REGAN YOUNG ENGLAND BUTERA
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ADDENDUM - 01

DATE: .....Friday, 05 November 2021
FROM:.....Angelo P. Butera, AIA
VIA: ..... Facsimile

SUBJECT:
RYEB Project #5642F
Gloucester City BOE
Cold Springs School
PARTIAL HVAC REPLACEMENT
NJDOE SP# 1770-160-22-1000

This addendum is issued to clarify, correct or supplement the Documents as originally issued and will become a part of the Contract. Receipt thereof shall be acknowledged by Bidders in space provided in the Form of Bid. Failure to acknowledge this Addendum on the official Form of Bid may be cause for rejection of Bid.

1.01. Change: The Bid date has been extended from 30 Nov to 11:00 AM Thu, 02 Dec 21.

1.02. Clarification: Section 002000 - Form of Bid, Bidder shall correlate all required documents in the order listed on the Form of Bid & place an "X" in the box next to each item provided. Failure to provide all required documents and required number of copies may be cause for disqualification and rejection of bid.

1.03. Replace: Section 002000 - Form of Bid as found in the Project Manual w/ the attached REVISED Section 002000 - Form of Bid consisting of seven (7) pages.

1.04. Add: Section 012971 - Certification of Non-Debarment for Federal Government Contracts consisting of five (5) pages to the Project Manual.

1.05. Replace Section 235000 - HVAC Water Treatment as found in the Project Manual w/ the attached 235000 - HVAC Water Treatment consisting of seventeen (17) pages.

1.06. Clarification: The exist'g loops do not contain glycol.

1.07. Replace: HVAC dwgs HD1.1, HD1.4, H1.1, H1.4, H2.1, H3.1 and H3.2 w/ the attached seven (7) pages dated 05 Nov 21.

1.08. Replace: Electrical dwgs E1.1, E1.2, E1.3 and E1.4 w/ the attached seven (4) pages dated 05 Nov 21.

1.09. The list of current plan holders and addenda can be found at www.ryebread.com under the "Bidding" tab.

Including this page, Addendum 01 consists of (41) page(s).

END OF ADDENDUM 01

SECTION 002000 - FORM OF BID (REVISED)

TO:
Terri Weeks, Business Administrator/Board Secretary
GLOUCESTER CITY BOARD OF EDUCATION
1300 Market Street
Gloucester City, New Jersey 08030

FROM:

_____ (NAME)

_____ (ADDRESS)

_____ (CITY, STATE, ZIP)

_____ (PHONE/FAX NUMBER)

_____ (EMAIL ADDRESS)

Operating as an individual, a partnership, corporation under the laws of the State of New Jersey

_____
(Input words that apply)

BID FOR: RYEBREAD PROJECT NO. 5642F

FAN COIL, AIR HANDLER & BOILER REPLACEMENTS
Cold Springs School
1194 Market Street
Gloucester City, New Jersey 08030

This Bid is based on Specifications and Drawings dated 24 September 2021 and prepared by:

ARCHITECTURAL, MECHANICAL & ELECTRICAL
REGAN YOUNG ENGLAND BUTERA, PC
456 High Street
Mt. Holly, New Jersey 08060

BASE BID - REPLACEMENT OF AIR HANDLER UNITS AHU-01, AHU-02 & AHU-03 - Provide:

1. Removable louver;
2. Pre-demolition airflow survey;
3. Internal chemical cleanout of the chilled water, condenser water and heating hot water systems, video scoping of the piping and leak reapair;

4. Demolition, general construction, air handling equipment, sheetmetal, piping, insulation, vibrations isolators, controls, electrical, appurtenances and testing and balancing; and
5. New chemical treatment system as indicated in the Project Documents.

Pursuant to and in compliance with your request for Bids for the above named project and contract, and having examined the site where the work is to be located, and having become familiar with local conditions as they may, in any way, affect the cost and/or execution of the work, and having carefully examined the specifications and drawings named above, the Undersigned Bidder hereby agrees to provide all plant, labor, materials, supplies equipment, transportation and other facilities necessary and proper for, or incidental to, or required for complete and satisfactory execution of work. For a one-time lump sum bid, which shall include the allowance(s) and unit price total(s) listed below:

_____($_____)

ALLOWANCES below, which include labor, materials, taxes, insurance, overhead, profit and other costs in connection therewith, shall be included in the Base-Bid proposal for the quantities listed. Allowances listed shall include all incidental items required to render the allowance fully complete and operational whether specifically referenced or not. Any unused allowances shall be deducted from the contract value at the stated amount.

Contingency Allowance - 01: Include in the Base-Bid a contingency allowance amount of $200,000 for additional work as directed by the Architect and approved by the Owner.

ALTERNATE BIDS below to be executed by the Undersigned Bidder in accordance with the Specifications and Drawings for the addition (ADD) to the Base Bid as follows.

All costs listed for each alternate shall include costs of related coordination, revision, or adjustment.

All Prime Bidders shall complete the schedule for each Alternate Bid. If the space is left blank, it will be construed to mean there is no cost impact of that Alternate. Prime Bidders shall be required to bid on all alternates listed below.

ADD ALTERNATES

ALTERNATE - 01 - REPLACEMENT OF AIR HANDLER UNITS AHU-05, AHU-06 & AHU-07 - Remove and replace existing air handling units and four (4) fan coil units serving the Kitchen, Office and Teacher's Lounge and the associated pre-demolition airflow survey, demolition, general construction, air handling equipment, sheetmetal, piping, insulation, vibrations isolators, controls, electrical, appurtenances and testing and balancing. as indicated in the Project Documents for a lump sum total of:

_____($_____)

ALTERNATE - 02 - REPLACEMENT OF BOILERS-01 & 02 - Remove and replace boilers and heating hot water circulators, and associated, circulators, piping and insulation as indicated in the Project Documents for a lump sum total of:

_____($_____)

ALTERNATE - 03 - REPLACEMENT OF FAN COIL UNITS - Remove and replace four (4) fan coil units serving first floor classrooms and the associated pre-demolition airflow survey, demolition, general construction, air handling equipment, sheetmetal, piping, insulation, vibrations isolators, controls, electrical, appurtenances and testing and balancing as indicated in the Project Documents for a lump sum total of:

_____($_____)

ALTERNATE - 04 - REPLACEMENT OF FAN COIL UNITS - Remove and replace nine (9) fan coil units serving second floor Classrooms, Faculty Prep Room and Offices and the associated pre-demolition airflow survey, demolition, general construction, air handling equipment, sheetmetal, piping, insulation, vibrations isolators, controls, electrical, appurtenances and testing and balancing as indicated in the Project Documents for a lump sum total of:

_____($_____)

ALTERNATE - 05 - REPLACEMENT OF FAN COIL UNITS - Remove and replace five (5) fan coil units serving Locker Rooms, Gym Offices and the Main Vestibule and the associated pre-demolition airflow survey, demolition, general construction, air handling equipment, sheetmetal, piping, insulation, vibrations isolators, controls, electrical, appurtenances and testing and balancing indicated in the Project Documents for a lump sum total of:

_____($_____)

NO MATERIAL ADVERSE CHANGE IN QUALIFICATION: The undersigned bidder hereby certifies that there has been no material adverse change in the qualification information last submitted to the New Jersey Department of the Treasury pursuant to NJSA 18A: 18A-28.

HOLD HARMLESS AGREEMENT: By submitting and executing a bid the Bidder, if corporation, also responsible individual of corporation signing individually agrees to indemnify and hold harmless the Owner, Architect, and their agents and employees, from all and against all claims, damages, losses, and expenses, including reasonable attorney's fees in case it shall be necessary to file an action, arising out of bodily injury, illness or death, or for property damage, by the Contractor negligent, reckless or intentional acts or omission or that of a Subcontractor, or that of anyone employed by them or for whose acts contractor or subcontractor may be liable. This indemnification and agreement shall apply in all instances whether Owner, Architect is made a

party to the action by third-party in-pleading or is made party to a collateral action arising, in whole or in part, from any of the issues emanating from the original cause of action or claim.

TIME OF COMPLETION: The Undersigned Bidder agrees to complete the work as indicated in the Advertisement, (Bidder is referred to AIA GENERAL CONDITIONS, Par. 8.1).

ATTACHED TO THIS BID is **ONE** original copy of all the following documents (Fill in all blank spaces, alternate bids and unit prices. Failure to comply may be cause for rejection of bid.).

DOCUMENTS ACCOMPANYING BID

Failure to provide all required documents and required number of copies may be cause for disqualification and rejection of bid.

Bidder shall correlate the following required documents in the order listed below & place an "X" in the box next to each item provided.

In bid envelope:

1. ☐ Form of Bid.

2. ☐ DPMC Notice of Classification.

3. ☐ Total Amount of Uncompleted Contracts Affidavit (DPMC Form 701).

4. ☐ Business Registration of Public Contractors from the New Jersey Division of Taxation.

5. ☐ Bid Security in the form of a Bid Bond, certified check or cashier's check in the amount of 10% of the Base Bid, or $500.00 whichever is more, but in any event not more than $20,000.00. The Bid Security must be in a form consistent with the statutory requirements of the State of New Jersey.

   The Bid Security must be accompanied by a valid power of attorney authorizing the signer to bind the surety company.

6. ☐ Consent of Surety: Section 002800, or similar.

   Consents Security must be accompanied by a valid power of attorney authorizing the signer to bind the surety company.

7. ☐ Surety Company & Agency Information: Section 002801.

8. ☐ Affirmative Action Evidence: Section 002850.

9. ☐ Ownership Disclosure Starement: Section 002900 or similar if Bidder is a partnership or a corporation.

10. ☐ Non-Collusion Affidavit: Section 002950.

11. ☐ No Material Change of Circumstances: Section 002960.

12. ☐ Form of certification stating that bidder is not currently debarred, suspended or disqualified under N.J.A.C. section 19:32-1.8. Section 002970

13. ☐ Certification Of Non-Debarment for Federal Government Contracts: Section 002971.

14. ☐ Disclosure of Investment Activities in Iran. Section 002980.

15. ☐ Contractor's Sworn Contractor Certification. Section 004580; and

Credentials A, B & C listed below must be stapled to this certification.

☐ A. "Contractor Registration Certificate" from the New Jersey Department of Labor in accordance with the "Public Works Contractor Registration Act."

☐ B. "Certificate of Authority" issued by the Department of Treasury.

☐ C. Contractor or trade license. (Not applicable for General Contractor).

16. ☐ Political Contributions Disclosure Form: Section 004590.

17. ☐ Byrd Anti-Lobbying Amendment Certification: Section 004591.

18. ☐ Prevailing Wages Certification Form: Section 004595.

19. ☐ List of Prime Subcontractors: Section 005290.

For each Prime subcontractor listed, attached a copy of:

☐ A. DPMC Notice of Classification.

☐ B. Total Amount of Uncompleted Contracts Affidavit (DPMC Form 701).

☐ C. Business Registration of Public Contractors from the New Jersey Division of Taxation.

☐ D. No Material Change of Circumstances: Section 002960.

☐ E. Contractor's Sworn Contractor Certification. Section 004580; and

Credentials 1, 2 & 3 listed below must be stapled to this certification.

☐ 1. "Contractor Registration Certificate" from the New Jersey Department of Labor in accordance with the "Public Works Contractor Registration Act."

☐ 2. "Certificate of Authority" issued by the Department of Treasury.

☐ 3. Contractor or trade license. (Not applicable for General Contractor or Structural Steel).

☐ F. Evidence of Prime Subcontractor's performance security. (Required only if Bidders Bid Bond does not cover Bidders Prime subcontractors.) (Attach to Prime Bidder's Bid Bond).

20. ☐ **ONE (1)** original copy of all required documents.

IF AWARDED CONTRACT, the Undersigned Bidder agrees to execute the AGREEMENT and to furnish the required Performance and Payment Bonds and evidence of required insurance as soon as practicable after Notice of Acceptance of bid or in any event not later than 10 calendar days after receipt of such notification.

If the Undersigned Bidder fails to execute AGREEMENT and furnish required bond and evidence of insurance, the Bid Security accompanying this Bid will be forfeited to the Owner as liquidated damages for the delay and loss caused to the Owner by reason of such failure by the Undersigned Bidder.

THE UNDERSIGNED BIDDER HAS COMPLIED with all requirements concerning licensing and with all Local, State and Federal laws. No legal requirement has been violated in making this Bid nor will be violated in the execution of the Work if this Bid is accepted.

In addition, the undersigned hereby certifies that there has been no material adverse change in the qualification information last submitted to the New Jersey Department of Treasury pursuant to N.J.S.A. 18A:18A-28.

IT IS UNDERSTOOD that the right is reserved by the Owner to reject any and all bids and to waive all informalities in connection therewith as may be permitted by law.

AWARD OF CONTRACT(S)

A Single Prime Contract shall be awarded for all of the work and materials required to complete the project, unless all bids are rejected, to the lowest responsible bidder based on the total amount of the Base Bid and Alternates (if any), accepted by the Owner.
IT IS AGREED THAT THIS BID MAY NOT BE WITHDRAWN for a period of 60 days after the actual date of receipt of bids.

RECEIPT OF THE FOLLOWING ADDENDA is acknowledged by the Undersigned bidder (List by number and date):

ADDENDUM NO.	DATED	ADDENDUM NO.	DATED

Respectfully submitted this _____ day of _____ 20_____.

_____(Name of Firm)

By: _____L.S.
Print

*(SEAL IF BIDDER
IS A CORPORATION)

_____
Signature

_____
Title

_____
Federal Employment Identification Number (FEIN)

END OF SECTION 002000

SECTION 002971 - CERTIFICATION OF NON-DEBARMENT FOR FEDERAL GOVERNMENT CONTRACTS

N.J.S.A. 52:32-44.1 (P.L. 2019, c.406)

This certification shall be completed, certified to, and submitted to the contracting unit prior to contract award, except for emergency contracts where submission is required prior to payment.

PART I: VENDOR INFORMATION	
Individual or Organization Name	
Address of Individual or Organization	
DUNS Code (if applicable)	
CAGE Code (if applicable)	
Check the box that represents the type of business organization:	

☐Sole Proprietorship (skip Parts III and IV) ☐Non-Profit Corporation (skip Parts III and IV)

☐For-Profit Corporation (any type) ☐Limited Liability Company (LLC) ☐Partnership

☐Limited Partnership ☐Limited Liability Partnership (LLP)

☐Other (be specific): _____

PART II – CERTIFICATION OF NON-DEBARMENT: Individual or Organization			
I hereby certify that the **individual or organization listed above in Part I** is not debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the ***Board of Education*** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the ***Board of Education*** to notify the ***Board of Education*** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the ***Board of Education***, permitting the ***Board of Education*** to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

PART III – CERTIFICATION OF NON-DEBARMENT: Individual or Entity Owning Greater than 50 Percent of Organization	
Section A (Check the Box that applies)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of its voting stock, or of the partner in the partnership who owns more than 50 percent interest therein, or of the member of the limited liability company owning more than 50 percent interest therein, as the case may be.
Name of Individual or Organization	
Home Address (for Individual) or Business Address	
OR	
☐	No one stockholder in the corporation owns more than 50 percent of its voting stock, or no partner in the partnership owns more than 50 percent interest therein, or no member in the limited liability company owns more than 50 percent interest therein, as the case may be.
Section B (Skip if no Business entity is listed in Section A above)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of the voting stock of the organization's parent entity, or of the partner in the partnership who owns more than 50 percent interest in the organization's parent entity, or of the member of the limited liability company owning more than 50 percent interest in organization's parent entity, as the case may be.
Stockholder/Partner/Member Owning Greater Than 50 Percent of Parent Entity	
Home Address (for Individual) or Business Address	
OR	

☐	No one stockholder in the parent entity corporation owns more than 50 percent of its voting stock, no partner in the parent entity partnership owns more than 50 percent interest therein, or no member in the parent entity limited liability company owns more than 50 percent interest therein, as the case may be.

Section C – Part III Certification

I hereby certify that no individual or organization that is debarred by the federal government from contracting with a federal agency owns greater than 50 percent of the **Organization listed above in Part I** or, if applicable, owns greater than 50 percent of a parent entity of the **Organization listed above in Part I**. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the ***Board of Education*** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award the ***Board of Education*** to notify the ***Board of Education*** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the ***Board of Education***, permitting the ***Board of Education*** to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

Part IV – CERTIFICATION OF NON-DEBARMENT: Contractor – Controlled Entities	
Section A	
☐	Below is the name and address of the corporation(s) in which the **Organization listed in Part I** owns more than 50 percent of voting stock, or of the partnership(s) in which the **Organization listed in Part I** owns more than 50 percent interest therein, or of the limited liability company or companies in which the **Organization listed above in Part I** owns more than 50 percent interest therein, as the case may be.
Name of Business Entity	**Business Address**
Add additional sheets if necessary	
OR	
☐	The **Organization listed above in Part I** does not own greater than 50 percent of the voting stock in any corporation and does not own greater than 50 percent interest in any partnership or any limited liability company.

Section B (skip if no business entities are listed in Section A of Part IV)	
☐	Below are the names and addresses of any entities in which an entity listed in Part III A owns greater than 50 percent of the voting stock (corporation) or owns greater than 50 percent interest (partnership or limited liability company).
Name of Business Entity Controlled by Entity Listed in Section A of Part IV	**Business Address**
Add additional Sheets if necessary	
OR	
☐	No entity listed in Part III A owns greater than 50 percent of the voting stock in any corporation or owns greater than 50 percent interest in any partnership or limited liability company.

Section C – Part IV Certification			
I hereby certify that the **Organization listed above in Part I** does not own greater than 50 percent of any entity that that is debarred by the federal government from contracting with a federal agency and, if applicable, does not own greater than 50 percent of any entity that in turns owns greater than 50 percent of any entity debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the ***Board of Education*** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the ***Board of Education*** to notify the ***Board of Education*** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the ***Board of Education***, permitting the ***Board of Education*** to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

END OF SECTION 002971

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Biocide chemical-feed equipment and controls.
3. Chemical treatment test equipment.
4. HVAC water-treatment chemicals.
5. HVAC pipe cleaning chemicals.
6. Internal neutral pH based chemical cleaning of all existing heating hot water, chilled water and condenser water systems prior to execution of work.
7. Internal cleaning, flushing and charging of new and renovated heating hot water, chilled water and condenser water systems prior to testing and balancing and owner acceptance.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Renovated closed hydronic systems, including hot-water heating loop, shall have new treatment program to maintain the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

D. Existing closed hydronic systems, including the chilled water loop, shall remain under the existing treatment program that is administered for owner by Limbach, Inc.

E. Existing open hydronic systems, including condenser water loop, shall have new treatment program to maintain the following water qualities:

1. pH: Maintain a value within 8.0 to 9.1.
2. "P" Alkalinity: Maintain a maximum value of 100 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. Conductivity: Maintain a maximum value of 1800 µS/cm “micro siemen per cm”.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm
8. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

9. Polymer Testable: Maintain a minimum value within 10 to 40.

1.5 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.

5. Conductivity controllers.
6. Biocide feeder timers.
7. Chemical solution tanks.
8. Injection pumps.
9. Chemical cleaning and treatment agents.
10. Chemical test equipment.
11. Chemical material safety data sheets.

B. Shop Drawings: Chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: In order to maintain continuity of all water treatment services at the site, Limbach, Inc. shall be considered as the sole source-treatment service provider, capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

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

1.9 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for

heating, hot-water piping, condenser-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance and supervision for contractor during chemical cleanout process.
3. Startup assistance and supervision for contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
4. Periodic field service and consultation.
5. Customer report charts and log sheets.
6. Laboratory technical analysis.
7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.
8. All necessary cleaning and treatment chemicals.

PART 2 - PRODUCTS

2.1 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, removable bag filter, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal..
2. Minimum Working Pressure: 125 psig.

2.2 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C708, multi-jet type, totalization meter, with 100-gallon pulse type contact closure for interface with building management system (BMS). Provide necessary wiring, programming and graphics for complete installation at the BMS.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig.
4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons.
6. End Connections: Threaded.
7. Contacting head water meter.

B. Cooling Tower Controller:

1. The cooling tower control system shall be a capable of measuring system conductivity and temperature. The conductivity sensors shall be either a contacting style or an electrodeless style. An optional second sensor shall be a choice of conductivity, pH, ORP, PTSA, free chlorine, total chlorine, chlorine dioxide, ozone, Peracetic acid, hydrogen

peroxide, or one or two 4-20 mA inputs. Six digital inputs are available for sensors that shall include a flow switch, contacting water meter, paddlewheel flowmeter or other dry contact devices. Outputs shall include six mechanical relays, and two optional 4-20 mA outputs. Digital communications shall be via Ethernet. The controller shall be accessible via the Internet for configuring, data logging, and control of relay outputs. The USB port shall provide the ability to upgrade the software in the controller to the latest version, save all the set points from a controller onto a USB flash disk and import settings into another W600 controller, and download datalog files to a USB flash disk. On screen graphing of one analog signal and one digital signal/relay state shall be available on the touchscreen display.

2. Control Module:

   a. Enclosure: Polycarbonate Resin, NEMA 4X, lockable hinged door.

   b. Power: 100-240 VAC, 50 or 60 Hz, 7A max

   c. Inputs:

Sensor Input Signals (0, 1 or 2 depending on model code)

Contacting Conductivity	0.01, 0.1, 1.0, or 10.0 cell constant OR
Electrodeless Conductivity	OR
Disinfection	OR
Amplified pH, ORP, or Ion Selective Electrode	Requires a preamplified signal. Walchem WEL or WDS series recommended. ±5VDC power available for external preamps.

Each sensor input card contains a temperature input

Temperature	100 or 1000 ohm RTD, 10K or 100K Thermistor

Analog (4-20 mA) Sensor Input (0, 1, 2 or 4 depending on model code)

	2-wire loop powered or self-powered transmitters supported 3 or 4 –wire transmitters supported Each dual sensor input board has two channels Channel 1, 130 ohm input resistance Channel 2, 280 ohm input resistance The combination input board has one channel Channel 1, 280 ohm input resistance
Available Power	One independent isolated 24 VDC ± 15% supplies per channel 1.5 W maximum for each channel 2W (83 mA at 24 VDC) total power consumption for all channels (four total channels if two dual input boards are installed; 2W is equivalent to 2 Little Dipper sensors)

Digital Input Signals (6):

State-Type Digital Inputs	Electrical: Optically isolated and providing an electrically isolated 9V power with a nominal 2.3mA current when the digital input switch is closed Typical response time: < 2 seconds

	Devices supported: Any isolated dry contact (i.e. relay, reed switch) Types: Interlock
Low Speed Counter-Type Digital Inputs	Electrical: Optically isolated and providing an electrically isolated 9V power with a nominal 2.3mA current when the digital input switch is closed 0-10 Hz, 50 msec minimum width Devices supported: Any device with isolated open drain, open collector, transistor or reed switch Types: Contacting Flowmeter
High Speed Counter-Type Digital Inputs	Electrical: Optically isolated and providing an electrically isolated 9V power with a nominal 2.3mA current when the digital input switch is closed, 0-500 Hz, 1.00 msec minimum width Devices supported: Any device with isolated open drain, open collector, transistor or reed switch Types: Paddlewheel Flowmeter

d. Outputs:

Powered mechanical relays (0 or 6 depending on model code):

Pre-powered on circuit board switching line voltage
6 A (resistive), 1/8 HP (93 W)
All six relays are fused together as one group, total current for this group must not exceed 6A

Dry contact mechanical relays (0, 2 or 4 depending on model code):

6 A (resistive), 1/8 HP (93 W)
Dry contact relays are not fuse protected

Pulse Outputs (0, 2 or4 depending on model code):

	Opto-isolated, Solid State Relay 200mA, 40 VDC Max. VLOWMAX = 0.05V @ 18 mA
4 - 20 mA (0 or 2)	Internally powered Fully isolated 600 Ohm max resistive load Resolution 0.0015% of span Accuracy ± 0.5% of reading
Ethernet	10/100 802.3-2005 Auto MDIX support Auto Negotiation

e. Software features:

Six relay outputs may be set to a variety of control modes:

On/Off set point control

Time Proportional control

Pulse Proportional Control (requires pulse output relay option)

PID Control (when purchased with 4-20mA or pulse solid state opto outputs)

Dual set point

Bleed or Feed based on a Water Contactor or Paddlewheel flow meter input

Feed and Bleed

Feed and Bleed with Lockout

Feed as a percent of Bleed

Feed as a percent of elapsed time

Daily, Weekly, 2-week or 4-week Biocide timers with pre-bleed and post-add lockout of bleed

Intermittent sampling for boilers with proportional blowdown, controlling on a trapped sample

Spike Set Point

Always on unless interlocked

Probe wash

Diagnostic Alarm

Manual activation of the relays shall be easily accomplished via the keypad, or a PC.

A maximum output on-time shall be available on the control relays to prevent run-away control.

Any relay may be reconfigured to any one of a number of control algorithms, responding to the signal from any input desired.

The optional analog inputs shall be configurable for fluorometers, level sensors, corrosion monitors, or any other type of transmitter, providing appropriate units of measure and scaling.

The digital inputs shall be configurable for level switches, flowmeters, flow switches, or generic interlock operation.

Two Virtual Inputs shall be available that are calculated from two real inputs (cycles of concentration, % rejection, etc.) or one input and a constant.

The optional analog outputs shall be configurable for retransmitting a sensor signal or for proportional, flow proportional or PID control.

The controller set points may be entered by downloading them from one controller and uploading them into another controller.

Access to the controller shall be possible using Ethernet, locally or via the Internet, or via the local touchscreen display, simultaneously if desired.

No proprietary software shall be required on the user's computer to communicate with the controller, or to view or change set points.

3. Sensors:

   a. Contacting Conductivity

      1. Operating principle: The conductivity sensor shall be driven with a low voltage AC signal, and the return signal voltage will vary with the conductivity of the intervening solution. The temperature sensor within this sensor compensates for the effect of temperature on the conductivity signal.
      2. Materials of construction: Glass-Filled Polypropylene, Graphite or 316SS, FKM
      3. Process connections: ¾" NPTF
      4. Temperature range: 32-158 F, 0-70 C
      5. Pressure range: 0-150 psi
      6. Other materials and higher pressure sensors shall be made available.

   b. Electrodeless Conductivity

      1. Operating principle: The conductivity sensor shall be driven with a low voltage AC signal, which induces a current in the surrounding liquid which varies in intensity with the conductivity of the liquid, which is picked up by the sensor and transmitted to the controller. The temperature sensor within this sensor compensates for the effect of temperature on the conductivity signal.
      2. Materials of construction: CPVC, FKM
      3. Process connections: ¾" NPTF
      4. Temperature range: 32-158 F, 0-70 C
      5. Pressure range: 0-150 psi

   c. pH

      1. Operating principle: The pH sensor shall consist of a replaceable cartridge containing a pH sensitive glass and silver/silver chloride reference. Voltage signals from these shall be measured against the solution ground, and the differential voltage measurement sent to the control module. The temperature signal from the conductivity sensor shall be used to compensate the pH reading as well.
      2. Materials of construction: Glass-Filled Polypropylene, CPVC, HDPE, FKM, Glass
      3. Process connections: ¾" NPTF
      4. Temperature range: 50-158 F, 10-70 C
      5. Pressure range: 0-100 psi
      6. Other materials and higher pressure sensors shall be made available.

d. ORP

1. Operating principle: The ORP sensor shall consist of a replaceable cartridge containing a platinum electrode and silver/silver chloride reference. Voltage signals from these shall be measured against the solution ground, and the differential voltage measurement sent to the control module.
2. Materials of construction: Glass-Filled Polypropylene, CPVC, HDPE, FKM, Glass, and Platinum.
3. Process connections: ¾" NPTF
4. Temperature range: 32-158 F, 0-70 C
5. Pressure range: 0-100 psi
6. Other materials and higher pressure sensors shall be made available.

e. DISINFECTION

1. Operating principle: The oxidizer molecules diffuse through the membrane and in the acidic environment of the electrolyte fill solution, a redox reaction occurs at the electrodes in the sensor. The current generated by this reaction is converted to a robust voltage signal that is linear with the concentration of the oxidizer.
2. Materials of construction: Glass-Filled Polypropylene, PVC, Silicone rubber, polycarbonate, 316SS, PEEK.
3. Process connections: ¾" NPTF
4. Temperature range: 41-113 F, 5-45 C (typical)
5. Pressure range: 0-14.7 psi (0-1 atmosphere)

4. Controller and Sensor Performance

a. 0.01 Cell Contacting Conductivity
Range 0-300 µS/cm
Resolution 0.01 µS/cm, 0.0001 mS/cm, 0.001 mS/m, 0.0001 S/m, 0.01 ppm
Accuracy ± 1% of reading

b. 0.1 Cell Contacting Conductivity
Range 0-3,000 µS/cm
Resolution 0.1 µS/cm, 0.0001 mS/cm, 0.01 mS/m, 0.0001 S/m, 0.1 ppm
Accuracy ± 1% of reading

c. 1.0 Cell Contacting Conductivity
Range 0-30,000 µS/cm
Resolution 1 µS/cm, 0.001 mS/cm, 0.1 mS/m, 0.0001 S/m, 1 ppm
Accuracy ± 1% of reading

d. 10.0 Cell Contacting Conductivity
Range 0-300,000 µS/cm
Resolution 10 µS/cm, 0.01 mS/cm, 1 mS/m, 0.001 S/m, 10 ppm

Accuracy ± 1% of reading

e. pH

Range -2 to 16 pH units
Resolution 0.01 pH units
Accuracy ± 0.01% of reading

ORP/Ion Selective Electrode
Range -1500 to 1500 mV
Resolution 0.1 mV
Accuracy ± 1 mV

f. Disinfection Sensors

Range (mV) -2000 to 1500 mV
Resolution (mV) 0.1 mV
Accuracy (mV) ± 1 mV

Range (ppm) 0-2 ppm to 0-20,000 ppm
Resolution (ppm) Varies with range and slope
Accuracy (ppm) Varies with range and slope

g. Temperature

Range 23 to 500°F (-5 to 260°C)
Resolution 0.1°F (0.1°C)
Accuracy ± 1% of reading

Analog (4-20 mA)
Range 0 to 22 mA
Resolution 0.01 mA
Accuracy ± 0.5% of reading

h. Electrodeless Conductivity

Ranges	Resolution	Accuracy
500-12,000 µS/cm	1 µS/cm, 0.01 mS/cm, 0.1 mS/m, 0.001 S/m, 1 ppm	± 1% of reading
3,000-40,000 µS/cm	1 µS/cm, 0.01 mS/cm, 0.1 mS/m, 0.001 S/m, 1 ppm	± 1% of reading
10,000-150,000 µS/cm	10 µS/cm, 0.1 mS/cm, 1 mS/m, 0.01 S/m, 10 ppm	± 1% of reading
50,000-500,000 µS/cm	10 µS/cm, 0.1 mS/cm, 1 mS/m, 0.01 S/m, 10 ppm	± 1% of reading
200,000-2,000,000 µS/cm	100 µS/cm, 0.1 mS/cm, 1 mS/m, 0.1 S/m, 100 ppm	± 1% of reading

5. Indication

a. Graphic User Interface

1) A 320 x 240 pixel monochrome backlit display with touchscreen shall indicate the process values, the status of outputs and alarms, and provide for all settings and calibrations.

2). Six LED lamps shall indicate the on/off status of the control outputs.

6. Equipment

a. The cooling tower controller shall be a Walchem WCT600 series.

C. Operator Functions

1. Calibration

a. The sensor calibration shall be a one point process calibration, a two point buffer calibration, or a one point buffer calibration.

b. All set points shall be set through the touchscreen, or via a PC connected either locally or remotely via Ethernet.

c. Two levels of access codes shall be available to protect all set points and calibrations, while allowing the user to view any set point.

2. Control Module Function Details

   a. Each control output shall be able to be set to any of the available control modes listed above.

   b. The inhibitor chemical feed output shall be on/off control with four choices of feed modes.

   c. All control relays shall have limit timers to prevent runaway control.

   d. he biocide programs shall provide a conductivity-based or a time-based prebleed prior to the biocide addition, and a time-based lockout of the bleed after the biocide addition.

   e. The controller shall be able to interlock any relay output based on a digital input, or based on another specific relay being active.

D. Execution

1. Installation

   a. The sensors shall be installed in a location where they will always remain immersed in the sample.

   b. The sensors shall be installed in a location where there is good solution movement and where they will respond rapidly to changes

   c. The sensor cables shall be routed such that they are separated from any AC voltage by at least 6 inches.

   d. If the sensor cable needs to be extended beyond the standard length, then 24 AWG, 3 twisted pair, shielded cable shall be utilized.

   e. If the optional 4 – 20 mA output or water meter contactor are installed, then 22-26 AWG, twisted pair, shielded cable shall be utilized.

   f. The sample line shall be tapped from the discharge side of the cooling tower recirculation pump, and returned to either the cooling tower sump or the suction side of the recirculation pump.

E. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.

2. Molded cover with recess for mounting pump.

3. Capacity: 20 gal.

4. Containment: Tank shall be constructed of double wall for containment.

F. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.

2. Adjustable flow rate.

3. Metal and thermoplastic construction.

4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

G. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints.

H. Injection Assembly:

1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Three-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.
5. Injection into controllers piping loop is acceptable alternative to quill/packing gland method described above.

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness for closed loop systems, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop hydronic heating system.
2. Four-station rack for open cooling tower system.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install interconnecting control wiring for chemical treatment controls and sensors.

D. Mount sensors and injectors in piping circuits.

E. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply, and interface meter with BMS to totalize flow and alarm when make-up water consumption exceeds 20 gallons per hour.
3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

F. Install automatic chemical-feed equipment for condenser water and include the following:

1. Install makeup water softener.
2. Install water meter in makeup water supply.
3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

    a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

4. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
5. Install TDS controller with sensor and bleed valves.

    a. Bleed valves shall cycle to maintain maximum TDS concentration.

6. Install pH sensor and controller with injection pumps and solution tanks.

    a. Injector pumps shall operate to maintain required pH.

7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.

    a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.4 CLEANING OF ALL HVAC PIPING SYSTEMS AFTER INSTALLATION OF NEW WORK IS COMPLETE

A. Preliminary Cleaning:

1. Clean piping internally by flushing prior to the application of pressure tests and before the chemical cleanout procedures specified herein. Provide temporary strainers at the inlet to the chilled water and hot water pumps before the start of cleaning procedures.

2. Block off and isolate circulating pumps, cooling coils, heating coils and steam traps during the preliminary flushing and draining process.

3. Thoroughly flush piping clear of foreign matter with City water under pressure, and then drain before proceeding with pressure testing. Blow down accumulations of grit, dirt and sediment at each strainer and each low point in the piping systems.

4. Provide bypass flush valves and required piping to permit full circulation of water during the washout of the piping systems. Close shutoff and balancing valves on branch piping to the terminal equipment units during the washout operation to prevent water circulation through the automatic control valves.

B. Chemical Cleanout:

1. After completion of pressure testing, chemically clean internally each recirculating water system (including chilled water, hot water, and condenser water).

2. Provide temporary connections with valves to fill the piping and remaining equipment with water for the purpose of draining piping and equipment after completion of the chemical cleanout procedure. Provide temporary blind flanges and/or caps to isolate the piping and equipment noted herein.

3. Provide temporary piping connections, valves, strainers, bypasses, and blank connections where required to clean out systems. Line each strainer basket with a fine mesh nylon screen and replace the screens at the end of each day's circulation until each system is thoroughly cleaned.

C. Hot Water Heating System: Fill each system with City water; start circulation pump and vent high points manually until all air is released from the system.

1. All new recirculating water systems, both open and closed, to be filled and flushed with a solution of a non-foaming chemical detergent, to remove all foreign matter. Circulate the solution for a minimum of 8 hours and drain as rapidly as possible to remove suspended matter. Flush the system with fresh water, drain a second time and refill. After final filling, the pH of the water must not exceed the pH of the fresh incoming water by more than 0.5 pH.

2. Introduce the chemical solution into the system gradually by injecting into the suction side of the circulating pump, or by means of a bypass chemical feeder located on the discharge side of the permanent hot water secondary system circulating pump. Slowly raise and then maintain the temperature of the circulating water at 150°F by circulating through the hot water converter.

3. While the water is being heated and circulated, open each drain connection for a short flow. Repeat at hourly intervals. Replace any water drained during blow down with chemical solution as required until air is eliminated from the system. The chemical cleanout procedure to be continuous in this manner for 2 full 8-hour periods.

4. At the conclusion of the chemical cleanout period, completely drain the entire system and allow to cool. Flush out with fresh City water prior to final activation of the system. Remove temporary equipment and strainers, reconnect permanent pump and replace items previously removed.

D. Chilled Water and Condenser Water Systems:

1. Clean these systems as described for the hot water heating systems with the following exceptions:

2. Circulate the chemically treated water at ambient temperature.

3. Accomplish the chemical cleanout during a minimum of three (3) 8-hour periods.

E. Filling of Water Systems:

1. After completion of the chemical cleanout, fill each water system with fresh water, air vent, and add chemical treatment.

2. If the outdoor ambient temperature drops to 32°F., and the danger of freeze-up exists, drain water systems.

3.5 INTERNAL NEUTRAL PH BASED CHEMICAL CLEANOUT OF ALL EXISTING HVAC PIPING SYSTEMS PRIOR TO EXECUTION OF WORK

A. This work shall include the internal protective coating of all distribution systems on this construction such as, but not limited to, steam piping, hot water heating and cooling, chilled water and condenser water systems and components. The Q Kleen 403 treatment shall be applied by Limbach, Inc., or as approved equal.

B. It shall be the sole responsibility of the approved firm for the application of this process. He shall supply all labor, materials, and equipment for this purpose. A competent supervisor and/or equipment operator shall be kept at the site from commencement of his work until completion. None but experienced men shall provide treating of piping. Any repairs or servicing of components of these systems shall be done by the Contractor.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232500