) hereinafter called "**CONTRACTOR**".

**WITNESSETH:** That for and in consideration of the payments and agreements hereinafter  
mentioned:

1. The **CONTRACTOR** will commence and complete the construction of

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**VFD INSTALLATION**

(Project)

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2. The **CONTRACTOR** will furnish all of the material, supplies, tools, equipment, labor and  
other services necessary for the construction and completion of the **PROJECT** described herein.

3. Execution of this Contract/Agreement shall constitute authorization to proceed and the start  
of contract time.

Liquidated damages will be in the amount of 250.00 for each calendar day of delay  
\$ \_\_\_\_\_ beyond

the contract period established for substantial and final completion as proposed by the Bidder.

4. The **CONTRACTOR** agrees to perform all of the **WORK** described in the **CONTRACT  
DOCUMENTS** and comply with the terms therein for the sum of \_\_\_\_\_ or as shown in the  
\$ **BID** schedule with Substantial Completion by \_\_\_\_\_

, and

Final Completion by \_\_\_\_\_.

5. The term "**CONTRACT DOCUMENTS**" means and includes the following:

- (A) REQUEST FOR PROPOSALS/BIDS
- (B) INFORMATION FOR BIDDERS
- (C) BID
- (D) CONTRACT/AGREEMENT
- (E) CONTRACTOR'S RELEASE
- (F) GENERAL CONDITIONS
- (G) SPECIAL CONDITIONS
- (H) TECHNICAL SPECIFICATIONS
- (I) DRAWINGS DATED 11/18/16.

6. The **OWNER** will pay to the **CONTRACTOR** in the manner agreed to by negotiations between the Bidder and the Town of Salem.

7. This Agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

**IN WITNESS WHEREOF**, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in Four (4) original copies, each of which shall be deemed an original on the date first above written.

**OWNER:** TOWN OF SALEM

By: \_\_\_\_\_

Name: \_\_\_\_\_  
(Please type)

(SEAL)

ATTEST: \_\_\_\_\_  
Name: \_\_\_\_\_  
Title: \_\_\_\_\_

**CONTRACTOR:** \_\_\_\_\_

By: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_

(SEAL)

ATTEST: \_\_\_\_\_  
Name: \_\_\_\_\_  
Title: \_\_\_\_\_

## E. CONTRACTOR'S FINAL RELEASE AND WAIVER OF LIEN

Project/OwnerProject: **VFD INSTALLATION**

Address: Town of Salem, NH  
33 Geremonty Drive  
Salem, NH 03079  
 City      State      Zip

Owner Town of Salem, NH  
 \_\_\_\_\_

Contractor

Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 \_\_\_\_\_  
 City      State      Zip

Contractor License: \_\_\_\_\_  
 Contract Date: \_\_\_\_\_

**TO ALL WHOM IT MAY CONCERN:**

For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned Contractor hereby waives, discharges, and releases any and all liens, claims, and rights to liens against the above-mentioned project, and any and all other property owned by or the title to which is in the name of the above-referenced Owner and against any and all funds of the Owner appropriated and available for the construction of said project, and any and all warrants drawn upon or issued against any such funds or monies, which the undersigned Contractor may have or may hereafter acquire or process as a result of the furnishing of labor, materials, and/or equipment, and the performance of Work by the Contractor on or in connection with said project, whether under and pursuant to the above-mentioned contract between the Contractor and the Owner pertaining to said project or otherwise, and which said liens, claims or rights of lien may arise and exist.

The undersigned further hereby acknowledges that the sum of

Dollars (\$ \_\_\_\_\_) constitutes the entire ***unpaid*** balance due the undersigned in connection with said project whether under said contract or otherwise and that the payment of said sum to the Contractor will constitute payment in full and will fully satisfy any and all liens, claims, and demands which the Contractor may have or assert against the Owner in connection with said contract or project.

Dated this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_

\_\_\_\_\_  
 Contractor

Witness to Signature

By \_\_\_\_\_

By \_\_\_\_\_

Title \_\_\_\_\_

Title \_\_\_\_\_

**F. GENERAL CONDITIONS:**

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1. Materials, Services, Facilities and Workmanship shall be furnished as follows:
  - 1.1 Except as otherwise specifically stated in the contract documents, the Contractor shall provide all materials, labor, tools, equipment, supplies, as transportation, superintendence, temporary construction as required, and all other services and facilities necessary to execute, complete, and deliver the work within the specified time.
  - 1.2 Unless otherwise specifically provided for in the specifications, all equipment, materials and articles incorporated in the work shall be new.
  - 1.3 Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, and started up in compliance with the manufacturer's recommendations.
2. Contractor's obligation is as follows: The Contractor shall in good workmanlike manner, perform and complete all the work required by this contract, within the time stated in the proposal in accordance with the plans and drawings covered by this contract. He shall furnish, erect, maintain and remove such construction plant and such temporary works as may be required. The Contractor shall observe, comply with, and be subject to all terms, conditions, requirements, and limitations of the contract documents, and shall complete the work to the satisfaction of the Owner.
3. Protection of work and property shall be provided as follows:
  - 3.1 The Contractor shall at all times protect the Owner's property from injury or loss in connection with this contract. He shall at all times protect his own work, and that of adjacent property, from damage. The Contractor shall replace or make good any such damage, loss or injury related to this work unless caused directly by errors contained in the contract, or by the Owner.
  - 3.2 The Contractor shall take all necessary precautions for the safety of his employees on the work site, and shall comply with all applicable provisions of local, federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed.
  - 3.3 In case of emergency which threatens loss or injury of property, and/or safety of life, the Contractor is allowed to act, without previous instructions.
4. Defective work shall be processed as follows:
  - 4.1 The Contractor shall promptly remove from the premises all materials and work determined to be defective or failing to meet contract requirements,

whether incorporated in the work or not, and shall promptly replace such work in accordance with the contract at no additional expense to the Owner.

5. Acceptance, payment, and retainage provisions shall be as follows:

- 5.1 Progress Payments. The Owner will once each month make a progress payment to the Contractor on the basis of an estimate of total of work done to the time of the estimate and its value as prepared by the Contractor and approved by the Engineer.
- 5.2 Retainage by Owner. The Owner will retain a portion of the progress payment, each month, in accordance with the following procedures:
  - a. The Owner will establish an escrow account in the bank of the Owner's choosing. The account will be established such that interest on the principal will be paid to the Contractor. The principal will be the accumulated retainage paid into the account by the Owner. The principal will be held by the bank, available only to the Owner, until termination of the contract.
  - b. Until the work is 50% complete, as determined by the Engineer, retainage shall be 10% of the monthly payments claimed. The computed amount of retainage will be deposited in the escrow account established above.
  - c. After the work is 50% complete, and provided the Contractor has satisfied the Engineer in quality and timeliness of the work, and provided further that there is no specific cause for withholding additional retainage no further amount will be withheld. The escrow account will remain at the same balance throughout the remainder of the project.
- 5.3 Substantial completion and payment.
  - a. Substantial completion shall be that point, as certified by the Owner, or his Agent, at which the contract has been completed to the extent that the Owner may make full use of the replacement VFDs.
  - b. Upon substantial completion, the entire balance due and payable to the Contractor less 2 percent retainage of the Contract Price, and less a retention based on an estimate of the fair value for the cost of completing or correcting listed "punch list" items of work with specified amounts for each incomplete or defective item of work shall be made.
  - c. A guarantee period of one year for the work shall begin on the date certified by the Owner that the work is substantially completed.

- 5.4 Final completion shall be that point at which all work has been completed and all "punch list" and/or defective work has been corrected. Unless the Owner has issued a certificate of substantial completion, the general guarantee period shall begin upon certification by the Owner of final completion.
- 5.5 At the end of the general guarantee period when it is found that the work is satisfactory and that no work has become defective under the terms of the contract, the Owner will accept the entire project and make final payment, including the reimbursement of the 2% monies retained.
- 5.6 If the guarantee inspection discloses any work as being unsatisfactory, the Owner will give the Contractor the necessary instructions for correction of such work, and the Contractor shall immediately execute such instructions. Upon Correction of the work, another inspection will be made which shall constitute the guarantee inspection, provided the work has been satisfactorily completed.
- 5.7 The acceptance by the Contractor of final payment shall release the Owner from all claims and all liability to the Contractor relating to this work, and for every act and neglect of the Owner and others relating to or arising out of this work. No payment, however, final or otherwise, shall release the Contractor or his sureties from any obligations of the performance and payment bond under this contract.

6. The Contractor and any Subcontractor shall obtain all the insurance required under this article.
  - 6.1 The Contractor and all Subcontractors shall procure and shall maintain during the life of this contract workmen's compensation insurance as required by applicable state law. The Contractor shall provide and shall cause each Subcontractor to provide adequate employer's liability insurance.

Limits of Liability:  
\$100,000 each accident;  
\$500,000 disease - policy limit;  
\$100,000 disease - each employee.
  - 6.2 The Contractor shall procure and shall maintain during the life of this contract Commercial General Liability insurance to include contractual liability, explosion, collapse and underground coverages, including the Owner as an insured party.

Limits of liability:

\$1,000,000 each occurrence bodily injury and property damage;  
\$2,000,000 general aggregate - include per project aggregate endorsement;  
\$2,000,000 products/completed operations aggregate.

If blasting or demolition or both is required by the contract, the Contractor

or

Subcontractor shall obtain the respective coverage and shall furnish the Owner a certificate of insurance evidencing the required coverages prior to commencement of any operations involving blasting or demolition or both.

- 6.3 The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies. Such insurance shall not be canceled or materially altered, except after 10 days written notice has been received by the Owner.
7. The Contractor shall not commence work until a pre-construction conference has been held at which representatives of the Owner are present.

G. **SPECIAL CONDITIONS:****Note:**

The following Special Conditions may modify, change, delete, or add to the "General Conditions." Where any part of the General Conditions is modified or voided by these Special Conditions, the unaltered provisions of that part shall remain in effect.

<u>SC No.</u>	<u>SC Title</u>	<u>Page</u>
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## **SPECIAL CONDITIONS**

### **1. WORKING HOURS**

The CONTRACTOR shall not begin work until after 07:00 hours and no construction activities shall be allowed after 15:30 hours. All cleanup shall have been completed by this hour. No work shall be allowed on weekends or holidays.

### **2. CHARACTER OF THE CONTRACTOR'S SUPERINTENDENT AND WORKERS**

- A. The CONTRACTOR'S superintendent shall conduct himself in a professional, cooperative, and responsible manner. If, in the opinion of the OWNER, the superintendent does not conduct him/herself in a manner that is professional and courteous, the OWNER may direct the CONTRACTOR to relieve the superintendent of his/her responsibilities and have him/her removed from the project. Upon written notice from the OWNER to the CONTRACTOR the superintendent shall immediately be relieved of his/her responsibilities and removed from the project. If a superintendent change is to be made, work shall be terminated until qualifications of a new superintendent have been submitted and approved by the OWNER. The superintendent that was removed from the site shall not be allowed to work on any other portion of work in this Contract without written approval of the OWNER.
- B. Any person employed by the CONTRACTOR or by any subcontractor who, in the opinion of the OWNER, does not conduct him/herself in a proper and professional manner or is intemperate or disorderly shall, at written request of the OWNER, be removed immediately by the CONTRACTOR or subcontractor employing such person, and shall not be allowed to work on any other portion of work in this Contract without written approval of the OWNER.

### **3. SITE SECURITY**

The CONTRACTOR shall be required to place temporary barriers or fencing (snow fence, fluorescent orange security fencing, etc.) around all storage yards at all times and around all equipment during non-working hours.

### **4. SCHEDULE**

The CONTRACTOR shall submit a proposed progress schedule to the OWNER with their proposal.

### **5. PRECONSTRUCTION PHOTOGRAPHS**

The CONTRACTOR shall take pre-construction digital photographs of the existing Pumping Station Building and Electrical and Controls system and supply two (2) sets of photographs to the Town clearly indicating the pre-construction physical condition of the existing Pumping Station Building and Electrical and Controls system prior to the start of work.

**6. OWNER'S RIGHT TO MATERIAL**

The OWNER retains the right to the existing soft starts and other electrical equipment after demolition by the CONTRACTOR under this Contract. The OWNER also retains the right to all existing conduit and wiring removed and/or replaced under this project. The CONTRACTOR shall package and deliver these items to a location at the water treatment facility site designated by the OWNER, covered on a suitable pallet or platform as appropriate. Should the CONTRACTOR wish to make an offer to the OWNER for the salvage value of these items; such an offer shall be made in writing to the OWNER for consideration as a deductive change order.

**7. CLEANUP**

The CONTRACTOR shall remove all construction material, equipment, or other debris remaining on the construction site as a result of construction operations and render the site of the work in a neat and orderly condition at least equal to that which existed prior to the start of construction.

The CONTRACTOR shall dispose of all materials and debris off-site in accordance with local, state, and federal regulations.

Once all work is complete, the CONTRACTOR shall perform a final cleaning of the work areas to remove any dust/dirt/debris from the areas to leave them in a clean and orderly fashion for use by the OWNER.

**8. OCCUPYING PRIVATE PROPERTY**

The CONTRACTOR shall not enter upon nor occupy with men, equipment or materials any property outside of the town property, unless written consent of the owner is obtained prior to entry.

## H. TECHNICAL SPECIFICATIONS

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#### Division 1 – General Requirements

<u>Section No.</u>	<u>Section Title</u>
01010	Summary of Work
01340	Submittals
01668	Services of Manufacturers' Representatives
01720	Project Record Documents
01730	O&M Manuals

#### Division 16 - Electrical

<u>Section No.</u>	<u>Section Title</u>
16402	Electrical Work

DIVISION 1  
GENERAL REQUIREMENTS

Scope of Work

The scope of this Division covers the General Administrative Requirements and the general work related provisions of the Construction Contract.

Contents of Division

<u>Section No.</u>	<u>Section Title</u>
01010	Summary of Work
01340	Submittals
01668	Services of Manufacturer's Representatives
01720	Project Record Documents
01730	Operation & Maintenance Manuals

SECTION 01010

SUMMARY OF WORK

PART 1 -- GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, equipment and materials necessary to install and construct:

**VFD INSTALLATION AT ARLINGTON POND PUMPING STATION:**

1. Furnish and install (3) variable frequency drives (VFDs) to replace existing soft starts at the Arlington Pond Pumping Station.
2. Installation of all associated conduit, electrical power wiring, control systems and control wiring, assembly, and other construction activities necessary to provide complete and fully operational systems.

B. In addition, this Contract shall include, but not be limited to, the following:

1. All demolition and all other construction activities necessary to provide a complete and fully operational system to meet the intent of the construction Drawings and Project Manual.

1.2 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall have the following responsibilities:

1. Furnish all labor, material, equipment, survey control and incidentals as required to perform the work in its entirety as shown on the Construction Drawings and specified herewith.
2. Coordinate all construction activities, including bypass pumping or temporary power, as necessary, with the Engineer and Owner.
3. Complete this construction project in accordance with the bid documents within the allotted time schedule and provide the required warranties.
4. The Contractor is responsible for all applicable health and safety requirements during construction.
5. Any damage to existing structures, equipment and property, accepted equipment or structures, and property or work in progress by others; as a result of the Contractor's or his subcontractor's operations shall be repaired/restored by the Contractor at no additional cost to the Owner.
6. The work includes, but is not limited to, furnishing all materials, labor and equipment to perform the following activities:
  - a. Preparation and submittal of contract specified submittals
  - b. Preconstruction Conference
  - c. Project meetings (monthly or more often as necessary)
  - d. Construction safety and quality control
  - e. Temporary utilities
  - f. Bypass pumping or other temporary systems
  - g. Project closeout
  - h. Project record documents
  - i. State and local permits, if applicable.

**1.3 ENUMERATION OF CONTRACT DOCUMENTS**

- A. Construction Drawings
  1. The Construction Drawings, which form a part of this contract, include Drawings **Dwg-1** through **Dwg-5** (Appendix H).
- B. Project Manual
  1. The Project Manual, which forms a part of this contract, includes the following:
    - a. Request for Proposals/Bids
    - b. Information for Bidders
    - c. Bid Form
    - d. Contract Agreement
    - e. Contractor's Release
    - f. General Conditions
    - g. Special Conditions
    - h. Technical Specifications
  2. All Addenda issued during the Bidding process also form a part of this contract.
- C. The Construction Drawings and the Project Manual form the Contract Documents.
- D. The Contractor will be given three (3) additional sets of contract documents (ie. plans and project manuals) for use during construction. If the Contractor requests additional sets, the Contractor shall pay for the cost for reproduction of the sets and the cost of the Engineer for the time required making the reproductions. The Contractor shall pay the Engineer directly for these additional charges.

**PART 2 -- PRODUCTS**

(NOT PART OF THIS SECTION)

**PART 3 -- EXECUTION**

**3.1 WORK SEQUENCE**

- A. It is the intention that the work required to be completed under this contract be performed in an organized and work-like manner. The construction shall be done to accommodate the existing wastewater treatment facility and can only proceed in accordance with the approved scheduling to ensure the new system ties into the existing treatment process as intended in the contract and as shown on the drawings. The Contractor shall coordinate progress, schedule and performance with the Owner and the Engineer during construction.

**3.2 SPECIAL REQUIREMENTS**

- A. Contractor shall determine the lead time of all materials required and shall schedule and coordinate work to accommodate the delivery of equipment and materials.
- B. Any proposed change in the existing system status (pumps, valves, controls, etc.) shall be coordinated in advance with the Owner and Engineer.

3.3 USE OF PREMISES

- A. Contractor shall limit use of premises for work, for storage, and for access, to allow:
  - 1. Owner occupancy on Owner's property
  - 2. Normal public use of public property, rights-of-way, etc.
  - 3. Access to public property
- B. Coordinate use of premises under direction of Owner.
- C. Assume full responsibility for protection of safekeeping of products under this Contract.
- D. Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

3.4 WORK RESTRICTIONS

- A. Work on the project will be only allowed between the hours of 7:00 am and 3:30 pm, excluding holidays and weekends, except during emergencies, unless requested in writing and approved by the Owner.

END OF SECTION

SECTION 01340

SUBMITTALS

PART 1 -- GENERAL

**1.1 DESCRIPTION**

A. Work Included:

1. Submit to the Engineer, Shop Drawings, Operation and Maintenance Manuals, Manufacturers' Certificates, Project Data, and Samples required by the Specification Sections.

B. Alternates

1. If the Contractor elects to submit an Alternate that is considered a "substitute", the Contractor will be responsible to make all modifications to the Work resulting from the use of the Alternate at no additional cost to the Owner.

**1.2 SHOP DRAWINGS**

- A. Shop Drawings are required for each and every element of the work. Each shop drawing shall be assigned a sequential number for purposes of easy identification, and shall retain its assigned number, with appropriate subscript, on required resubmission.
- B. Shop Drawings are generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists, and other data prepared by the Contractor, his subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction, and installation of the work, or a portion thereof.
- C. The Contractor shall submit to the Engineer a minimum of six (6) copies of Shop Drawings and approved data. The Engineer will retain four (4) copies (for Owner's, Engineer's and Field Representative's files) and return two (2) copies to the Contractor for distribution to subcontractors, suppliers and manufacturers. If the Contractor requires more copies, then the number of copies submitted shall be adjusted accordingly.
- D. The Contractor shall provide a copy of a completed submittal certification form which shall be attached to every copy of each shop drawing. Shop Drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the work.
- E. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings.
- F. No material or equipment shall be purchased or fabricated especially for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such

materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.

- G. Until the necessary review has been made, the Contractor shall not proceed with any portion of the work (such as the construction of foundations), the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which review is required.
- H. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. Shop drawings shall be of standardized sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard sizes shall be: (a) 24 inches by 36 inches; (b) 11 inches by 17 inches, and (c) 8-1/2 inches by 11 inches. Provision shall be made in preparing the shop drawings to provide a binding margin on the left hand side of the sheet. Shop drawings submitted other than as specified herein may be returned for re-submittal without being reviewed.
- I. Only drawings, which have been checked and corrected by the fabricator, should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer.
- J. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in his letter of transmittal.
- K. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, he shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications.
- L. A maximum of two submissions of each Shop Drawing will be reviewed, checked, and commented upon without charge to the Contractor. Any additional submissions which are ordered by the Engineer to fulfill the stipulations of the Drawings and Specifications, and which are required by virtue of the Contractor's neglect or failure to comply with the requirements of the Drawings and Specifications, or to make those modifications and/or corrections ordered by the Engineer in the review of the first two submissions of each Shop Drawing, will be reviewed and checked as deemed necessary by the Engineer, and the cost of such review and checking, as determined by the Owner, and based upon Engineer's documentation of time and rates established for additional services in the Owner-Engineer Agreement for this Project, may be deducted from the Contractor to make all modifications and/or corrections as may be required by the Engineer in an accurate, complete, and timely fashion.

### 1.3 SAMPLES

- A. The Contractor shall submit samples when requested by the Engineer to establish conformance with the specifications, and as necessary to define color selections available.

### 1.4 OPERATION AND MAINTENANCE MANUALS

- A. At least 2 months prior to the expected substantial completion date, the Contractor shall submit to the Engineer all manuals in accordance with the requirements specified herein Specification Section 01730, and within individual equipment specification sections.
- B. The Contractor shall furnish the Engineer a minimum of six (6) copies of a complete instruction manual for installation, operation, maintenance, and lubrication of each item specified. The Engineer will retain four (4) copies (for Owner's, Engineer's and Field Representative's files) and return two (2) copies to the Contractor for distribution to subcontractors, suppliers and manufacturers. If the Contractor requires more copies, then the number of copies submitted shall be adjusted accordingly.
- C. Manuals shall include operating and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules, equipment numbers, shop drawings corrected to as-built conditions, wiring diagrams, and assembly drawings which shall describe capacity location, operation, maintenance, lubrication, operating weight, lubrication charts showing manufacturer recommended lubricants for each rotating or reciprocating unit, and other necessary information for the Engineer to establish a complete maintenance program.
- D. The submittal shall also include details of all replacement parts; "Nameplate" data for all equipment; detailed instructions for start-up, normal operation, shutdown procedures, safety procedures and control techniques; and a guide to troubleshooting the system.

### 1.5 MANUFACTURER'S CERTIFICATES

- A. Prior to accepting the installation, the Contractor shall submit manufacturer's certificates for each item specified.
- B. Such manufacturer's certificates shall state that the equipment has been installed under either the continuous or periodic supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements, to the manufacturer's satisfaction. All costs for meeting this requirement shall be included in the Contractor's bid price.
- C. Certified performance test data will also be submitted to the Engineer as required by the specifications.

### 1.6 RECORD DRAWINGS

- A. The Contractor shall submit, at the end of the Project, a clean, legible, and accurate set of red-lined drawings indicating any and all field changes that occurred during the course of construction. These drawings shall document all differences between what

was called for in the executed contract drawings and what was actually constructed in the field. These drawings shall constitute record drawings for the Project.

**1.7 SUBMISSION REQUIREMENTS**

- A. Submittals not meeting these requirements will be returned to the CONTRACTOR without review by the ENGINEER for completion of this information and resubmittal without a claim of lost time being allowed for this deficiency.
- B. Accompany submittals with transmittal found on Page 01340-6, containing:
  1. Date.
  2. Project title and number.
  3. Contractor's name and address.
  4. The number of each Shop Drawing, Project Data and Sample submitted.
  5. Notification of deviations from Contract Documents.
  6. Other pertinent data.
- C. Submittals shall include:
  1. Date and revision dates.
  2. Project title and number.
  3. The names of:
    - a. Engineer.
    - b. Contractor.
    - c. Subcontractor.
    - d. Supplier.
    - e. Manufacturer.
    - f. Separate detailer when pertinent.
  4. Identification of product or material.
  5. Relation to adjacent structure or materials.
  6. Field dimensions, clearly identified as such.
  7. Specification section number.
  8. Applicable standards, such as ASTM number or Federal Specification.
  9. A blank space, 4" x 4", for the Engineer's stamp.
  10. Identification of deviations from Contract Documents.
  11. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.
  12. Where specified or when requested by the Engineer, manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements.
  13. Where specified, manufacturer's guarantee.

**1.8 RESUBMISSION REQUIREMENTS**

- A. Revise initial submittals as required and resubmit as specified for initial submittal.
- B. Indicate on submittals any changes which have been made other than those required by Engineer.

**1.9 ENGINEER'S REVIEW**

A. The review of shop and working drawings hereunder will be general only, and nothing contained in this specification shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified thereunder.

**PART 2 -- PRODUCTS**

(NOT PART OF THIS SECTION)

**PART 3 -- EXECUTION**

(NOT PART OF THIS SECTION)

SUBMITTAL CERTIFICATION FORM

PROJECT: Arlington Pond Pumping Station VFD Installation CONTRACTOR'S PROJ. NO: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_ ENGINEER'S PROJ. NO: 2119

ENGINEER: UNDERWOOD ENGINEERS, INC.

TRANSMITTAL NUMBER: \_\_\_\_\_ SUBMITTAL NUMBER: \_\_\_\_\_

SPECIFICATION SECTION OR DRAWING NO: \_\_\_\_\_

DESCRIPTION: \_\_\_\_\_

MANUFACTURER: \_\_\_\_\_

The above referenced submittal has been reviewed by the undersigned and I/we certify that the material and/or equipment meets or exceeds the project specification requirements with

NO DEVIATIONS

or

A COMPLETE LIST OF DEVIATIONS AS FOLLOWS<sup>a</sup>:

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By: \_\_\_\_\_

By: \_\_\_\_\_

Contractor<sup>b</sup>

Manufacturer<sup>c</sup>

Date: \_\_\_\_\_

Date: \_\_\_\_\_

<sup>a</sup> Any deviations not brought to the attention of the Engineer for review and concurrence shall be the responsibility of the Contractor to correct, if so directed.

<sup>b</sup> Required on all submittals

<sup>c</sup> When required by specifications

END OF SECTION

SECTION 01668

SERVICES OF MANUFACTURER'S REPRESENTATIVES

PART 1 -- GENERAL

1.1 WORK INCLUDED

- A. Coordinate and provide an overall startup, testing, and operator training schedule.
- B. Arrange for the observation of the installation of the equipment.
- C. Arrange for the checking, inspection, and adjustment of the equipment and certification of the equipment, alarms, instrumentation, and controls.
- D. Provide power, labor, materials, equipment, and temporary facilities necessary for the performance testing and start-up of the equipment, alarms, instrumentation, and controls.
- E. Arrange for operator training.

PART 2 -- PRODUCTS

Not used.

PART 3 -- EXECUTION

**AT LEAST SEVEN (7) DAYS IN ADVANCE OF THE PROPOSED EQUIPMENT STARTUP, THE CONTRACTOR SHALL SUBMIT A PROPOSED STARTUP SCHEDULE IN WRITING TO THE ENGINEER FOR REVIEW.**

3.1 TESTING IN PREPARATION FOR OPERATIONAL READINESS

- A. The minimum period of time that the service representatives shall be available to perform the services described herein shall be in accordance with the schedule in the individual specification sections. Any delays resulting in additional time required by manufacturers to allow the Contractor to correct and make equipment ready to start-up as a result of support systems not being ready for startup will be provided at no additional cost to the OWNER.
- B. Furnish the services of a manufacturer's qualified representative to observe, check, and certify as to the adequacy of the installation of equipment indicated in the individual specification sections.
- C. Furnish the services of a manufacturer's qualified trained service representative or designee acceptable to the ENGINEER, to check, inspect, and adjust all equipment and accessories in preparation for operation in accordance with the individual specification sections prior to equipment startup. The services shall begin when the equipment is requested to be placed into operation by the CONTRACTOR and as approved by the ENGINEER.
- D. The service representative shall: inspect the equipment for proper installation, lubrication and adjustment, damage and missing parts; inspect and check control systems and accessory equipment whether or not supplied by other manufacturers; and, make all

necessary corrections to make equipment ready to start-up and properly operate after start-up.

- E. Prior to equipment start-up, the service representative shall furnish a written report to the ENGINEER confirming that equipment installation is in conformance with the manufacturer's recommendations; that all alignments, adjustments and corrections have been made; and, that the equipment is ready for operation.

### 3.2 PERFORMANCE TESTING

- A. The CONTRACTOR shall provide the services of a manufacturer's qualified service representative or designee acceptable to the ENGINEER, as required for equipment provided on the Project, to directly supervise the performance testing of equipment installed on the Project. These services shall be provided in addition to the installation observation and/or installation certification requirements and operator training requirements as described in this section.
- B. Performance testing shall not be performed until after the service representative's written confirmation of proper installation and preparation for startup has been furnished to ENGINEER.
- C. Performance testing of all electrical, mechanical and hydraulic equipment and associated controls and instrumentation shall be performed to demonstrate that the equipment and associated systems meet the specified performance conditions (and documented to the Engineer in writing).
- D. Performance criteria and/or procedures are contained in various sections of the individual equipment specifications. Where a specific procedure is not described in the individual specifications, testing procedures common to the industry shall be employed to verify performance.
- E. All scheduling of performance testing shall be approved by the ENGINEER and a minimum of seven (7) days notice shall be provided to the ENGINEER by the CONTRACTOR prior to scheduling of testing. In addition, when more than one system is to be tested within a given week, the CONTRACTOR shall provide a proposed equipment testing schedule to the ENGINEER for review at least one week prior to initiating equipment tests.
- F. Performance testing of all equipment shall be performed prior to acceptance of the Work.
- G. Prior to initiating the performance tests, the procedure to be used shall be submitted to the ENGINEER for his review and approval at least 48 hours in advance.
- H. During the performance tests, the designated manufacturer's service representative shall record all necessary data to verify that the equipment being tested meets the specified performance criteria, on forms acceptable to the ENGINEER.
- I. Following completion of the performance tests, the CONTRACTOR shall submit a written performance test report to the ENGINEER which summarizes the results of the performance tests and certifies that the equipment meets the specified performance requirements.
- J. If the equipment fails to meet the specified performance requirements, the equipment shall be modified or replaced and retested with the end result being that the equipment meets the specified performance criteria. Modification, replacement and retesting shall be provided at no extra cost to the OWNER.

- K. Requests to place a piece of equipment or system into service will be considered only after completion of successful performance testing and submittal of the performance test report to the ENGINEER by the CONTRACTOR.
- L. Successful Completion of Performance Acceptance Testing does not start the Warranty Period for that equipment. The start of the Warranty Period is defined by Substantial Completion.

**3.3 OPERATOR TRAINING**

- A. Operator training shall not be performed until after the service representative's written report of installation certification and performance test report has been approved by the ENGINEER.
- B. After certifying to the installation of the equipment and at the direction of the ENGINEER, the manufacturer's representative shall train the OWNER'S operational staff in the start-up, operation, controls, alarms, and routine maintenance and troubleshooting of the equipment in the presence of the ENGINEER.
- C. A proposed training schedule shall be submitted to the ENGINEER for approval at least seven (7) days in advance of the proposed operator training. When more than one system is proposed for operator training in a given week, a proposed schedule for that week shall be submitted to the ENGINEER for approval at least one (1) week in advance.
- D. Following the training, the manufacturer shall provide written certification to the ENGINEER that the required training was provided.
- E. All training shall be coordinated with the ENGINEER.
- F. All operator training shall be video taped by the CONTRACTOR with two (2) copies provided to the OWNER.

**3.4 SCHEDULE OF MANUFACTURER'S SERVICE REPRESENTATIVE**

- A. Services of the manufacturer's representatives for observing installation, inspecting, adjusting, testing and start-up shall be provided in accordance with the schedule defined in Part 3 of the respective equipment specification section.
- B. The minimum period of time that the service representatives shall perform the services described herein shall be in accordance with the schedule defined in Part 3 of the respective equipment specification section. Any additional time to correct and make adjustments so that equipment is ready for start-up as a result of improper equipment installation or unavailability of water, power, or other support systems/controls will be provided "as required" and at no additional cost to the OWNER.

01668-4  
SERVICES OF MANUFACTURER'S REPRESENTATIVES

**UNDERWOOD ENGINEERS**  
**EQUIPMENT START UP LOG**

EQUIPMENT	Date:	Time:
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PROJECT		REPRESENTATION	
Project No. Project Name Location Owner		Engineer Owner Contractor Vendor/Mfr	

MANUFACTURER		VENDOR	
Name Address  Phone No.		Name Address  Phone No.	

EQUIPMENT			
Equipment Name		Equipment No.	
Model No.		Serial No.	
Capacity		Type	
ELECTRICAL			
Motor Mfr		Drive Type	
Motor Size		Motor Type	
V/Ph/Hz		Initial Amperage	

SPARE PARTS				
Qty.	Description	Part No.	Prov'd	Due

***Comments***

Prepared by \_\_\_\_\_  
Date \_\_\_\_\_

01668-5  
SERVICES OF MANUFACTURER'S REPRESENTATIVES

UNDERWOOD ENGINEERS  
EQUIPMENT START UP LOG

*EQUIPMENT CERTIFICATION*

Owner: \_\_\_\_\_ Date: \_\_\_\_\_

Project: \_\_\_\_\_

Contractor: \_\_\_\_\_

Equipment Manufacturer: \_\_\_\_\_

Equipment: \_\_\_\_\_

As an authorized representative of the Equipment Manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of the construction contract between the Contractor and the Owner. The undersigned further certifies that the equipment has been installed in accordance with the Manufacturer's written instructions, that it is ready for permanent operation and that nothing in the installation will render the Manufacturer's warranty null and void.

\_\_\_\_\_  
(Authorized Representative  
of the Manufacturer)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Witness)

\_\_\_\_\_  
(Date)

01668-6  
SERVICES OF MANUFACTURER'S REPRESENTATIVES

UNDERWOOD ENGINEERS  
EQUIPMENT START UP LOG

*EQUIPMENT TRAINING CERTIFICATION*

Owner: \_\_\_\_\_ Date: \_\_\_\_\_

Project: \_\_\_\_\_

Contractor: \_\_\_\_\_

Equipment Manufacturer: \_\_\_\_\_

Equipment: \_\_\_\_\_

1. I have trained the Owner's personnel in the proper operation and maintenance of the above equipment.

\_\_\_\_\_  
(Authorized Representative  
of the manufacturer)

\_\_\_\_\_  
(Date)

2. The personnel listed below attended the training session.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
(Owner's Representative)

\_\_\_\_\_  
(Date)

3. Witnessed by \_\_\_\_\_  
Underwood Engineers, Inc. \_\_\_\_\_ (Date)

Underwood Engineers, Inc.  
25 Vaughan Mall  
Portsmouth, New Hampshire 03801

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 -- GENERAL

1.1 DESCRIPTION

A. Work Included: Keep accurate Record Documents of all additions, substitutions of material, variations in work, and any other additions or revisions to the Contract.

PART 2 -- PRODUCTS

2.1 DOCUMENTS

A. Maintain at the job site, one copy each of:

1. Contract Drawings.
2. Specifications.
3. Addenda.
4. Reviewed Shop Drawings.
5. Change Orders.
6. Any other modifications to the Contract.
7. Field Test Reports.
8. Inspection certificates
9. Manufacturer's certificates
10. Manufacturer's operation and maintenance manuals

PART 3 -- EXECUTION

3.1 STORAGE AND MAINTENANCE

A. Store Record Documents in approved files and racks apart from documents used for construction.

B. File Record Documents in accordance with Project Filing Format of Uniform Construction Index.

C. Maintain Record Documents in clean, dry, legible condition.

D. Do not use Record Documents for construction purposes.

E. Make Record Documents available at all times for inspection by the Engineer and Owner.

3.2 RECORDING

A. Label each document "PROJECT RECORD" in large printed letters.

B. Keep Record Documents current and do not permanently conceal any work until required information has been recorded.

C. Contract Drawings: Legibly mark to record actual construction (when applicable)

1. Method of locations and recording shall have prior approval of the Engineer.
2. Depths of various elements of foundations in relation to survey datum.
3. Horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
  - a. Include all water, sewer, steam, air, instrumentation and fuel piping systems and all electrical and communications circuits including all direct burial cables.
  - b. Whenever any existing utility line is uncovered in the course of excavation for new utility installation, record the location dimensions of such lines.
4. Location of house service connection points with any utility (water, sewer, electrical, telephone, etc.) and the location of capped or plugged ends of these same house service lines.
  - a. Locations shall be recorded by accurate "swing ties" or other methods approved by the Engineer.
5. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
  - a. Electrical equipment such as conduits, piping, instrumentation located in slabs, walls and ceilings and to include approximate locations and routing.
  - b. Schematic diagram of actual electric conduit or instrument tubing routing between equipment and supply.
6. Field changes of dimension and detail and changes made by Change Order or Field Order.
7. Details not on original Contract Drawings.

D. Specifications and Addenda: Legibly mark up each Section to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by Change Order or Field Order.

### 3.3 SUBMITTALS

- A. At the completion of the project, deliver Record Documents to the Engineer.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
  1. Date, project title and number.
  2. Contractor's name and address.
  3. Title and number of each Record Document with certification that each document is completed and accurate.
  4. Signature of Contractor, or his authorized representative.
- C. Failure to record these locations on the Project Record Drawings shall result in non-approval of the final payment to the Contractor and/or if contract time (as specified in the Contract and/or modified in accordance with the Standard General Conditions of the Construction Contract) has elapsed, this shall be grounds for the assessment of the liquidated damages as specified.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE MANUALS

PART 1 -- GENERAL

**1.1 DESCRIPTION**

A. Work Included:

1. Submit to the Engineer, all Operation and Maintenance Manuals required by the individual Specification Sections.

**1.2 SUBMISSION REQUIREMENTS**

- A. At least 2 months prior to the expected substantial completion date, the Contractor shall submit to the Engineer all manuals in accordance with the requirements specified herein Specification Section 01730, and within individual equipment specification sections.
- B. The Contractor shall furnish the Engineer a minimum of six (6) copies of a complete instruction manual for installation, operation, maintenance, and lubrication of each item specified. The Engineer will retain four (4) copies (for Owner's, Engineer's and Field Representative's files) and return two (2) copies to the Contractor for distribution to subcontractors, suppliers and manufacturers. If the Contractor requires more copies, then the number of copies submitted shall be adjusted accordingly.

**1.3 CONTENTS**

- A. Table of contents
- B. Operating and maintenance information on all systems and items of equipment. The data shall consist of:
  1. Catalogs, brochures and bulletins of parts
  2. Charts and graphs
  3. "Nameplate" data for all equipment including equipment serial and model number
  4. Wiring diagrams
  5. Assembly drawings of location
  6. Schedule of maintenance
  7. Lubrication requirements
  8. Lubrication charts showing manufacturer recommended lubricants for each rotating or reciprocating unit
  9. Operating weight
  10. Name, address and telephone number of subcontractors, manufacturers and suppliers for each piece of equipment.
  11. Shop drawings corrected to as-built conditions
  12. Operation descriptions
  13. Warranties
  14. List of replacement parts

15. Detailed instructions for start-up, normal operation, shutdown procedures, and control techniques
16. Guide to troubleshooting the system
17. Description of controls including sequencing, diagrams, charts of valve tag numbers, etc.
18. Other necessary information for the Engineer to establish a complete maintenance program

C. Materials and Finishes. The data shall consist of:

1. Building products
2. Instructions for care and maintenance
3. Additional requirements

1.4 FORMAT

- A. Provide binders with covers identifying detail title.
- B. Provide tabs for each separate product and system
- C. Provide drawings bound in with text or folded to text size pages.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

END OF SECTION

SECTION 16402  
ELECTRICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Include Conditions of the Contract and applicable parts of Division 1.
- B. Examine all other sections of the Specifications for requirements which affect the work of this Section, whether or not such requirements are particularly mentioned herein.
- C. Coordinate the work of this Section with the related work of other trades, and cooperate with such trades to assure the steady progress of all work of this Contract.
- D. The intent of this project is to require the facility to be completed and fully operational in accordance with the intent of the Contract Documents.

1.2 SCOPE

- A. The work covered by this Specification consists of furnishing all labor, materials, equipment, supplies, devices, electrical apparatus, conversion of the existing Raw Water Pump motor controls from solid state soft starters to new Variable Frequency Drives, wiring modifications for the drive changes involved; modifications to the existing motor control center to accommodate the changes; and the performance of all operations necessary for the installation of electrical changes to accommodate the drive as indicated on the Contract Documents or as required to leave a fully and functionally operating facility..
- B. Without limiting the scope of work, the following is included in this project:
  1. Provision and setting of all VFDs etc. as applicable for three (3) Raw Water Pumps.
  2. Modifications to existing Motor Control Center units as noted on Contract Documents
  3. All wiring modifications for the new VFD's to have controls interface when completed and provide operations sequences the same as with the original controls.
  4. All removals of existing electrical components and wiring discontinued by this project.
  5. Any and all required conduits and conductors, fully installed, to provide all systems in full operational, whether such are shown in detail or not.
  6. Obtain and pay for all required permits, inspections, etc.

1.3 WORK OF OTHER SECTIONS OR OTHER CONTRACTORS

- A. This is not applicable to this project.

## 1.4 SUBMITTALS

### A. Shop Drawings:

1. Submit shop drawings (a minimum of 6 copies) in accordance with the requirements of the General Conditions and specification 01340 in the manner described therein. Shop drawings shall indicate specifications section and paragraph requiring equipment indicated.
  - a. Shop drawings are required on all major pieces of equipment in the following list, but not necessarily limited thereto: variable frequency drives (VFD); contactors/ relays of all types involved; motor control center modifications plans; wire; conduits, etc.

### B. Samples:

1. Submit samples of all materials requested by the Engineer. Samples shall be prepared and submitted in accordance with the requirements of General Conditions, all postage and transportation costs being paid by the Contractor submitting same.

### C. Record Drawings:

1. In accordance with requirements of the General Conditions and Division 1, the Contractor shall furnish and keep on the job at all times one complete set of blue line prints of the electrical work, on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all electrical changes, revisions and additions to the work. Wherever work is installed otherwise than as shown on the Contract Drawings, such changes shall be noted.
2. The Contractor shall indicate on these prints the daily progress by coloring in the various apparatus and associated appurtenances as they are installed.
3. No approval of requisition for payment for work installed will be given unless supported by record prints as required above.
4. At the conclusion of work, prepare record drawings in accordance with the requirements of the General Conditions and Division 1 and deliver them to the Engineer for transmittal to the Owner.

### D. Operating Instructions and Maintenance Manual:

1. The Contractor shall instruct, to the Owner's satisfaction, such persons as the Owner designates in the proper operation and maintenance of systems and their parts.
2. Parties indicated above sign affidavits stating that the above instructions were given by the Contractor.
3. Furnish three (6) copies of operating and maintenance manuals as noted in specification section 01730 and forward same to the Engineer for transmittal to the Owner.

4. The operating instructions shall be specific for each system and shall include copies of posted specific instructions.
5. For maintenance purposes, provide shop drawings, parts lists, specifications and manufacturer's maintenance bulletins for each piece of equipment. Provide name, address and telephone number of the manufacturer's representative and service company, for each piece of equipment so that service or spare parts can be readily obtained.

E. Manufacturer's Data:

1. Within ten days of award of Contract, the Contractor shall submit for Engineer's approval a complete list of manufacturer's names of all materials and equipment proposed for the project.
2. After approval of the above list, the Contractor shall submit for Engineer's approval complete detailed manufacturer's data consisting of bulletins, shop drawings, and parts lists of the materials and equipment to be furnished, as required.
3. Shop drawings and manufacturer's data submitted must bear the Contractor's stamp stating that the shop drawings and data have been checked and meet the plans and specifications before being submitted for Engineer's approval, or they will not be considered and will be returned for resubmission. If the shop drawings and data show proposed variations from the requirements of the plans and specifications because of standard practice or other reason, specific mention shall be made of such variations in the letter of transmittal.
4. The Contractor shall assume the entire cost and responsibility for any changes in the work, which may be occasioned by approval of materials other than those specified.
5. Errors, omissions and coordination of shop drawings shall be the sole responsibility of the Contractor whether or not the shop drawings are approved.
6. In the event that any specified manufacturer's number has been superseded by a new number since the writing of this specification, the new manufacturer's number shall be immediately submitted to the Engineer for approval. It shall be the responsibility of the Contractor to notify the Engineer of any superseded manufacturer's numbers mentioned in these specifications.

## 1.5 QUALITY ASSURANCE

### A. Applicable Standards, Permits and Codes

1. The installation shall comply with all laws applying to electrical installations in effect in Salem, New Hampshire, and with regulations of any other governmental body or agency having jurisdiction with regulations of the National Electrical Code where such regulations do not

conflict with those laws, with the regulations of the electrical utility company involved, with the telephone utility, and with ASHRAE Standard 70, as amended.

2. File all required notices and plans. Obtain and pay for all permits, inspections, licenses, and certificates required for work under this Section.
3. If any portion of the electrical plans or specifications conflict with the laws or ordinances with regard to type of materials, equipment or fixtures to be used, the Contractor shall bring it to the Engineer's attention at least seven days before submitting the bid. Otherwise the cost of all work necessary to make the installation comply with said laws or ordinances shall be paid by the Contractor and shall become a part of this Contract.

#### **1.6 EXAMINATION OF SITE AND CONTRACT DOCUMENTS**

- A. Before submitting prices or beginning work, thoroughly examine the site and Contract Documents.
- B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and Contract Documents prior to executing the Contract would have revealed.

#### **1.7 DRAWINGS**

- A. The Contractor shall refer to the Contract Drawings etc., and the plans and details for a full comprehension of the extent and detail of the work to be performed. These drawings are intended to be supplementary to the specifications, and any work indicated, mentioned or implied in either is to be constructed as specified by both.
- B. All work shown on the Drawings is intended to be approximately correct to the scale of the drawings, but figured dimensions and detailed drawings are diagrammatic and are not intended to show every detail of construction or the exact location of equipment. Where project construction makes it advisable or necessary to change the location of equipment, the Contractor shall perform such work without cost to the Owner on written request of the Engineer. Any doubt as to the intended location of equipment shall be resolved by the Engineer before proceeding with the installation.
- C. The intent is to obtain an electrical installation of all systems, complete in every detail within and about the site, and with all facilities properly interconnected with power and controls. The Contractor shall complete the systems in accordance with the best trade practice and to the satisfaction of the Engineer. Upon completion, the electrical systems and all equipment throughout the project shall operate properly and adequately and function as intended.
- D. In any discrepancy between requirements of any specification Section, between notes on the drawings, between drawings, between details in the specifications, or between drawings and specifications, that which is in the best interest of the Owner shall apply.

1. Testing by Contractor: Provide equipment and personnel for operating test of electrical system.
2. Changes by Contractor: The contract drawings indicate the extent and schematic arrangement of the equipment modifications. If changes from the drawings are deemed necessary by the Contractor, submit details of such changes within 30 days of award of Contract. Make no changes without written authorization of Engineer.

1.8 ELECTRICAL REFERENCE SYMBOLS

- A. Standard symbols have been employed where such will meet the need. These are augmented and modified to illustrate as necessary. The chart on the Contract Drawings is intended to illustrate all symbols and explain the function and installation method of the device represented. When not clear, or where one has been inadvertently omitted, it shall be the responsibility of the Contractor to obtain a ruling on the intent before proceeding with any work.

1.9 TEMPORARY POWER

- A. It is the intent of this project that the Contractor shall utilize the Owner's existing power while making the installations required. IF the Owner's existing power installation is not adequate to accommodate the Contractor's equipment requirements, then the Contractor shall furnish and install temporary service and feeders of proper capacity power required for the project while under construction. The Contractor shall provide all required transformer(s), panels, etc. Sufficient outlets shall be installed at convenient locations so that extension cords of not over 50 feet will reach all areas requiring power.
- B. IF the Owner's power system can accommodate the construction power needs of the Contractor, such power will be paid for by the Owner as part of the normal facility operations. IF, however, the Contractor requires a temporary service to accommodate his equipment during the construction, then he Contractor will pay for the energy consumed while on the temporary power service, and all costs for such power shall be included in the Contractor's Bid.
- C. The Contractor shall furnish his own extension cords and such lamps as may be required for their work, and shall pay for the cost of temporary wiring of construction offices or shanties used by them and any temporary wiring of a special nature for light and power required other than that mentioned above.

1.10 GUARANTEE

- A. Contractor's guarantee for items furnished covers and includes:
  1. Faulty or inadequate design of equipment provided.
  2. Improper installation.
  3. Defective workmanship and materials.
- B. Warranties of Manufacture

1. Not less than one year.
2. As specified.
3. As normally supplied if greater than one year.

**1.11 SEISMIC RESTRAINT FOR ELECTRICAL SYSTEMS AND EQUIPMENT**

The electrical installations shall be provided with seismic restraints for all conduits and equipment in accordance with requirements of the IBC or other applicable building codes. The Contractor shall retain a Professional Engineer duly licensed to practice in New Hampshire to provide and require design in conjunction with this and shall include all associated costs in his bid. Use nationally recognized methods of complying with this requirement and provide submittal drawings of these details to the Project Manager with shop drawing submittals. These are subject to review and acceptance or rejection by the Project Manager. The Contractor shall retain the design Professional Engineer to inspect the installations and provide written certification that installations so conform to design.

**1.12 BID ALLOWANCES**

Items indicated as bid allowances shall be carried at the allowance values stated in the Contract Documents in the preparation of the bid.

The payment to the Contractor for work and/or materials and/or Contractor invoices will be limited to the actual, documented costs incurred under the allowance. If costs exceed allowance values, the Contractor must obtain formal approval as with any change order before exceeding the stated allowance amounts.

At this time no bid allowance items have been identified.

**1.13 BID ALTERNATES**

Refer to Bidding Forms, etc., for Bidding Alternates and provide additive and/or deductive amounts in bids provided in accordance with those alternatives.

At this time no Alternative Bid items have been identified.

**1.14 ALTERATIONS**

The Contractor shall execute all alterations, additions, removals, relocations or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the drawings and specifications.

Remove all existing equipment to be discontinued.

Existing equipment to be discontinued and removed shall remain the property of the Owner and shall be carefully packed and delivered by the Contractor for storage on site by the Owner. If the Owner indicates that any removed materials and/or equipment are not desired for retention by the Owner, the Contractor shall then dispose of such item in a legal and lawful manner.

Any existing work disturbed or damaged by the alterations or new work shall be repaired or replaced to the Owner's satisfaction at no added cost to the Owner.

Renovations in existing areas may not be limited to those noted in Contract Documents. Review the existing building to determine the full scope of removals and/or relocations as required by the Contract prior to bidding.

Any existing wiring discontinued under this project shall be completely removed.

1.15

#### SCEDULING

The Electrical Subcontractor shall schedule his work in accordance with Contract Requirements re any interruption of electrical, or other services and/or the requirements to maintain building areas or spaces available for the Owner's use during construction.

It is required to maintain Owner's operations, so work must be scheduled with the Owner.

It is a requirement of this Contract that the Contactor must complete the installation of the modifications of each Raw Water Pump and have the installation accepted by the Owner prior to starting modifications on another pump.

The building is to be in use by the Owner during construction.

1.16

#### EQUIPMENT/MATERIAL REMOVED

All electrical equipment, etc. removed shall remain the Owner's property, except for any items specifically noted herein. The Bidder is notified herewith that the design includes the reuse of certain components, and possibly other equipment. Damage to items removed and/or indicated for reuse will result in the Bidder being responsible for all costs of acceptable and approved replacements of such damaged items, without added cost to the Owner.

Bidder must field verify scope of removals/demolition of electrical installations.

1.17

#### HAZARDOUS MATERIALS

The Contractor under this specification section shall review all associated Contract Sections and Conditions to determine whether his work will encounter hazardous materials (asbestos, lead based paint, PCB's, etc.) and shall take all steps to insure his employees are properly trained and equipped for any work he must provide where such materials are known to or found to exist within the existing facility.

If hazardous materials are encountered their removal will be by an appropriately qualified firm and the costs of such removals/abatement will not be the responsibility of this Contractor.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

A. All materials, devices, and equipment, unless specifically excerpted, shall be new.

B. Service: Electrical service is existing and 480/277 volt, 3 phase, 4 wire, 60 Hertz.

**2.2 IDENTIFICATION**

- A. All materials shall bear UL labels where such have been established for the particular device.
- B. All devices shall show make, type, serial number (where applicable), voltage, amperage, wattage, motor ratings, and all other pertinent data.
- C. All wire shall have make, type of insulation, size, and voltage rating clearly marked upon it.

**2.3 SLEEVES/JUNCTION BOXES/ANCHORS**

- A. This is not applicable for this project.

**2.4 CONDUITS**

- A. Exterior Installations:
  - 1. This is not applicable for this project
- C. Interior Installations:
  - 1. Conduit shall be installed exposed and shall be rigid aluminum or electrical metallic tubing.
- D. General:
  - 1. Rigid aluminum conduit shall be manufactured by Reynolds, Alcoa, or equivalent.
  - 2. Liquid-tight flexible metallic conduit shall be used to tie in all motors or similar equipment.
  - 3. EMT conduit and/or fittings are approved for use on this project.
  - 4. All terminations of conduits shall have smooth, rounded bushings. All conduit 1" or larger shall have insulation which may be integral with the bushing connector, or an insulated bushing may be added
  - 5. All rigid conduit joints shall be threaded. Do not use any type of clamp fittings.

**2.5 WIRE AND CABLE**

- A. All cable and wire shall comply with the latest requirements and specifications of the NFPA and/or the Insulated Power Cable Engineers Association (IPCEA) and shall be as manufactured by General Cable, General Electric, Anaconda, Phelps Dodge, or approved equal, unless otherwise specified or indicated.
- B. All conductors used in the wiring system shall be soft-drawn copper wire having a conductivity of not less than 98% of that of pure copper, unless otherwise indicated or

specified. Wire No. 10 AWG or smaller may be solid and wire No. 8 AWG and larger shall be stranded.

- C. All wire and cable shall be stamped approximately every two feet to indicate voltage, type, temperature rating, UL listing, manufacturers' name, size, etc.
- D. All cable and wire shall be: 600 volt; installed in approved raceways or conduits; not less than No. 12 AWG (except that No. 14 AWG may be used for control wiring).
- E. Insulation for cable and wire shall be as follows:

All Areas XHHW-2 or THWN-2

F. The following color code shall be used for all conductors. The colors must be fast, fadeless, and capable of withstanding cleaning.

	120/240 Volt	277/480 Volt
Phase A	Black	Brown
Phase B	Red	Yellow
Phase C	-----	Orange
Neutral	White	Gray
Bond	Green	Green

- G. All circuit wires shall be tagged in cabinets, etc., with 1/16" thick tags securely fastened to the conductors with a heavy type of linen wrap at time wires are pulled in and tested. Circuit numbers shall be indicated on the tags. Tags shall not be removed for any reason.
- H. At least 8" loops or ends shall be left for all conductors at any point of termination.
- I. Wires and cables shall be carefully handled during installation.
- J. Conductors shall be continuous from connection point to connection point. No splices shall be made without the formal approval of the Engineer and Owner.
- K. Type NM, NMC, AC, MC or similar cables will NOT be permitted on this project.
- L. All conductors and connections shall be free of grounds, shorts, and opens.

## 2.6 OUTLET BOXES AND PULL BOXES

A. Not applicable to this project.

## 2.7 PULLING CABLES

A. All raceways are to be equipped with conductors. Swab all conduit before cable is drawn into them. Any crushed raceways shall be replaced before drawing in cables.

## 2.8 DISCONNECT SWITCHES:

A. Not applicable for this project.

2.9 OVERCURRENT PROTECTION

A. Overcurrent protection for motors is to be in the drives.

2.10 WIRE CONNECTORS AND DEVICES

A. Wherever only a screw connector is available, install a conductor terminal like T & G Stakon spade or donut and designed for the application and compression set to the conductor.

2.11 MOTORS

A. The existing Raw Water Pump motors are retained and reused for this project.

2.12 UTILITY SERVICES

A. The existing utility services shall not be modified for this project.

2.13 ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM

A. The existing electric service and distribution system are not modified by this project other than the controller changes for the 3 Raw Water Pumps.

2.14 SCADA / PLC CONTROL SYSTEM

A. The Contractor under this section shall field confirm the interface of the existing SCADA/PLC Inputs and Outputs to the existing solid state soft start units and associated contactors that are being removed and shall reconnect these in conjunction with the new VFD's to provide the same control sequence and status/alarms interface. The Contract Drawings indicate the Engineer's opinion of the probable existing interface based on the solid state soft start manufacturer's standard controls. There are no available shop drawing of the Motor Control Center units to confirm the details, so the Contractor must field confirm the present controls interface arrangement. It is not planned to increase data to the SCADA/PLC system from the new VFD or to provide any analog data flow to or from the VFDs at this time. A future project may upgrade the amount of data and modify the controls.

B. The Owner does have copies of loop sheets and of the overall PLC/SCADA panel. They indicate the following I/O for each Raw Water Pump Controller:

1) Inputs to PLC from the Controller

- a) Status (Pump Run)
- b) Overload ( VFD would be VFD Fault/Trip)

2) Outputs from the PLC to the Controller:

- a) Start/Stop
- b) Pump Shutdown

2.15 VARIABLE FREQUENCY DRIVES

A. Variable Frequency Drives:

1. Variable frequency controllers shall be listed by Underwriters Laboratories (UL).

2. Construct the drives with three major sections: a full wave, 3 phase diode rectifier section to convert from alternating current (ac) to direct current (dc), a dc filter section to smooth the dc voltage, and a pulse width modulated 3 phase inverter section to provide a variable voltage, variable frequency output at a constant voltage to frequency ratio. The output frequency range shall be a minimum of 6 to 120 hertz (Hz). The drives shall be provided with passive harmonic filters housed inside the drive enclosure as required. These shall include as a minimum a separate 5% full rated input line reactor or its equivalent designed and incorporated into the manufactured drive equipment. If required due to motor lead lengths, the units shall include a built-in output power filter. The vendor must provide written documentation confirming there is no requirement for an output power filter if no output filter is included.
3. General:
  - a. Pump applications, constant torque.
  - b. Motor type – standard NEMA design B.
  - c. The controller shall not require an isolation transformer, even if motors are located in a damp area.
  - d. All components shall include original manufacturer's identification and part number.
  - e. High power factor input with minimal line distortion, notching or harmonics.
  - f. Basic drive design shall be pulse width modulated with carrier frequency adjustable to 10 KHZ.
  - g. The controller shall comply with Federal Communications Commission requirements under Part 15 Rules for Radio Frequency Interference and IEEE 519 for 5% maximum harmonics. Provide documentation of this plainly stated within the shop drawings submittal or the submittal will be rejected.
  - h. All controllers shall be subjected to a 22-hour burn-in test.
4. Environmental:
  - a. Ambient operating temperature range – 10 to 40° C.
  - b. Humidity: 5 to 95%, noncondensing.
  - c. Altitude: 0 to 3300 feet above sea level.
5. Electrical:
  - a. Input line voltage: 480 volts, 3-phase, 60 Hz, +/- 10% fluctuations.
  - b. Motor nameplate voltage: 460 volts, 3-phase, 60 Hz.
  - c. Output frequency range: 0 to 120 Hz.
  - d. Minimum drive efficiency: 95% at 100% speed.
  - e. Current rating: 110% of connected motor full load ampere (output rated current) continuous at full speed, 150% for one minute.

- f. Power loss ride through: 16 ms.  
g. Input line fuses.  
h. Built in control circuit voltage: 120 V AC, maximum. ( to power any devices needing same)
6. The controller shall include the following protective features with status indicators:
  - a. Overvoltage.
  - b. Undervoltage.
  - c. Overcurrent.
  - d. Ground fault.
  - e. Overtemperature.
  - f. Phase loss/blown fuse.
  - g. Running overload protection.
  - h. Common alarm contact for external user.
  - i. Line circuit breaker.
  - j. Passive harmonic filter installed in line side of the drive and housed within the VFD enclosure.
7. The power circuit design shall be such that the following conditions will not damage the drive:
  - a. Single or three-phase fault from line-to-line or line-to-ground.
  - b. Opening of all three phases during operation by disconnect switch at motor location.
8. Indicator light safety feature shall indicate when DC bus is energized and capacitors are charged.
9. Internal calibration adjustments:
  - a. Minimum speed.
  - b. Maximum speed.
  - c. DC boost.
  - d. Acceleration/deceleration rates.
  - e. Stop mode (ramp or coast).
  - f. Automatic restart after fault trip with lockout after five attempts to restart.
  - g. Anti-windmilling adjustable brake time.
  - h. Adjustable volts/Hertz.
10. Unit mounted operator controls:
  - a. Hand-Off-Auto switch.
  - b. Speed adjust potentiometer.
  - c. Indicating speed meter.
  - d. Power ON light.
  - e. Alarm reset, lights and additional devices as shown on the drawings.
  - f. All indicating lights shall be push-to-test type.
  - g. Intrinsically safe relays.
11. Provision for remote external controls:
  - a. Two wire ON-OFF control.

- b. Speed adjust, analog input (4-20 MADC).
  - c. Remote Forward-Reverse switch input (if shown on the drawings).
12. Provide control interlocks and alarms as shown on the drawings. The drives shall disable the operation of the equipment when any associated connected alarm signal is activated. The drives shall not require a manual reset prior to restart after the alarm or interlock condition has been corrected.
13. Each VFD shall be wired to be able to receive a load shed contact from the automatic transfer switch (ATS) (although this feature is not planned to be utilized on this project). It shall also be wired for a start/stop signal from the PLC system and a stop signal input for motor over-temperature or other conditions presently programmed. Additional interlocks shall be accommodated if identified.

B. Harmonic Requirements:

1. Under normal operation conditions when the 3 new VFD's are operating, the line harmonics introduced into the power system from the VFD controller shall be within the distortion limits as defined in IEEE 519, latest edition.
2. Total harmonic distortion (THD) for both voltage and current shall not exceed 5 percent, when measured at the point of common coupling (PCC).
3. An independent testing company shall perform the harmonic analysis after all systems have been in place and fully operational. The cost of this testing and the provision of the resulting reports shall be included in the Contractor's bid under this specification section.

C. Enclosures. Drives shall be mounted in NEMA 12 enclosures for stand-alone drives located in dry areas. Coat the enclosures with the manufacturer's standard color finish. Main power disconnect switches shall be the existing devices in the existing MCC, reconnected to the new VFDs. Drive assemblies shall have the drive operator and monitor interface unit accessible from the exterior of the enclosure. Assembled units shall be UL listed and labeled.

D. Spare parts: Provide one set of spare fuses for each voltage and each current rating for each VFD provided.

E. Drives required for this project are:

- a. 3 rated for 60 HP, 460 Volt, 3 phase, 60 Hertz Raw Water Pump motors

G. Preferred manufacturer for the variable frequency drives is:

1. Danfoss: Drive to be same type as presently in use at Canobie Lake Pump Station.
2. Allen Bradley
3. Toshiba

4.ABB

5. Alternative VFD manufacturer's must be submitted for Engineer and Owner review no later than 10 calendar days prior to the advertised bid date so an Addendum can be issued to all bidders if an alternate manufacturer is acceptable. Requests received at later dates will not be reviewed.

2.16 NAMEPLATES

Provide nameplates for all items of equipment on all switchgear, motor control centers, panel boards, controllers, selector switches, starters, safety switches, push-button stations, feeder switches and relay and equipment enclosures.

Nameplates shall be black laminated plastic or bakelite, approximately 3/4" x 2-1/2" x 1/16", with four edges neatly beveled. Lettering shall be engraved, white, with a height of approximately 3/16" x 1/4".

Provide two holes in nameplate and secure to equipment with stainless steel screws. If adequate space is not available on item to which nameplate is to be affixed nameplate may be installed adjacent to and as close to the item as possible, and in a position where it is readily visible.

Notations on nameplates shall be exactly the same as corresponding notations that appear on the Drawings. Submit proposed engraving list for approval before obtaining.

2.17 MOTOR CONTROL CENTER

- A. The existing Motor Control Center is a Square D, Model 5, FO 6869615-A-S. Modifications are required to Units J550182, J550183, and J550184, the existing Raw Water Pump starter units with built-in solid state reduced voltage starters and Isolation and Shorting Contactors plus auxiliary control relays. No wiring diagrams for these units are available. It is the Contractor's responsibility to confirm the existing control sequences and to modify the controls to operate the new VFDs in the same operating sequence.
- B. The intended modifications to the present Raw Water Pump Starter units is to maintain the existing unit main breaker, main fuses, and control transformer and associated fuses "as is", and to modify the door of the units to present an appearance similar to the existing Canobie Lake Raw Water Pump VFD installations. That will involve cutting the unit door and possibly modifying the latch and/or hinge installations to properly support the remaining upper section of the door. The door modification shall include provision of a metal strip at the bottom of the cut such that when the door is closed and the modified base with VFD installed is in place, that no wires or other foreign objects can enter the closed enclosure. All metal work shall be made to present a neat appearance and not to leave any sharp corners accessible.
- C. Modifications to the lower section of the starter units shall include the taking of field measurements and fabricating a sheet metal insert that will fit in the area and provide side, top and bottom shielding and which shall have supports to mount the VFD, with mounting to leave clear air circulation spaces for the VFD as recommended by the VFD manufacturer. The sheet metal work shall utilize a

minimum of 16 gage steel, cleaned and painted after fabrication and shall present a neat, clean appearance and shall have no sharp edges or corners. As with the door modifications above, when in place there shall be no openings that will permit wires or other foreign materials to enter the space behind, above, or below the insert.

- D. Necessary conduits and wireways shall be incorporated in the modified assembly to accommodate power and control wiring. The Contractor shall complete all power and control wiring of each unit to leave a completed appearance similar to that of the Canobie Lake Raw Water Pump VFD installations.
- E. All modifications must be made in accordance with the most stringent safety standards.

## 2.18 DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall be responsible for the work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to the site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

# PART 3 - INSTALLATION

## 3.1 GENERAL

- A. The entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner.
- B. The Contractor shall obtain detailed information from the manufacturer of apparatus as to the proper method of installing and connecting same.
- C. Before installing any of the work, the Contractor shall see that it does not interfere with the clearances required.
- D. Work installed by the Contractor which interferes with or modifies the project design shall be changed as directed by the Engineer, and all costs incidental to such changes shall be paid by the Contractor.
- E. In any and all cases of discrepancy in figures, plans or specifications the matter shall be immediately submitted to the Engineer for decision.

## 3.2 SITE VISITS

- A. The Contractor will be required to visit the site as the work progresses and to carefully investigate the structural and finished conditions affecting all details of the work, and shall arrange such work required to meet such conditions.

## 3.3 CUTTING AND PATCHING

- A. This is not applicable for this project.

## 3.4 ALUMINUM CONDUITS

- A. Aluminum conduits may be installed where noted.

## 3.5 CONDUIT SYSTEMS

- B. As applicable, exposed runs of conduit shall have supports not more than 8'-0" apart and shall be installed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes with right angle turns consisting of cast metal fittings or symmetrical bends. Conduit bends and offsets shall be avoided where possible, but where necessary, shall be made with an approved hickey or conduit bending machine. Conduit which has been crushed or deformed in any way shall not be installed. The Contractor shall exercise the necessary precautions to prevent the lodgement of dirt, trash, or plaster in conduits, fittings or boxes during the course of installation. A run of conduit which has become clogged shall be entirely freed of the accumulation or shall be replaced.
- C. Conduits shall be securely fastened to all sheet metal outlets, junction boxes, and pull boxes with galvanized locknuts and bushings, care being taken to establish a firm mechanical and electrical contact between the box and the conduit.
- D. Flexible conduit shall be installed where necessary to overcome vibration at motor connection, and shall be as short as possible between the motor terminal box and the junction box on the branch circuit rigid conduit. All flexible conduit shall be of the liquid-tight type similar to "Sealtite", with proper fittings.
- E. All rigid metallic conduit shall utilize threaded fittings.
- F. Pull boxes, junction boxes and cabinet boxes shall be constructed of code gauge sheet metal ( to match conduit material) of not less than the minimum size recommended by the National Electrical Code. Locations shall be as inconspicuous as possible.

### 3.6 CONDUCTORS

- A. A complete system of conductors shall be installed in the raceway system, except where otherwise noted. Conductors shall be continuous from point to point.

### 3.7 GROUNDING

- A. The conduit system and the neutral conductor of the wiring system shall be grounded. The ground connection between the Electrical system neutral and the conduit system is existing and is not modified under this project.
- B. Ground wires shall be grouped and bonded to panel boxes, not to system neutrals.
- C. Where flexible metallic conduit is used, it shall be suitable for grounding service.
- D. All electrically powered equipment shall be grounded.
- E. Conduit and/or raceway shall not be utilized as the bonding conductor.

### 3.8 EXPLOSION PROOF REQUIREMENTS

- A. If encountered, equipment shall be rated for the classification involved.

### 3.9 PULLING CABLES

- A. Cables shall be installed utilizing pulling equipment designed for the types of wireways or conduits installed. Where lubricating material is required, it shall be a material manufactured for and designated by UL label as suitable for the types

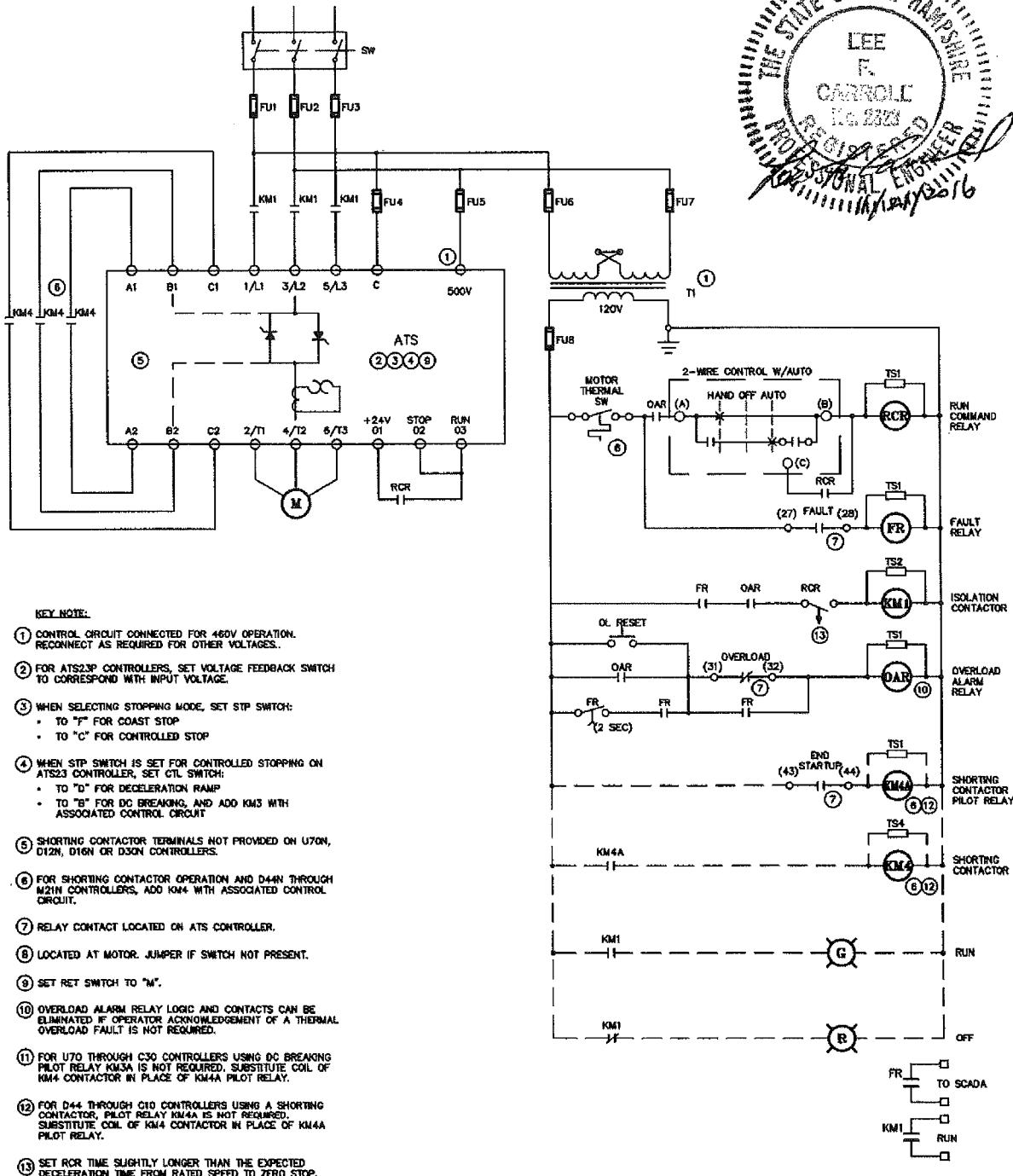
of insulation involved on the conductors. Care shall be taken during cable pulling so as not to cause kinks or sharp bends in the conductors. If insulation on conductors is cut or knicked during pulling, the conductors involved shall be removed and replaced at no added cost to the Owner. During pulling, the maximum strain applied to the conductors shall not exceed 50% of the ultimate strength of the conductors.

**3.10 EXAMINATION AND APPROVAL OF WORK**

- A. No work shall be covered before examination and approval by the Engineer and by all inspectors and authorities having jurisdiction. Replace any imperfect or condemned work with work conforming to requirements and satisfactory to the Engineer and Authority Having Jurisdiction, without extra cost to the Owner. If work is covered before due inspection and approval, the Contractor shall pay all costs of uncovering and reinstating the work.

END OF SECTION

**I. DRAWINGS**



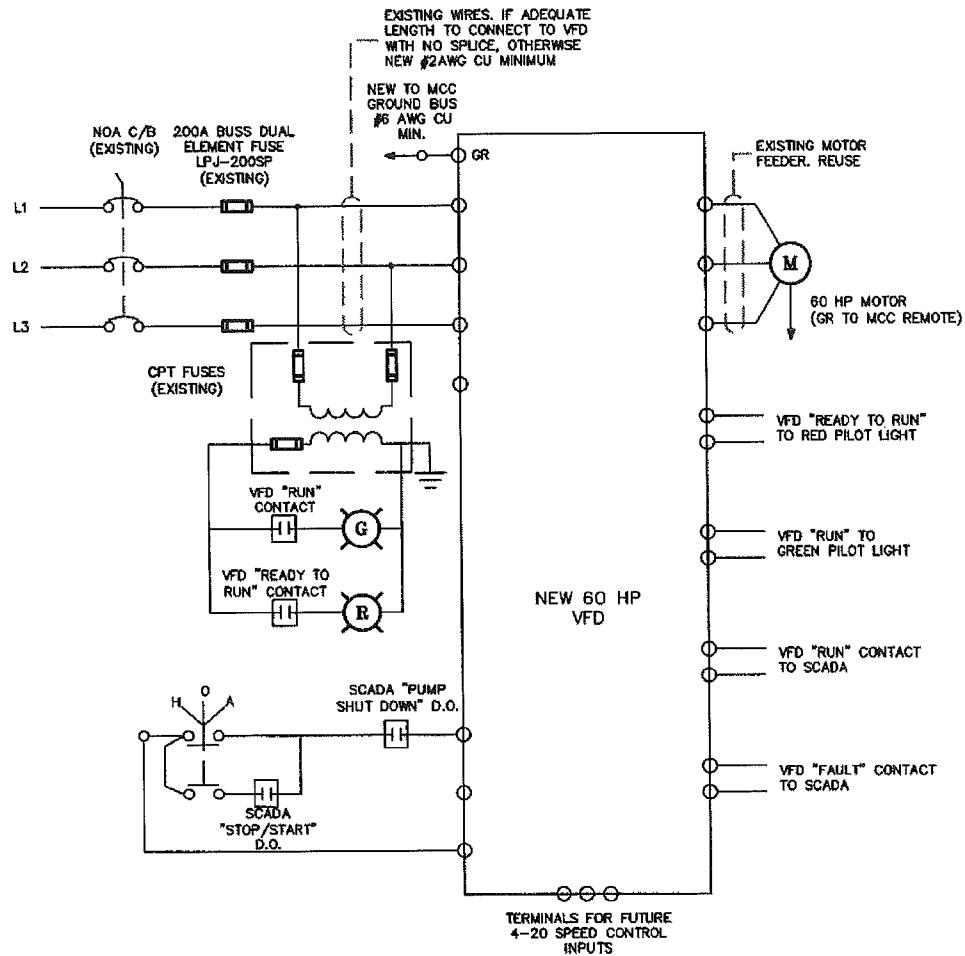
TYPICAL WIRING DIAGRAM FOR EXISTING SOFT START  
TO BE FIELD CONFIRMED BY CONTRACTOR

The logo for Underwood engineers, featuring a stylized 'U' and 'E' graphic followed by the company name in a bold, sans-serif font.

## ARLINGTON POND PUMPING STATION VFD INSTALLATION

SALEM, NH

FIG.  
DWG 1

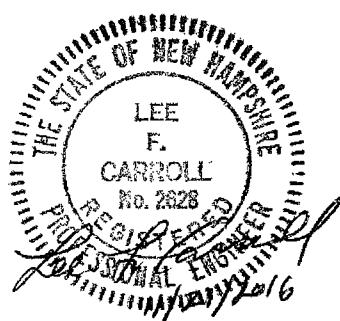


### PROPOSED TYPICAL RAW WATER PUMP VFD CONTROLS

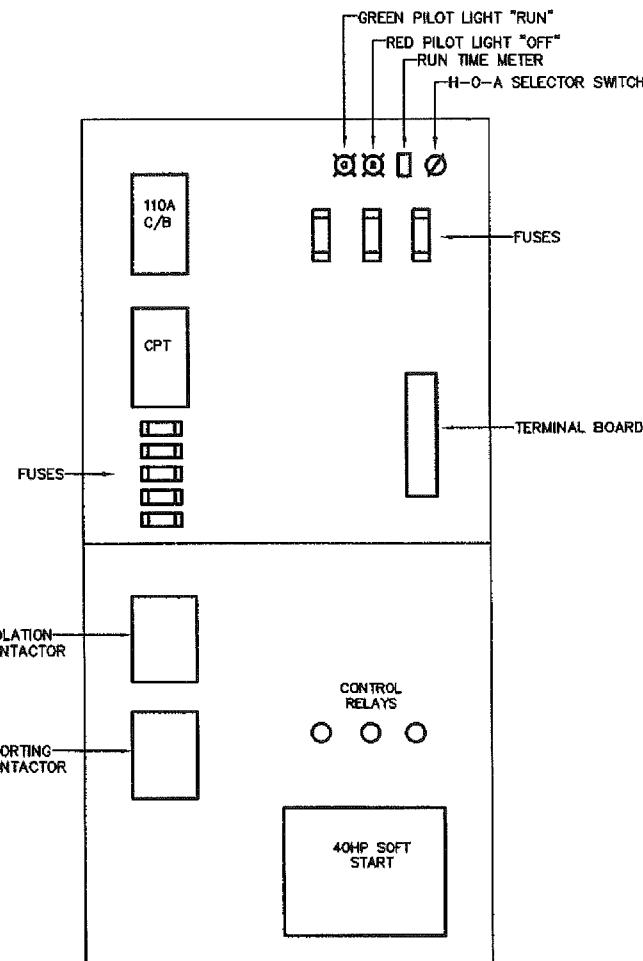
3 UNITS

NOTE:

EXISTING MCC UNIT DRAWINGS NOT AVAILABLE. EXISTING CONTROL LOOP DIAGRAMS INDICATE THE PLC AT THE SCADA/ANNUNCIATOR PANEL HAS A DIGITAL OUTPUT TO THE MCC LABELED "PUMP SHUTDOWN" FOR LOW WATER LEVEL AND ANOTHER UNIDENTIFIED "SHUTDOWN" COMMAND. IT IS INDICATED ABOVE AS A MASTER CONTROL SHUTDOWN. CONTRACTOR TO CONFIRM EXISTING CONTROL USE AND NOTIFY ENGINEER IF UTILIZED OTHERWISE WITH EXISTING SOFT START CONTROLS.



DATE 11/16	<b>UNDERWOOD</b> engineers	ARLINGTON POND PUMPING STATION VFD INSTALLATION	FIG. DWG 2
PROJECT 2119	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733		



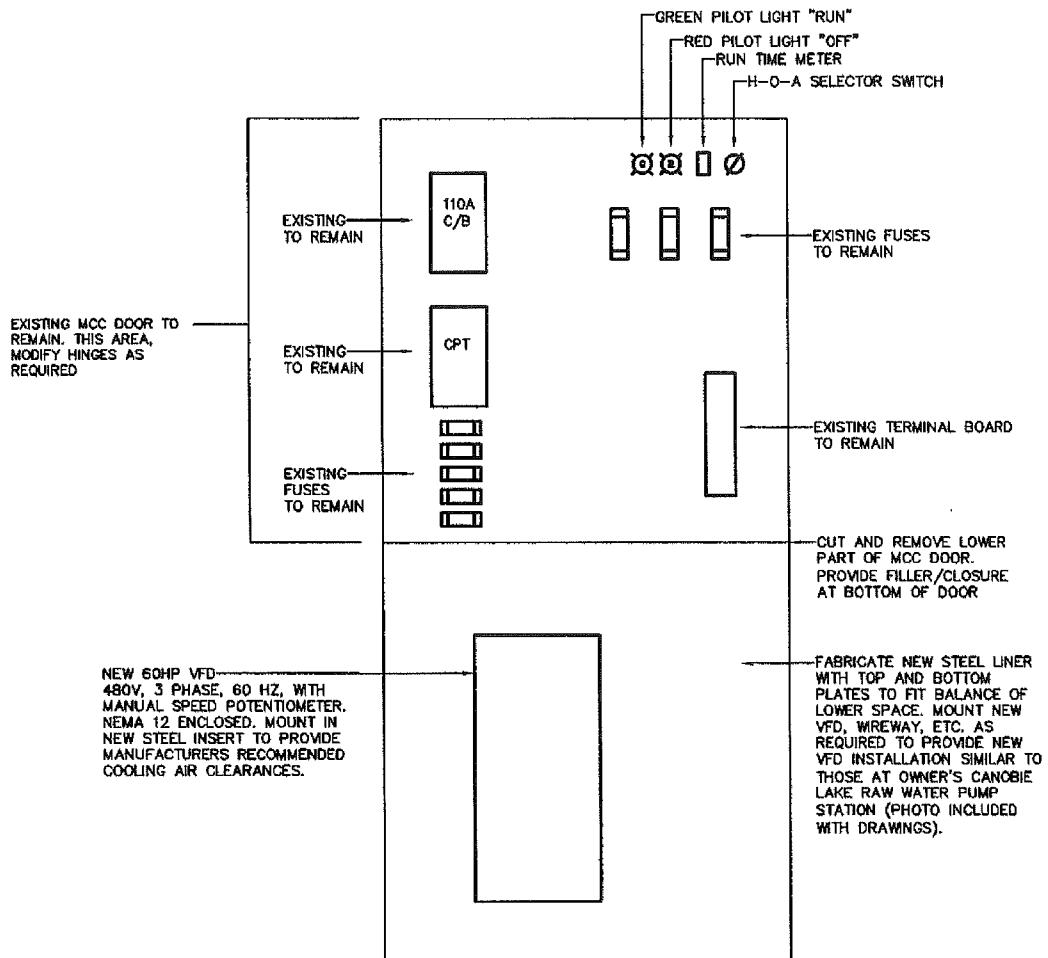
TYPICAL EXISTING RAW WATER PUMP STARTER

3 UNITS

3 SECTIONS OF EXISTING SQUARE D, MODEL 5 MOTOR CONTROL CENTER. 1 EACH FOR PUMP #1, PUMP #2 AND PUMP #3. F.O. 6869615-A-S UNITS #J550182, J550183, J550184.



DATE 11/16	UNDERWOOD engineers	ARLINGTON POND PUMPING STATION VFD INSTALLATION SALEM, NH	FIG. DWG 3
PROJECT 2119	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733		



## TYPICAL MODIFIED RAW WATER PUMP STARTER

3 UNITS

REMOVE EXISTING ISOLATION CONTACTOR, STARTING CONTACTOR, SOFT START, CONTROL RELAYS AND MODIFY CONTROL WIRING TO ACCOMMODATE NEW VFD. MAINTAINING CONTROLS AND ALARMS AS EXISTING.

DATE 11/16	 <b>UNDERWOOD</b> engineers	ARLINGTON POND PUMPING STATION VFD INSTALLATION	FIG. DWG 4
PROJECT 2119	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733	SALEM, NH	



FIGURE 1 CANOBIE LAKE RAW WATER PUMP VFD (EXAMPLE)

DATE 11/16	 <b>UNDERWOOD</b> engineers	ARLINGTON POND PUMPING STATION VFD INSTALLATION	FIG. DWG 5
PROJECT 2119	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733	SALEM, NH	