

Addendum No. 1

**CITY OF ABERDEEN
ABERDEEN, MARYLAND
DEPARTMENT OF PUBLIC WORKS**

ABERDEEN ADVANCED WWTP HEAT EXCHANGER REPLACEMENT

Engineering Project 11205021

Receipt of this Addendum shall be automatically recorded by the City of Aberdeen once each Bidder downloads the Addendum No. 1 file from the City of Aberdeen website. No further action on the part of a Bidder is required to acknowledge receipt.

BIDS DUE REMINDER

Bids remain due **January 15, 2020 at 12:00 PM.**

General Clarifications

1. *Do you have gas composition information available?*

No. Fuel to the boiler will be natural gas. Include control provisions for adding digester gas in the future as a secondary fuel source.

2. *Are we providing a new exhaust stack for the boiler or just a connection point?*

Provide a connection point only.

3. Please note that the System Supplier shall quantify their proposal with relevant exceptions taken to the specification. Consideration will be given to the exception(s) during the bid evaluation.

Modifications to the Preselection Document

1. **REPLACE** SPECIFICATION 11395 – DIGESTER HEATING EQUIPMENT with the attached.

Modifications to the Project Drawings

1. **NONE.**

End of Addendum No. 1

SECTION 11395

DIGESTER HEATING EQUIPMENT

PART 1 GENERAL

1.01. SUMMARY

- A. This Section specifies requirements for furnishing two (2) Digester Heating Equipment, including heat exchangers, boilers, internal hot water circulation pumps, dual fuel gas trains, controls, instrumentation, accessories, spare parts, and manufacturer's services to be installed in the location as indicated on the conceptual drawings.
- B. The equipment specified in this Section is designated as follows:
 - 1. Digester Sludge Heater No.1.
 - 2. Digester Sludge Heater No. 2.
 - 3. Only one digester heating equipment is required to be in service and the other one is a standby unit, when only one digester is heated.
- C. The Digester Heating Equipment will be purchased from the Preselected Vendor or Equipment Supplier by the General Contractor. The System will be installed and powered by the General Contractor and tested and commissioned by the Equipment Supplier as specified in this Section.
- D. Natural gas will be used as primary fuel to the boiler. Each boiler will be equipped to allow use of digester gas as a secondary fuel. The digester gas train will not be connected to the digester gas piping as part of this project.
- E. There are 4 existing heated sludge recirculation pumps that will remain and their operation will be controlled by the new digester heating equipment control panel.
- F. The existing Heater Room is designated as "Unclassified".

1.02. SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings for equipment provided under this Section. Format and content of the shop drawing submittal shall conform to requirements specified in Section 01300.
 - 2. The shop drawing submittal shall include the following as a minimum:
 - a. Manufacturer's performance affidavit conforming to requirements specified in this Section.
 - b. Manufacturer's catalog information, descriptive literature, specifications, material of construction, etc.

- c. Manufacturer's certified installation drawings containing all critical dimensions, sizes, weights, anchorage location, etc. required for installation of the equipment.
- d. Power wiring single line diagrams.
- e. Shop and field painting information.
- f. Manufacturer's written installation instructions, including any special requirements for shipping, handling, and storage of equipment prior to installation.
- g. Manufacturer's warranty.

B. Shop Test Results:

- 1. Equipment shall be hydrostatically tested ~~in the shop to a pressure of 60 psig~~ **[Addendum No. 1]** after the unit has been assembled, and ~~the System be~~ **[Addendum No. 1]** shop fired and tested and all control circuits thoroughly checked for satisfactory operation at the manufacturing facility prior to shipment. Testing reports to be submitted to Owner or Engineer at their request.
- 2. Test reports shall include the following information.
 - a. Manometer readings at the main gas regulator, pilot gas regulator, boiler inlet, boiler, and furnace.
 - b. Amps drawn by all motors.
 - c. Voltage of pilot and main flame control signal.
 - d. ~~Flue gas characteristics including percent oxygen, percent carbon dioxide, temperature, and efficiency results.~~ **[Addendum No. 1]**
- 3. Manufacturer's Data Reports
 - a. A Manufacturer's Data Report for Boilers, Form H-2, as required by the provisions of the ASME Code Rules, shall be furnished to the General Contractor for transmittal to the Owner. This form shall be signed by a qualified inspector, holding a National Board commission, certifying that boiler construction conforms to the latest revision of the ASME Code.
 - b. *Applicable additional A* **[Addendum No. 1]** Manufacturer's Data Report for Unfired Pressure Vessels, Form U-1, as required by the provisions of the ASME Code Rules, shall be furnished to the Contractor for transmittal to the Owner. This form shall be signed by a qualified inspector, holding a National Board commission, certifying that construction conforms to the latest revision of the ASME Code. The ASME "U" symbol shall also be stamped on the heat exchanger nameplate.

C. Operation and Maintenance Manuals:

- 1. Submit manufacturer's written instructions for proper operation and maintenance of equipment provided under this Section. Format and content of the manufacturer's

operation and maintenance instructions shall conform to the requirements specified in Section 01300.

2. The manuals shall include the following:
 - a. Equipment operating and maintenance instructions.
 - b. Parts lists.
 - c. Assembly and disassembly instructions.
 - d. Equipment specifications and guaranteed performance data.
 - e. Recommendations for preventive maintenance.
 - f. Step-by-step operating and start-up procedures.
 - g. Lists of spare parts, tools, and supplies.
 - h. Wiring diagrams of all control and power circuits.
 - i. Software programming as updated after final acceptance.
 - j. Troubleshooting instructions.
- D. Manufacturer's Field Service Documentation:
 1. Manufacturer's Certification of Equipment Compliance.
 2. Manufacturer's Certification of Equipment Installation.
 3. Manufacturer's Field Testing Report.
 4. Manufacturer's Training Plans, Record of Training, and Training Report.
 5. ~~Equipment Warranty.~~ **[Addendum No. 1]**

1.03. QUALITY ASSURANCE

- A. Equipment shall, as applicable, meet the requirements of the following industry standards:
 1. American National Standards Institute:
 - a. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings
 2. ASME Boiler and Pressure Vessel Code :
 - a. ASME SA53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - b. ASME SA106 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - c. ASME SA178 Specification for Electric-Resistance-Welded Carbon Steel Boiler Tubes.

- d. ASME SA516 Specification for Pressure Vessel Plates, Carbon Steel, For Moderate and Lower Temperature Service.
- 3. American Society for Testing and Materials.
- 4. National Electrical Code.
- 5. Steel Structure Painting Council.
 - a. Surface preparation specifications.
- B. The Equipment manufacturer shall be regularly involved in the manufacture and supply of digester heating equipment for at least 15 years, and with a history of at least 25 successful municipal wastewater installations of similar design.
- C. All equipment components specified in this Section shall be furnished by a single supplier having overall responsibility for proper installation, startup, testing and performance.
- D. The boiler and heat exchanger shall be fabricated as an integral unit by a single manufacturer. A separate boiler and heat exchanger, connected by external structural members and piping, will not be considered an integral unit.

1.04. DESIGN AND PERFORMANCE REQUIREMENTS

- A. Specific design requirements related to this project include:

- 1. General:

- a. Number of units: 2
- b. Digester operating temperature: 95 °F
- c. Site elevation above sea level: 50 ft.
- d. System utilization: Digester sludge heating

- 2. Boiler:

- a. Minimum boiler output capacity: ~~825,000 BTU/hr.~~ 725,000 BTU/hr. **[Addendum No. 1]**
- b. Boiler inlet cold water temperature: 160 °F
- c. Boiler outlet hot water temperature: 180 °F (minimum)
- d. Minimum working pressure: 30 psi.
- e. ~~Minimum fired surface per unit: 114 sq. ft.~~ **[Addendum No. 1]**
- f. Boiler shall be a two-pass furnace tube type incorporating a water cooled return back.
- g. ~~No refractory or non-water cooled steel surfaces shall be allowed in areas of flame impingement or in the path of hot gases.~~ **[Addendum No. 1]**

- h. The exhaust breeching and return back shall be readily removable for access to fire tubes.
 - i. A flame inspection port shall be provided in the water cooled return back.
 - j. Access hand holes and water bath drain shall be provided in the front plate.
3. Heat Exchanger:
- a. Design heat exchanger capacity: 750,000 BTU/hr.
 - b. Heated sludge recirculation flow: 200 GPM
 - c. Hot water circulation rate: 120 GPM
 - d. Sludge tube diameter: 4.0 inch
 - e. Hot water tube diameter: 6.0 inch *(when required)* **[Addendum No. 1]**
 - ~~f. Minimum heated surface area / unit: 87 sq. ft. **[Addendum No. 1]**~~
 - g. Minimum sphere tubes shall pass: ~~3-1/2 inch dia.~~ 3.0 inch dia. **[Addendum No. 1]**
 - h. Maximum headloss through unit: ~~3.5 ft of H₂O~~ 8.8 ft of H₂O (sludge) **[Addendum No. 1]**

1.05. PERFORMANCE AFFIDAVIT

- A. Provide performance affidavits for products as required herein.
- B. By these affidavits, the manufacturer must certify to the Owner, that manufacturer has examined the Preselection Documents, and that the equipment, apparatus, process or system offered to furnish by manufacturer will meet in every way the performance requirements set forth in the Preselection Documents. Equipment design, manufacturing and assembly specifications are an integral part of the performance requirements.
- C. Shop drawings will not be reviewed prior to receipt by the Engineer of an acceptable performance affidavit.
- D. The performance affidavit must be signed by an officer (vice president or higher) of the basic corporation, partnership or company manufacturing the equipment, and witnessed by a notary public.
- E. The performance affidavits shall be in the following format:

Addressed to: (Owner)
Reference: (Project)

Text: "(manufacturer's name) has examined the Preselection Documents and verified that the (product) meets in every way the performance requirements and design specifications set forth in Section(s) of the Preselection Documents."

Signature: Corporate officers shall be vice president or higher (unless statement

Notary: authorizing signature is attached).
Signature(s) must be notarized.

F. Performance Requirements:

1. The digester heating system manufacturer shall provide a written guarantee that the equipment will meet the specified performance requirements ~~and all specified conditions in paragraph 1.04.~~ **[Addendum No. 1]**

1.06. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage and handling of equipment shall comply with manufacturer's instructions.
- B. Delivery time shall be in accordance with RFP requirements after the receipt of Engineer's approval of submittals, and will be confirmed at the time of issuing a purchase order by the General Contractor.
- C. Equipment shall be delivered in a manner suitable for storage by General Contractor. General Contractor will be required to off-load equipment upon arrival.
- D. General Contractor shall inspect all equipment upon receipt. Replace or repair damaged items at no additional cost to the Owner.
- E. Spare parts and assemblies shall be packaged in separate, structurally sound, waterproof containers clearly marked with the name of the part or assembly and the unit name of which it is a component.

1.07. TOOLS AND SPARE PARTS

- A. Special tools and standard spare parts shall be furnished with the equipment to Owner. All special tools and appliances necessary to disassemble, service, repair, and adjust the equipment and appurtenances shall be provided.

1.08. EQUIPMENT WARRANTY

- A. The Equipment Manufacturer shall warranty the supplied equipment for one (1) year from the date of Substantial Completion and acceptance of the Work by Owner. The warranty shall not be initiated until such time the digester heating system has been placed into operation and is operating in a stable manner for a minimum of 14 twenty four (24) hour consecutive days.
- B. If the System should fail during the warranty period due to defective parts, it shall be replaced or repaired at no expense to Owner.
- C. *Special Warranty:*
 1. ~~The boiler pressure vessel shall carry a 10-year warranty against thermal shock damage. Warranty shall cover 100% of labor and material required to repair damage such as loosened tubes, cracked ligaments or welds.~~
 2. ~~All burner components shall carry a 5-year warranty against failure due to defect when fuel sources are within specified parameters.~~ **[Addendum No. 1]**

PART 2 PRODUCTS

2.01. ACCEPTABLE MANUFACTURERS

- A. Model HeatX, Type EB4-750 by Walker Process Equipment, a Division of McNish Corporation.
- B. Model 754 by Evoqua Water Technologies LLC.
- C. Model BOF1 by WesTech Engineering, Inc.
- D. Or Approved Equal.

2.02. EQUIPMENT DESIGN

A. General – Equipment Package:

- 1. Combination of a fire tube boiler and ~~associated a concentric tube~~ **[Addendum No. 1]** heat exchanger, both so arranged that there is no transmission of heat from the boiler water to the tube jacket water by conduction or thermal circulation between sludge heating cycles. A hot water circulation pump, with manual and automatic controls, shall be provided with each unit to circulate water through the water jackets during the heating period.

B. Boilers:

- 1. The fire tubes in each boiler shall be No. 13 gauge boiler tubing having a minimum wall thickness of 0.095 inch. The tubes shall be rolled and beaded into tube sheets having a minimum thickness of 3/8 inch.
- 2. The furnace of each boiler shall be fabricated from seamless steel boiler tubing of suitable diameter, electrically welded between the tube sheets, ~~and fitted with refractory on the burner end to protect the burner parts and to promote efficient combustion.~~ **[Addendum No. 1]**
- 3. Both the head and back plates of each boiler shall be accessible and readily removable for inspection without need for draining the boiler. The back plate of the boiler shall be fitted with a sight port for visually checking the flame.
- 4. The boiler shall be wrapped with a minimum of 2 inch of glass wool blanket insulation and enclosed with No. 14 gauge steel paneling.
- 5. The boiler shall be fitted with a low water cut-off, an ASME-rated pressure relief valve, a compression tank with water level gauge, a makeup water regulator, a thermometer, and pressure gauge.
 - a. A carbon steel compression tank shall be supplied to replace the existing compression tank. The tank shall have a ~~100~~ **minimum of 30 [Addendum No. 1]** gallon capacity and shall be furnished with a water level gauge glass, 2 inch boiler water connection, ½ inch drain valve and factory finish paint. The tank shall have ASME construction.

6. The boiler shall be supplied with 2-1/2 inch NPT connections to permit connecting the building heat supply and return piping.

C. Boiler Burners:

1. Each burner shall be of either the forced draft design or the induced draft design. ~~The use of a gas booster pump is not permitted.~~ *The use of a gas booster is allowed if required by the System Supplier. However, the gas booster is not to be provided for this project. The System Supplier shall provide the controls that can be modified in the future to accommodate the gas booster for the dual fuel operation [Addendum No. 1].*
 - a. The forced draft design will furnish combustion air to the burner by a high-pressure air blower with a 1/3 Hp, 3,450 rpm, 3 phases / 60 Hz / 480 Volt motor.
 - b. The Induced draft design will furnish combustion air to the burner by an induced draft fan connected to the boiler exhaust breech with a 1/3 Hp, 3,450 rpm, 3 phases / 60 Hz / 480 Volt motor.
 - 1) The fan shall be designed to maintain a negative pressure of at least 1 inch w.c. in the furnace throughout boiler operation to prevent the leakage of combustion products to the surrounding room and to permit dependable operation at the low digester gas pressures listed herein.
 - 2) The fan shall have a capacity in excess of the maximum air requirements for combustion.
 - 3) The fan shall draw air in at the burner inlet and at the top of the exhaust breech. The burner inlet shall permit adjustment of combustion air volume and the exhaust stack inlet shall allow adjustment of negative furnace pressure.
 - 4) The fan shall be belt driven to permit field adjustment of the air capacity. The drive belts and open drip proof motor shall be enclosed in a removable housing.
 - 5) An exhaust gas temperature gauge shall be provided on the exhaust stack.
2. Each burner shall be provided with all controls required for the burning of either digester gas, natural gas, or a blend of the two gases. ***In the future***, when digester gas is to be used for the boiler, upon depletion of the available digester gas, the auxiliary supply of natural gas shall be automatically admitted to the burner to make up the gas deficiency until sufficient digester gas is once again available. All available digester gas shall be fully utilized.
3. Fuel piping: The burner shall be supplied with a sensitive gas pressure regulator for each gas supply, a low-pressure check valve for the digester gas line and an adjustable gas orifice valve for the natural gas line. Threaded connections for gas supply piping shall also be supplied.
 - a. Natural gas shall be delivered at a minimum of 1 psi and a maximum of 10 psi upstream of the boiler.

b. Digester gas shall be delivered at a minimum of 4½ inch w.c. pressure.

D. Heat Exchangers:

1. Each heat exchanger shall consist of a series of 4 inch ID, Schedule 40 steel pipe sludge tubes concentrically placed within 6 inch ID Schedule 40 steel pipe water jackets. The tubes shall be joined by neoprene-gasketed end castings so designed that any leakage occurring will be to the exterior of the heat exchanger. The tubes shall be supported by ¾ inch thick steel end plates with structural steel members serving as boiler supports and framing for the exterior steel paneling. The sludge and water tubes shall be independently removable and so arranged as to prevent contamination of the heating water by material circulated through the sludge tubes.
2. The sludge tube end castings shall be removable to permit tube inspection without having to drain the jacket water. All sludge passageways shall be designed to pass 3-1/2 inch spheres. The inlet and outlet connections shall be of cast iron and shall have 4 inch flanged connections for sludge piping and threaded connections for jacket water piping. In addition, these castings shall have ¾ inch NPT connections for attachment of sludge and water inlet and outlet thermometers. The entire sludge-water tube bundle shall be wrapped independently of the boiler with a minimum of 1-1/2 inch of blanket insulation.
3. Each heat exchanger shall have not less than twelve (12) sludge tubes that will provide a total heated surface area, measured on the inside of the sludge tubes, of not less than 87 sq. ft.

E. Hot Water Circulation Pumps:

1. Provide one centrifugal pump per boiler to provide positive, counter-flow circulation of hot water through the water jackets.
2. The pump shall be factory-mounted in an accessible part of the unit, and shall be driven by a minimum 3/4 Hp, 1,750 rpm, 3 phases / 60 Hz / 480 Volt motor.

F. Circulating Water Control Valves:

1. Provide a 3 inch diameter motorized mixing valve placed in the hot water circulating line to maintain a boiler water temperature of 180 °F and higher, regardless of the load on the boiler, so that a sufficient supply of heat will always be available for digester heating, and also to prevent condensate corrosion of the boiler. Boilers operating at temperatures less than 180 °F will not be allowed due to potential corrosion problems.
2. The valve shall also limit the heat exchanger jacket water from exceeding a temperature of 150 °F to prevent sludge "baking" and the resultant loss of heat transfer efficiency.
3. A temperature controller and a resistance temperature detector (RTD) assembly mounted in the water supply piping to the exchanger shall control the operation of the mixing valve to regulate the water temperature to the exchanger (refer to "Digester Temperature Control" below).

G. Motors:

1. The motors shall be squirrel cage, induction type, ball bearing, heavy duty units of ample power for starting and operating the equipment without overload. Each motor shall be NEMA Design B, open drip proof with Class B insulation, and shall include a sealed conduit box.

2.03. CONTROL

- A. The control panel shall contain a burner controller, circuit breaker and magnetic starter for the blower or fan motor, control for hot water circulation pumps, and digester temperature controls. Controls shall be mounted and wired with rigid conduit and flexible watertight connectors in accordance with NEC. The control panel shall be mounted on the side of the unit or the Heater Room wall so as not to interfere with access to the burner, return breech, sludge tubes, or gas piping. The control panel shall have a NEMA 12 enclosure with dual swing-out doors. The doors shall be lockable with disconnect switch and handle to ensure the doors are closed during operation.

1. The following labeled switches and indicating lamps shall be provided on control panel doors:

- a. Sludge heat hand/off/auto switch.
- b. Burner off /auto selector switch.
- c. Constant water bath on/off switch.
- d. Exhaust fan continuous/intermittent switch.
- e. Heated sludge recirculation pump continuous/intermittent switch.
- f. Low boiler water indicator lamp.
- g. Flame failure alarm horn, alarm horn silencer, and flame failure indicator lamp.
- h. Hot water circulation pump running lamp.

- B. Burner Controller:

1. Each burner shall be controlled by a microprocessor-based management control system designed to provide proper burner sequencing, ignition and flame monitoring protection on automatically ignited burners and programs the burner/blower (or fan) motor, ignition and fuel valves to provide for proper and safe burner operation. The system shall be equipped with self-diagnostics and vocabulary of different messages which provides the plant operator with status and failure mode information. In the event of a safety shutdown, the control system shall close the fuel valves and lock out the system. Manual reset of the controls shall be required following any safety shutdown.
2. The control system for the burner shall provide a 30-second pre-purge before any starting cycle, after a power failure, and at fuel switchover. A substantial pilot shall be established in the burner before admission of gas supply to the burner. Included with the burner shall be a control panel containing all burner controls, blower/fan motor relay, timers and other appurtenances, all of which shall be mounted on the boiler body, and completely wired to the necessary remote controls and valves through a numbered terminal block furnished with the panel.

3. Positive control of the fuel supply shall be maintained by employing an ultraviolet flame scanner solid-state flame protection device. The flame protection devices shall be Underwriters Laboratories and Factory Mutual approved. In the event of flame failure, the fuel supply valve shall be positively closed and an alarm sounded. All electric gas valves shall be motorized and of a type approved by Underwriters Laboratories and American Gas Association.

C. Digester Temperature Control:

1. Automatic control of the temperature of the digester contents within 0.5 °F, plus or minus, shall be accomplished by means of a temperature controller and an RTD inserted in the sludge inlet casting on each heat exchanger. An adjustable program timer shall be furnished to periodically start the heated sludge recirculation and hot water circulation pumps.
2. The controls shall be so arranged that the pumps will continue in operation until the temperature of the digester contents has reached the desired level or, if the digester contents do not require heat, the pumps will be shut down after a short period of operation. The hot water circulation pump starter shall be interlocked with the heated sludge recirculation pump starter so that the sludge recirculation pump must be operating before the hot water circulation pump can operate when the control cycle is on automatic. The control cycle shall also be arranged so that, if desired, the heated sludge recirculation pump can operate continuously, under manual control, with the temperature controller operating the hot water circulation pump only as required to maintain the temperature of the digester contents.
3. All operating controls, except the RTD, shall be mounted in or on an enclosed NEMA 12 control panel mounted on the units and wired to numbered terminal blocks. Each unit shall be provided with factory-installed water and sludge thermometers mounted in the inlet and outlet castings of each heat exchanger. All thermometers shall be of the non-mercury red reading type with a range of 30-240 °F for water and 0-160 °F for sludge.

2.04. FACTORY FINISH

- A. High-temperature aluminum paint shall be provided on the boiler shell of each unit.
- B. All other fabricated steel parts shall be commercially cleaned per SSPC-SP6, and given one (1) shop coat of rust-inhibitive primer and one (1) shop coat of the Equipment Manufacturer's standard machinery enamel.
- C. Provide a quart of Manufacturer's paint to the General Contractor for any field touch-up coating.

2.05. NAME PLATE

- A. Provide a stainless steel nameplate for each digester heating equipment and other major components supplied.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Install the equipment in strict conformance with the Manufacturer's installation instructions, approved Shop Drawings, and pre-installation checklist.
- B. No modifications to equipment shall be made without prior written consent of the Manufacturer and approval of the Engineer.
- C. Verify all dimensions and elevations prior to installing equipment. Notify Engineer and the Manufacturer of specific differences. If disassemble and reassemble of components are required during field installation, it should be at no additional cost to the Owner.
- D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.
- E. Perform field painting in accordance with the Manufacturer's requirements.
- F. Isolate dissimilar metals by back-painting or with dielectric using stainless steel fasteners.
- G. Anchor bolts and nuts shall be Type 316 stainless steel.

3.02. STARTUP AND TESTING

- A. Prior to start-up, clean the construction area by removing construction debris and foreign material.
- B. Contractor shall furnish the services of manufacturer's factory-trained service representative to inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise correction of defects or malfunctions, and participate in start-up. Start-up shall be minimum 32 hours (one man for four days excluding travel timing).
- C. The Manufacturer's service representative shall approve the installation prior to initial start-up.
- D. The system shall be field tested as a whole system, witnessed by the Manufacturer's service representative, Engineer and Owner. Contractor and Engineer to verify operation under field conditions. Testing of the system shall demonstrate that the equipment is fully operational.
- E. Contractor shall also furnish the oil and grease for initial operation. The grades of oil and grease shall be in compliance with the Manufacturer's recommendations.

3.03. TRAINING

- A. Contractor shall furnish the services of Manufacturer's qualified, factory-trained operations and maintenance technician to instruct and train Owner's personnel in the proper care, operation, and maintenance of the equipment. These services shall be in addition to the services specified under Article 3.02 above.
- B. One (1) training session is required. Training shall be completed after start-up services have been performed. Training shall be a minimum of eight (8) hours (excluding travel time) and shall occur not less than two (2) weeks after the start-up of the equipment. Time, location, and duration of all training sessions shall be coordinated with Owner's personnel.
- C. Each session shall include, but not be limited to, the following topics:
 - 1. Equipment design and theory of operation.

2. Controls and modes of operation.
3. Proper operation and maintenance of equipment.
4. Troubleshooting and problem identification.
5. Safety precautions/practices.
6. Equipment manual review.
7. Warranty/repair service information.

END OF SECTION