1. GENERAL
   1. SUMMARY
      1. Section includes horizontal, packaged, factory fabricated and assembled fire-tube boilers, trim and accessories for generating steam (60-475 HP)
   2. RELATED SECTIONS
      1. Section 01 11 00 – Summary of the Project
   3. REFERENCES
      1. ANSI Z223.1/NFPA 54 – National Fuel Gas Code
      2. ASME Section I – Boiler and Pressure Vessels Code – Rules for Construction of High Pressure Power Boilers
      3. ASME Section IV – Boiler and Pressure Vessels Code – Rules for Construction of Heating Boilers
      4. NFPA 70 – National Electrical Code
      5. CSD-1 - Control & Safety Devices for Automatically Fired Boilers
      6. FM
      7. NFPA 85/GE GAP
      8. NBIC – National Board Inspection Code
   4. SUBMITTALS
      1. Section 01 33 00 – Submittal Procedures: Submittal requirements.
      2. Product Data: Submit data on general layout, dimensions, size, and location of connections, wiring diagram and piping detail.
      3. Submit manufacturer's installation instructions.
      4. Submit Installation and appropriate air permitting reports to appropriate local government agency. Include copy in operation and maintenance data under provisions of Section 01 70 00.
   5. CLOSEOUT SUBMITTALS
      1. Section 01 70 00 – Execution Requirements: Project record document procedures.
      2. Maintenance Data: Include manufacturer's descriptive literature; operating instructions, cleaning procedures, replacement parts list and maintenance and repair data.
   6. QUALITY ASSURANCE
      1. Manufacturer Qualifications: Boilers in the specified size range must have been in production by the manufacturer for a minimum of ten (10) years.
      2. Substitute Equipment:
         1. Comply with requirements for substitutions specified in Division 1.
   7. REGULATORY REQUIREMENTS
      1. Conform to applicable NFPA 70 code for internal wiring of factory wired equipment.
      2. Conform to ASME Section I, CSD-1 for boiler construction. Provide boiler registered with National Board of Boilers and Pressure Vessel Inspectors and with the appropriate state agency.
   8. DELIVERY, STORAGE, AND HANDLING
      1. Section 01 60 00 – Product Requirements: Product delivery, storage, protection and handling requirements.
      2. Protect units before, during and after installation from damage to casing by leaving factory-shipping packaging in place until immediately prior to final acceptance.
      3. Manufacturer’s local representative shall be on site during the boiler rigging and installation to ensure proper handling.
   9. FIELD MEASUREMENTS
      1. Verify field measurements prior to fabrication.
   10. WARRANTY
       1. Section 01 70 00 – Execution Requirements: Product warranties and product bonds.
       2. Provide owner with manufacturer’s warranty for the entire system, including hardware, software and components for a period of one (1) year from startup or 18 months from shipment, whichever comes first, and acceptance by owner, in accord with conditions contract.
       3. Five (5) Year Material and Workmanship Warranty: The boiler pressure vessel shall be covered against defective material or workmanship for a period of Five (5) years from the date of shipment from the factory. Boiler manufacturer shall repair or replace F.O.B. factory any part of the equipment, as defined above, provided the equipment has been installed, operated and maintained by the buyer in accordance with approved practices and recommendations made by boiler manufacturer. The commissioning agency must also successfully complete and return the equipment installation and operation checklists to Boiler Manufacturer’s Quality Assurance department.
       4. Warranty shall be a standard offering of the boiler manufacturer and shall not be on an individual project or boiler basis. In the event the manufacturer does not offer a standard five (5) year minimum pressure vessel warranty, the manufacturer shall provide a bond in the amount of the boiler sell price for labor and material to repair or replace any pressure vessel component that fails for the life of the boiler.
2. PRODUCTS
   1. Horizontal Fire-Tube Boilers
      1. Acceptable Manufacturers:
         1. Fulton
      2. This specification is based on the Fulton FBS Horizontal Firetube boilers. Equivalent units and manufacturers must meet all performance criteria for all fuel options and will be considered upon prior approval.
      3. Basis of Design: Fulton Model:

FBS-60 – 2,070 lb/hr

FBS-100 – 3,450 lb/hr

FBS-125 – 4,313 lb/hr

FBS-150 – 5,175 lb/hr

FBS-200 – 6,900 lb/hr

FBS-250 – 8,625 lb/hr

FBS-300 – 10,350 lb/hr

FBS-350 – 12,075 lb/hr

FBS-400 – 13,800 lb/hr

FBS-475 – 16,388 lb/hr

Steam Output rating at 212 oF feedwater temperature, 0 psig (Sea Level to 2,000 ft)

* + 1. Customers, engineers, and contractors shall have the option to visit the boiler manufacturer’s factory to witness manufacturing, testing, and other operational safety inspections associated with the referenced boilers.
  1. BOILER CONSTRUCTION
     1. The boiler shall be completely factory assembled as a self-contained unit. Each boiler shall be neatly finished, thoroughly tested, and properly packaged for shipping.
     2. The pressure vessel design and construction shall be in accordance with Section I or Section IV of the ASME Code for steam boilers. The boiler shall comply with CSD-1 code requirements with input at or below 12,500,000 BTU/hr. The boiler shall comply with NFPA-85 code requirements with an input above 12,500,000 BTU/hr.
     3. Boiler tubes shall be a minimum of 0.118” thickness.
     4. Boiler tubes shall be welded to the tubesheets to prevent weeping,
     5. It shall be acceptable to vent the boiler using sealed combustion (drawing in fresh air from the outdoors) or to draw air from the mechanical room itself.
     6. The flue/economizer connection shall be top mounted and in the rear for 3 pass boilers and in the front for 4 pass boilers.
     7. The pressure vessel shall be insulated with a minimum of 3” high density insulation, and all necessary refractories shall be installed in the boiler.
     8. The boiler shall be supported on a frame consisting of H frame steel.
     9. The jacket shall be stainless steel and any non-stainless components shall have a primer and finish coat of paint.
  2. BOILER DESIGN
     1. The boiler shall be a horizontal, 3 or 4 pass, water back, firetube design. The mounted forced draft burner will fire from the end of the boiler down through a corrugated furnace. In the first pass, the flame and high temperature flue gas flows from the front to the back of the furnace. Through the second pass pipes, high temperature flue gas flows from the combustion furnace to the front chamber. In the third pass, the flue gas passes through the third pass pipes to the back of the boiler . In the fourth pass, the flue gases pass to the front of the boiler and vents out. Corrugated furnace highly increases the heat exchange area, heat transfer efficiency and reduces the possible damage to the boiler durability caused by heat expansion and cold contraction.
     2. Combustion turnaround must be water backed, hard or poured refractory is unacceptable.
     3. The FBS boiler is a cylindrical vessel, with horizontal tubes passing through and connected to the front and rear tube sheets. The vessel contains the water and absorbs the energy generated from the flame. The front door and rear door provide the seal to contain the hot combustion gasses. Baffles designed into the doors serve to redirect the combustion gasses through the various firetube passages. The flame originates in the furnace. As the combustion gasses travel down the furnace and through the various firetube channels, heat from the flame and combustion gasses is transferred to the water. Transferred energy develops into the required steam.
     4. The front door and rear door make it easy to clean the combustion passes. The pressure vessel can be inspected and repaired by the manhole on the top and handholes on the side or bottom.
     5. Front doors shall be hinged and davited for ease of maintenance. Rear doors on sizes over 200 HP shall be hinged and davited.
     6. Front and rear doors shall be insulated with fiberglass insulation and shall not contain hard or poured refractory.
     7. A front and rear flame observation port shall be provided.
     8. The boiler input shall not exceed the fuel usage specified on the Fulton FBS Product Data Submittal for the specified model size.
     9. The capacity of each unit shall be able to produce continuously the steam rate specified by the steam output on the Fulton FBS Product Data Submittal for the specified model size.
     10. Adequate hand-holes and man-ways shall be provided for access to the water side of the boiler.
     11. There shall be access to all flue passes.
     12. The operating water volume of the boiler shall not be less than:

FBS-60 – 864 gal

FBS-100 – 999 gal

FBS-125 – 1,114 gal

FBS-150 – 1,084 gal

FBS-200 – 1,169 gal

FBS-250 – 1,408 gal

FBS-300 – 1,805 gal

FBS-350 – 2,034 gal

FBS-400 – 2,163 gal

FBS-475 – 2,163 gal

* + 1. The dimensions of the boiler shall not be less than the dimensions as specified by the Fulton FBS Product Data Submittal for the specified model size.
    2. The dry weight of the boiler shall not be less than:

FBS-60 – 9,500 lbs

FBS-100 – 11,000 lbs

FBS-125 – 14,300 lbs

FBS-150 – 14,500 lbs

FBS-200 – 20,300 lbs

FBS-250 – 25,600 lbs

FBS-300 – 28,880 lbs

FBS-350 – 29,700 lbs

FBS-400 – 37,100 lbs

FBS-475 – 37,100 lbs

* 1. CONTROLS
     1. The flame safeguard control shall be provided for linkage-less type modulation on all fuels and shall provide the following:
        1. The control shall provide a 30 second minimum pre-purge and post-purge time.
        2. The control shall maintain a running history of operating hours, number of cycles, and the most recent six control lockouts.
        3. Air damper and fuel butterfly valves will be connected to servo motors
     2. Burner selection and Burner and Safety Controls:
        1. The boiler shall be provided with an integral burner for operating on:

Natural Gas/Propane/#2-6 Oil

Dual Fuel Natural Gas/Propane/#2-6 Oil

Digester Gas/Bio Gas - Factory engineers must have the opportunity to review and approve these applications in advance.

* + - 1. Burner to be mounted to the front of the boiler. Burner to include forced draft blower and pre-balanced drive motor. Burner controls shall be modulating type as described above and are to include the following:
         1. Operating pressure control for automatic start and stop of burner operation.
         2. High Limit Pressure switch with manual reset.
         3. Two low water cut-off devices to cause shut down of unit when water level drops to minimum safe level. One device shall be manual reset to comply with ASME CSD-1 Code.
         4. Boilers shall have an air safety switch to prevent operation until sufficient combustion is assured.
         5. Flame detector to prove combustion.
         6. An electronic type combustion flame safeguard shall be included to provide full protection against flame failure. The control shall maintain a running history of operating hours, number of cycles, and the most recent six flame failures. This control shall be connected to a display module to retrieve that information.
         7. Burner motor control shall have thermal overload protection.
         8. A low fire hold control shall be provided.
      2. All controls to be panel mounted in a NEMA 1 / 12 / 4 enclosure and so located on the boiler as to provide ease of servicing the burner and boiler without disturbing the controls. Panel shall be located to prevent possible damage by water, fuel or heat, of combustion gases. Controls connected to water or fuel shall be installed outside the main boiler control panel. All controls shall be mounted and wired according to Underwriters’ Laboratories requirements.
  1. FUEL TRAIN COMPONENTS
     1. A factory mounted main fuel train shall be supplied. The fuel train shall be fully assembled, wired, and installed on the boiler and shall comply with CSD-1 and/or CSA code (or NFPA-85 if input dictates the requirement). Compliance with other codes is available upon request.
     2. Standard CSD-1 fuel trains shall comply with IRI, which has been replaced by GE GAP. Normally open vent valves are no longer required between the safety shut off valves. NFPA 85 compliance shall be available from the factory to comply with local codes or regulations that specifically require a vent valve.
     3. A factory mounted pilot fuel train shall be supplied when necessary for the fuel type and fuel train code.
     4. The main and pilot fuel valves will automatically close during a power failure or safety shutdown as determined by the flame programmer.
  2. BOILER FITTINGS & TRIM
     1. The boiler shall be supplied with an ASME Section I safety relief valve. The safety relief valve size shall be in accordance with ASME code requirements and set at ### psig
     2. A float type level controller shall be piped to the boiler at the factory. A gauge glass and sample port valve will be supplied. The float control shall also include the primary low water cutoff to automatically shutoff burner operation when water falls below a predetermined level. An auxiliary low water cutoff shall also be supplied and mounted separately from the primary cutoff.
     3. A steam pressure gauge shall be included with the boiler, mounted, and shall be complete with test connection. Gauge shall be scaled to the requirements of NBIC.
     4. Feedwater stop and check valve shall be supplied at factory in line to an internally baffled feed connection in boiler shell to prevent thermal shock. A motorized modulating feedwater control valve with three valve bypass shall be provided.
     5. Additional standard trim shall include two quick opening bottom blowdown valves piped to a common outlet with single slow opening valve. Water column and sightglass blowdown valves will also be provided.
     6. A surface blowdown connection shall be provided with y-type strainer, conductivity sensor, surface blowdown controller, electronically operated control valve, flow control valve, and manual bypass. The surface blowdown controller shall be factory programmed for intermittent sampling and proportional blowdown control.
     7. The boiler shall come with lifting eyes accessible for rigging.
     8. Instructions for installation, operation and maintenance of the boiler shall be contained in a manual provided with each boiler.
     9. A wiring diagram corresponding to the boiler configuration shall be included with each boiler.

1. EXECUTION
   1. INSTALLATION
      1. Equipment and materials shall be installed in an approved manner and in accordance with the boiler manufacturers’ installation requirements.
      2. The installer shall construct a flat, level foundation designed to support the entire load. Calculations shall be based upon the maximum or filled weight of the system. The boiler should be located in dry surroundings on a level base, making sure that there is sufficient room around the boiler to enable the operator and/or the maintenance engineer to gain access to all parts of the boiler. Check location for ease of water supply and electrical connections. Place the boiler on a non-combustible floor with clearances to unprotected combustible materials, including plaster or combustible supports.
      3. Assemble unit sections and parts shipped loose or unassembled for shipment purposes. Follow manufacturer's installation recommendations and instructions.
      4. Install electrical control items furnished by manufacturer per wiring diagram provided by manufacturer.
      5. Complete feedwater, steam, blowdown, fuel, safety valve discharge, and vent piping installation as required by manufacturer for operation of system.
      6. Provide applicable air intake and exhaust piping, size and type as recommended by the manufacturer to maintain appropriate draft and rated for the temperatures as listed above.
   2. FIELD QUALITY CONTROL
      1. After boiler installation is completed, the manufacturer shall provide the services of a field representative for starting the unit and training the operator.
      2. Arrange with National Board of Boiler and Pressure Vessel Inspectors for inspection of boilers and piping. Obtain certification for completed boiler units, deliver to Owner, and obtain receipt.

END OF SECTION