SECTION 235233

WATER TUBE BOILER

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Smoke Flue Pipe and Breeching: Section 235116.

B. Cleaning and Testing: Section 230593.

C. Wiring for Motors and Motor Controllers: Section 260523.

D. Motors and Motor Controllers: Section 260221.

E. Seismic Restraints: Section 230550.

1.02 PERFORMANCE REQUIREMENTS

A. Design boiler and boiler supports to withstand all seismic loads. Refer to seismic loading criteria on the Contract Drawings.

B. Seismic Performance: Design and install boilers to assure continued performance of their intended function when subjected to the specified seismic forces.

C. Seismic Performance: Design and install boilers to assure that they remain in place with no separation of any parts when subjected to the specified seismic forces.

D. The design of the boiler and boiler supports shall be performed by a professional engineer experienced in the seismic design of boilers.

1.02 DEFINITIONS

A. Boiler Convection Bank Heating Surface: Surface not exposed to the radiant heat of the fire.

B. Effective Radiant Heating Surface (ERHS): Heat exchange surface within furnace boundaries directly exposed to the radiant heat of the flames on one side and to the medium being heated on the other. This surface shall consist of plain or finned tubes and headers, and plain surfaces which may be bare, metal covered or metallic ore covered. Do not count refractory covered surfaces. Measure surface on the side receiving the radiant heat.

C. Furnace Surface Area: Sum of the projected areas of the furnace enclosure, which includes the four furnace walls, furnace roof and furnace floor.

D. Furnace Volume: Cubical volume between the floor and the first plane of entry into or between the convection tubes. When screen tubes are used at entrance to convection tubes, they shall constitute the plane of entry.

E. Maximum Heat Input: Btu content of the fuel burned per hour in the furnace at maximum continuous load.

1.03 SUBMITTALS

A. Shop Drawings:
1. Boiler manufacturer's name.
2. Boiler manufacturer's supervisor's name and qualifications:
   a. Submit qualification of supervisory personnel simultaneously with shop drawings.
   b. Include with qualifications a list of previous installations, including size and location of boilers, that were installed under the applicant's supervision).
3. Boiler burner assembly drawing:
   a. Boiler details.
   b. Piping diagrams.
   c. Boiler trim items.
4. Boiler nameplate and number plate.
5. Burners.
6. Flame safeguard control system components:
   a. Wiring and logic diagrams.
7. Mechanical draft system:
   a. Fan assembly drawing and details.
   b. Performance data and curves.
   c. Fan inlet damper.
   d. Wiring diagram.
8. Soot blowers:
   a. Piping diagram.
9. Tube rolling and tube cleaning equipment:
   a. Detailed parts list.
10. Uptake damper.
11. Predicted performance data:
   a. Radiant Section.
   b. Heating surface - ERHS basis, sq ft.
   c. Number of tubes.
   d. Size of tubes, OD.
   e. Wall thickness.
   f. Material.
   g. Steam and Water Drums.
   h. Diameter and length.
   i. Shell thickness.
   j. Head thickness.
12. Convection Section:

a. Heating surface - circumferential basis sq ft.
b. Number of tubes.
c. Size of tubes, OD.
d. Wall thickness.
e. Material.

13. Boiler Data:
    a. Working pressure, psig.
    b. Hydrostatic test pressure, psig.
    c. Furnace Volume, cu ft.
    d. Design pressure, psig.
    e. Headers.
    f. Outside diameter.
    g. Wall thickness.
    h. Material.
14. Performance data - Predicted performance data shall be computed for 50 percent, 75 percent, and 100 percent of maximum continuous load.
    a. Output, Mbh.
    b. Steam, pph.
    c. Press. boiler drum, psig.
    d. Temp feed entering boiler, F.
    e. Temp air entering unit, F.
    f. Temp gas leaving boiler, F.
    g. CO2 at boiler exit, percent.
    h. Excess air boiler exit, percent.
    i. Wet gas boiler exit, pph.
    j. Air wt entering unit, pph.
    k. Draft in furnace, inches-water column.
    l. Draft loss thru boiler, inches-water column.
    m. Draft loss thru flues, inches-water column.
    n. Draft loss - total, inches-water column.
    o. Air press. loss thru ducts, inches-water column.
    p. Air press. in windbox, inches-water column.
    q. Air press. - total, inches-water column.
    r. Fuel burned, pph & gpm.
    s. Furnace liberation, Btu/hr/cu ft.
    t. Heat losses.
    u. Dry gas, percent.
    v. Moisture in fuel, percent.
    w. Combustion of H2 percent.
    x. Unburned combustible, percent.
    y. Radiation percent.
    z. Unmeasured losses 1.0 percent.
    aa. Total losses, percent.
    bb. Thermal efficiency, percent.

B. Certificates:
    1. Shop ASME boiler inspection certificates.
    2. Shop boiler hydrostatic test certificates.
    3. Shop boiler acceptance test data sheets.

4. Manufacturer's data reports for the shop construction and hydrostatic test result certification on the appropriate "P" forms contained in the ASME. Boiler Code, Section 1. Certification section shall be signed by a currently qualified boiler inspector in the employ of an insurance company and holding a National Board Commission.
5. Welded piping which requires certification and stamping in accordance to ASME and Industrial Code Rule No. 14 requirements shall be fabricated by a concern holding a certificate of authorization issued by the ASME. Piping shall be inspected during fabrication and the hydrostatic testing witnessed by an inspector employed by an inspection agency contracted by the fabricator. The appropriate "P4-A" forms shall be signed by the inspector and filed with the New York State Department of Labor, Bureau of Boilers.
6. Department of Labor Certification of Inspection:
   a. Deliver to the Director's Representative 2 copies of the NYS Department of Labor certificate of inspection.

B. Quality Control Submittals:
1. Certificates: Affidavit required under Quality Assurance Article.
2. Company Field Advisor Data:
   a. Name, business address and telephone number of Company Field Advisor secured for the required services.
   b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
3. Copy of Seismic Qualifications Certificate.

C. Maintenance Data and Operating Instructions:
1. Furnish 6 copies of the manufacturer's installation, maintenance and operating instruction manuals, complete with schematic wiring diagrams and detailed parts lists for all components of the boilers. Manuals shall contain drawings or pictures of equipment showing part names and numbers to facilitate the ordering of spare parts.

D. Maintenance Materials (Spare Assemblies and Parts):
1. Spare burning tips:
   For burning No. 6 oil (2 required)
   For burning No. 4 oil (2 required)
   For burning No. 2 oil (2 required)
2. Spare atomizing oil guns completely assembled:
   For burning No. 6 oil (_____ required)
   For burning No. 4 oil (_____ required)
   For burning No. 2 oil (_____ required)
3. Two of each size flexible hose connections (total No. _____).
4. One burner vise and wrench for servicing oil burner assembly.

E. Company Field Advisor Data:
1. Name, business address and telephone number of each Advisor.
2. Certified statement from each company listing the qualifications of each Advisor.

3. List services and each product for which authorization is given by the company to each Advisor.

1.04 QUALITY ASSURANCE

A. Equipment Qualifications For Products Other Than Those Specified:
   1. At the time of submission provide written notice to the Director of the intent to propose an "or equal" for products other than those specified. Make the "or equal" submission in a timely manner to allow the Director sufficient time to review the proposed product, perform inspections and witness test demonstrations.
   2. If products other than those specified are proposed for use furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the owners of the 5 comparable installations will allow inspection of their installation by the Director's Representative and the Company Field Advisor.
      a. Make arrangements with the owners of 2 installations (selected by the Director) for inspection of the installations by the Director's Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Director a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
      b. Only references from the actual owner or owner's representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual owners of the proposed products, are not acceptable.
         1) Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.
   3. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
      a. Make arrangements with the test facility for the Director's Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Director a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
   4. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

B. Acceptable Manufacturers: Factory assembled and packaged boilers shall be of a type regularly manufactured and similar units shall have been in operation for a period of not less than 5 years, in the State of New York, or nearby. The Director may require the manufacturer to submit evidence, that not less than 5 different installations of comparable size have been in satisfactory operation for this period of time. The 5 indicated installations shall be accessible for

inspection by the Director's Representative. When installations are not in New York State, pay costs of inspection including travel expenses for 2 Director's Representatives.

C. Design Criteria
1. Maximum continuous load (24 hours): _____lbs per hr.
2. Operating steam header pressure _____ psig.
3. Operating steam drum pressure _____ psig
4. Minimum allowable working pressure _____ psig
5. Feed water temperature _____ degrees F.
6. Final saturated steam temperature at header: _____degrees F.
7. Moisture content of saturated steam with boiler concentrations as qualified in ABMA manual, 1/2 of 1 percent.
8. Maximum furnace heat release rate: _____ Mbh.
9. Minimum effective radiant heating surface: _____ sq ft.
10. Maximum furnace heat release: _____ Mbh.
11. Minimum flue gas temperature at boiler exit under 25 percent of full load shall be not less than 350 degrees F.
12. Maximum boiler water concentrations shall not exceed 3500 ppm of total solids at any steam load.
13. Combustion air temperature: _____ degrees F.

D. Heat Transfer: Base measurement of "Effective Radiant Heating Surface" on the following:
1. Bare, metal-covered or metallic-ore-covered tubes and headers: The projected area (external diameter times length of tube) of the tube or header.
2. Extended surface (metal and metallic surfaces extending from the tubes or headers): Ninety percent of the flat projected area, except that the following are not included:
   a. Metal blocks not integral with the tubes or headers. Extended surfaces less than 1/4 inch thick or more than 1-1/4 inches in length.
   b. That portion of the extended surface which is more than one tube or header radius from the tube or header from which it extends.
3. Furnace Exit Tubes: The projected areas of those portions of the first 2 rows of exit tubes receiving radiant heat from the fire.
4. Heat Transfer: Rate of maximum heat input shall not exceed btu/hr/sq ft of "Effective Radiant Heating Surface".
5. Heat Release: Maximum heat input per cubic foot of furnace volume, as defined herein, shall be not greater than the following limit:
   a. For a boiler in which the effective radiant heating surface is 60 percent or less of the furnace surface area, 54 Mbh/cu ft of furnace volume.
   b. For each percent of increase of the effective radiant heating surface above 60 percent of the furnace surface area, the heat input can be increased by 200 Btu/hr/cu ft.
   c. For a boiler with an effective radiant heating surface equal to 100 percent of the furnace surface area - 62 Mbh/cu ft of furnace volume.

d. Convection Section: The heating surface in the convection section shall be measured as the circumferential area of the tube.
e. Surface Limitations: No surface shall be included in more than one category.

E. Fuel: Design fuel burning equipment for each boiler to burn; Commercial Grade No. _____ (CS-12-48) fuel oil with the following qualitative characteristics as determined by ASTM tests:

Gravity at 60 degrees F _____ API, minimum
Gravity at 60 degrees F _____ API, maximum
Flash Point _____ degrees F, minimum
Pour Point _____ degrees F, maximum
Water and Sediment _____ percent maximum with the amount of sediment by extraction not to exceed 0.5 percent
Sulphur _____ percent, maximum
Viscosity at 122 degrees F, _____ ssf, maximum
Viscosity at 122 degrees F, _____ ssf, minimum
Carbon Residue by weight _____ percent maximum
Heating Value (HHV) _____ Btu/gal
Ultimate Analysis: _____ (percentages by weight)
Carbon _____ percent
Hydrogen _____ percent
Nitrogen _____ percent
Sulphur _____ percent
Oxygen _____ percent

F. Requirements of Regulatory Agencies:
1. Boilers shall be fabricated, tested and installed in accordance with the ASME Boiler Pressure Vessel Code, Section 1.
2. Installation of boilers shall comply with the requirements of Part 4 & 14 of Title 12 Rules and Regulations of the State of New York Industrial Code Rule No. 14 (12NYCRR14).
3. Fuel burning equipment and flame safeguard control equipment shall meet the requirements of the Industrial Risk Insurers (IRI).
4. All electrical components shall be UL listed and installed in accordance with the National Electric Code.
5. Fans shall be licensed to bear the AMCA seal.

G. Source Quality Control:
1. Perform a boiler construction and hydrostatic test at the factory. Test shall be certified on "P" forms contained in the ASME Boiler Code. The "Certificate of Boiler Shop Inspection" shall be signed by a qualified boiler inspector in the employ of an insurance company.
2. Factory boiler inner casing shall be tested pneumatically before the installation of the outer casing. The inner casing shall be gas tight and capable of withstanding a minimum pressure of 15 inches of water gage, and boiler shall be sufficiently tight permitting no more than 10 percent drop in pressure in a 10 minute period. A certified statement indicating that the above test has been satisfactorily performed for each boiler, is

required. Notify the Director a minimum of 3 days before factory casing test is to be performed, to permit the Director's Representative to witness test.

H. Seismic Qualification Certificate: Certificate from boiler manufacturer covering boilers, accessories, supports, and components; and consisting of the following:
1. Basis for Certification: Indicate whether Withstand Certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions, and loads transmitted to structure at each attachment point.
3. Detailed description of equipment anchorage devices on which the certification is based including installation requirements.
4. Comprehensive seismic engineering analysis of boiler and boiler supports.

PART 2 PRODUCTS

2.01 FACTORY PACKAGED WATER TUBE BOILER

A. General Design: Boiler shall be a complete factory assembled and packaged "D" type unit of the fully automatic type consisting of the specified boiler, refractory, insulated casing, dampers, oil burner assembly, flame safeguard control system, forced draft fan assembly with windbox, soot blower system, piping components, electrical components, accessories and trim, all mounted on a steel frame, which shall be an integral part of the unit and shall include all additional steel members for mounting control panel and all accessories. Factory prime and finish coat all exposed surfaces of packaged boiler with high temperature paint. Fabricate shell and head plates of boiler from ASME A 515 grade 70 steel plates. Immediately prior to shipment certain components may be removed, crated and shipped with the boiler, if required to maintain shipping clearances.

B. Steel Base: Mount boiler on a heavy structural steel base, designed to support the completely assembled unit. Provide base with jacking pads and lugs, or equivalent method, to facilitate lifting and handling.

C. Steam Drum: Fabricate drum of ASTM A515, grade 70 steel plate, with seams fusion welded and stress relieved. Weld, test and X-ray all seams in accordance with ASME Code for Power Boilers, Section 1. Install ASME stamp on the exterior of steam drum near the manhole, which must be visible after insulating. Provide steam drum with minimum inside diameter of 36 inches and 2-12 inch x 16 inch manholes with hinged covers.

D. Water Drum: Fabricate drum of ASTM A515, grade 70 steel plate, a minimum of 24 inches outside diameter, welded, tested, stress relieved and X-rayed as specified for steam drum. Water drum fabricated of 24 inch OD seamless steel pipe, in conformance with the ASME Code is acceptable. Provide drum with 2-12 inch x 16 inch manholes with hinged covers.

E. Drum Connections: Provide ASA 300 lb flanged connections for connections 1-1/2 inch in size and larger, and forged steel couplings welded to the drums for all others, unless otherwise specified. Boiler manufacturer's standard connections may be submitted for approval. Drum connections shall include the following:

SERVICE	TYPE	SIZE (Inches)
Steam Outlet	Flanged	6
Safety Valve Outlets	Flanged	As required by ASME Code
Feed Water	Flanged	2
Water Column Connections	Screwed	Minimum
Continuous Blowdown	Screwed	1-1/4
Feedwater Regulator Connections	Screwed	3/4
Chemical Feed	Screwed	3/4
Vent	Screwed	3/4
Boiler Blowoff* (lower drum)	Flanged	1-1/2
Soot Blowers	Flanged	2

*Blowoff connection on the lower drum shall be located at the boiler front.

F. Internal Drum Piping: Provide steam drum with the following internal piping and appurtenances:

Feedwater distribution
Continuous blowdown
Baffles and scrubbers
Chemical feed (chemical feed may be located in lower drum, but piping shall be stainless steel in either case).

G. Boiler Furnace Walls:

1. Provide boiler with an integral furnace with water cooled side walls, roof and floor. Burner wall cooling may be omitted when the windbox covers 50 percent of the firing wall. Water cool a minimum of 60 percent of the rear furnace walls by means of tubes in direct contact with the wall. Water wall tubes may be tangentially spaced or have extended metal surface. Extended metal surfaces shall be as specified herein.
2. Install combustion settings, walls and floors in accordance with the best commercial design utilized by the boiler manufacturer. Install refractory consisting of high heat duty fire brick or tile, or insulating brick or 2000 degree F castable refractory. Provide refractory material in the furnace area of quality and thickness used in best commercial practice for factory assembled units. Cover furnace floor tubes with 2 inch thick refractory.

H. Boiler Tubes: Provide seamless or electric resistance welded boiler tubes conforming to ASME Code for the working pressure specified, a minimum of 2 inches OD. Provide sufficient straight length of tubes at point of entry into drum, to allow the use of tapered tube plugs. Design tube arrangement to provide free natural circulation in the proper direction at all loads. Design tube bends so that there are no measurable liquid retaining pockets which might prevent complete

drainage, or will interfere with internal cleaning by conventional methods. Where baffles are employed, arrange them to properly diffuse the gases over the heating surfaces, to obtain maximum heat absorption. Secure baffles in place in a manner whereby they will not be affected by or interfere with the expansion or contraction of the boiler. Provide baffles of the boiler manufacturer's standard construction, capable of withstanding the highest temperature developed during continuous maximum capacity operation.

I. Boiler Insulation and Casing: Provide all boilers with double casings.

1. Provide inner casing of the manufacturer's standard design, fabricated from a minimum of No. 10 gauge sheet steel or welded fin type panels. Provide gas tight inner casings suitable for pressurized firing.
2. Provide outer casing fabricated from sheet steel a minimum of No. 12 gage. Fabricate casing section over top of steam drum from No. 14 gage sheet steel. Provide casing of welded or bolted construction, stiffened by structural channels, angles or ribs. Do not submit corrugated sheet metal casings for approval.
3. Equip casing with a gas tight refractory lined steel access door, a minimum of 11 inches x 15 inches having a positive means of maintaining closure. Close opening with loose insulating firebrick or insulation. Provide access doors in addition to any provision made for utilizing burner opening for access.
4. Insulate all boiler exterior surfaces except drumheads, doors, vents and appurtenances. Insulate drum heads after boiler installation. Make provisions for removing manhole covers without disturbing insulation.
5. Install insulation of quality and thermal conductivity which will result in a maximum differential of 50 degrees F between the outer casing surface the ambient temperature, with a surface air velocity of 100 fpm when the boiler is operating at maximum continuous capacity.

J. Observation Ports: Provide a minimum of 2 observation ports to allow for proper observation of combustion conditions within the furnace and to permit a view of the entire inside surfaces of the furnace, including both side water walls. One port may be located in the oil burner or register. Equip each port with tinted glass and protective cover.

K. Uptake Damper: Provide an uptake damper of the opposed blade type in the smoke flue connection from boiler. Fabricate frame from 8 inch steel channel; damper blades from No. 14 gage black sheet steel, with bronze sleeve bearings and rods of one inch minimum diameter solid cold rolled steel. Provide damper with all attachments required for manual operation from the boiler room floor and operation by the combustion control positioner and be arranged for proper setting and fixing in any desired position. Provide damper mechanism with an adjustable stop and micro-switch to allow for minimum flue area as approved. Provide an observation door in the uptake breeching next to the uptake damper.

L. Manufacturer's Name Plate: Provide a bronze manufacturer's name plate securely attached to each boiler, stamped with the following information:

Type of Boiler

Model designation
Serial Number
Rated capacity, at max continuous load
Maximum allowable working pressure
Effective radiant heating surface
Convection Surface
Furnace volume
Year of manufacture

M. Number Plate: Provide plate with the number assigned to the boiler by the State Labor Department and the plant boiler number.

N. Steam Atomizing Oil Burner:

1. General Design: Design burner for firing with No. 6 fuel oil as the primary fuel and also for use with No. 4 and No. 2 fuel oils.
2. Burner: Provide inside mix, wide range, variable capacity burner with stainless steel atomizing gun capable of efficiently burning Nos. _____ fuel oils and producing a continuous and stable flame, throughout a 5 to 1 turndown ratio. Furnish burner capable of producing full boiler capacity with a minimum oil and steam pressure of psig at burner. Regulate steam pressure by means of a control valve responding to the oil pressure maintained by oil control valves. Maintain the relationship of steam pressure to oil pressure to suit the particular oil burning system, within the limits previously specified. Furnish burner complete with all valves and controls as indicated and as specified. In addition to the main atomizer, provide each burner with a stainless steel auxiliary atomizer of the same capacity as the main atomizer.
3. Air Register: Provide oil burner with a dual circular forced draft air register with adjustable louvers. Air register shall be suitable for forced draft air supply and designed for mounting igniter, flame failure devices, tinted glass peep hole in addition to gun mounting. Provide air control louvers with an adjustable handle. Provide hinged or bolted register front to allow entire burner assembly to be opened for access to the furnace or for examination of parts. Fabricate air register frame from cast iron or steel.
4. Burner Throat: Provide burner with a multi-piece refractory throat tile designed for installation in the approved boiler.

O. Alternate Air Atomizing Oil Burner:

1. Air atomizing burners may be submitted for approval. Submit burners having characteristics essentially equivalent to those specified for steam atomizing burners, complete with all required auxiliary equipment such as a remotely located atomizing air pump assembly, piping, gages and all accessories required for a complete air atomizing oil burner system. Provide any additional electric service, piping and appurtenances required by the use of air atomizing burners at no additional cost to the State. Metering of secondary air may be accomplished by automatic operation of the secondary air damper, in lieu of a fan inlet damper.

P. Mechanical Pressure Atomizing Oil Burner:

1. Burner: Provide wide range, variable capacity type, capable of efficiently burning No. 6 fuel oil at 300 psig and 180 ssu, and producing a continuous stable flame, throughout a 5 to 1 turndown ratio in firing rate, without changing tips or making other manual adjustments. Furnish burner capable of firing the boiler up to a peak load of _____ lbs of steam per hour, plus an additional safety factor of 25 percent. Furnish burner complete with all valves and controls. In addition to the main atomizer, provide burner with an auxiliary atomizer complete with all required valves, controls and appurtenances.
2. Air Register: Provide oil burner with a circular forced draft register, with steel air control louvers adjustable by means of an external lever. Design register for mounting igniter, flame failure devices, tinted glass peephole, in addition to burner. Provide hinged or bolted register front to allow entire burner assembly to be opened for access to the furnace or for examination of parts. fabricate air register from steel or cast iron.

Q. Natural Gas Burner: Provide a ring, multi-port peripheral type burner, designed to inject many high velocity jets of gas into the combustion air stream. Furnish burner capable of efficiently burning natural gas and producing a continuous stable flame, throughout a 5 to 1 turndown ratio.

R. Combination Oil-Gas Burner:
1. Equip boiler with variable capacity, wide range, fuel oil and gas burners, complete with forced draft registers. Furnish burners capable of at least 5 to 1 turndown ratio and with capacity as required to fire the boiler to maximum continuous load of _____ lbs of steam per hour.
2. Fabricate air register from steel, with hinged front to allow access to furnace or for examination of parts. Provide register with the following:

   Steel air control louvers, adjustable by means of an external lever.
   Tinted glass peephole with protective cover.
   Gas-electric ignition system.
   Gas ring or space to allow for gas firing.
   Flame failure device with one scanner per burner.

3. Provide burner with a multi-piece venturi tile designed for mounting in the approved boiler.

S. Flame Safequard Control System:
1. General Design: provide a flame safeguard control system for each burner consisting of an ultra violet flame detector, electric primary controller and program control, circuit breakers, limit switches, fuel safety shut-off valves and all accessories required to make up a complete system. Coordinate flame safeguard control system with combustion control system.
2. System Functions required to be performed:

   Manually actuated start by push button.
   Automatic component check before start up.

Timed pre-purge cycle (60 seconds) with low-high-low proved damper operation.
10 second timed trial for pilot ignition.
15 second timed trial for main flame ignition.
Fire rate control with guaranteed low fire start.
Timed post purge.

3. System conditions requiring a non-recycling shut down:

Electrical failure.
Loss or failure to establish flame.
Low boiler drum water level.
Loss of combustion air.
Low oil temperature.
Low atomizing steam pressure.

4. System Sub-panel and Related Accessories:
   a. Provide a complete factory assembled, prewired and test sub-panel, assembled with UL approved components. Fabricate panel in accordance with NEMA standards, with hinged gasketed door with latch and lock, designed for flush mounting on boiler control panel. Install all flame failure relays, circuit breakers, push buttons and indicating lights completely wired in the panel. Mount all push buttons, indicating lights and selector switches on the panel front, with approved laminated plastic engraved nameplates. Provide 2 wire, grounded, 120 volt, 1 phase control circuitry. Run all wiring to labeled terminal strips for field wiring connections.
   b. Provide electronic controller complete with an electronic circuit, master relay, flame detector relay, timer and required appurtenances, all prewired by the flame safeguard control manufacturer and mounted on a chassis, to provide for removal without disturbing the wiring connections. Controller shall be Fireye Type UVP-2, Model 6580 or Honeywell Model 4126A designed for operation on 120 volt circuit.
   c. Provide flame detector of the ultraviolet type, with the tube installed in protective cast aluminum removable enclosure with provisions for purge air connection. Mount unit on sighting tube properly placed to scan both pilot and main flame.
   d. Provide safety shut-off valves for instant and positive fuel shut-off upon shut down of the flame failure system, by the limits. Valves shall be IRI approved.
   e. Oil safety shut-off valve, OSSV _____, shall be a 3 way solenoid valve. Furnish General Controls Model No. HOV-13A.
   f. Gas safety shut-off valve, GSSV _____, shall consist of a triple solenoid valve assembly using 2 automatic opening, spring closing valves and one automatic closing, spring opening vent valve. Furnish Maxon Model No. 4808F.
   g. Provide gas pilot and gas vent solenoid valves, having soft seat construction with 0 psig minimum operating pressure differential. Furnish ASCO Bulletin No. 8042 or 8210.

h. Provide steam safety shut-off valve, SSV _____. Furnish ASCO Bulletin No. 8222.

i. Provide pressure and temperature limit switches in general purpose NEMA-1 plain steel cases complete with glass lens front, variable setting dial and mercury switch. For pressure sensors install bourdon type, differential pressure units of the diaphragm operated type and for temperature sensing install vapor actuated bourdon tube type. Provide IRI approved switches.

j. Provide an alarm circuit with a "Flame-out" pilot light, audible horn to sound on a flame out and a silence button.

k. Provide a Westinghouse No. EB-1015 thermal circuit breaker in panel.

l. Provide external wiring between the sub-panel and the flame detector, fuel safety shut-off valves, pilot valves, limit switches and electrical accessories, all in accordance with the appropriate electrical sections of this specification.

m. Provide fuel selector switch: "Primary Fuel" and "Secondary Fuel".

T. Piping Components:

1. General: Provide on the burner assembly the piping, fittings, valves, gages and accessories required for a complete approved IRI fuel piping train. Arrange piping neatly on the boiler front or in the burner assembly, so as to be readily accessible for maintenance and adjustment.
2. Flexible Metal Hose: Provide each burner connection including auxiliary burner and each pilot connection with a flexible stainless steel metal hose connection to allow for swing of the hinged burner front. Provide hose with a corrugated stainless steel base tube covered with a braided wire jacket, designed for a working pressure of 300 psi and 450 degrees F, with a screwed male coupling on one end and a union coupling on the other.
3. Differential Pressure Control Valve - Provide valve of the self-contained spring actuating regulating type, with a cast iron body, stainless steel valve seat and plug, bronze trim, closing cap and tapped spring chamber. Valve shall be Cash 1000HP-1+6.
4. Pressure Control Valve - Provide valve of the self-contained balanced diaphragm type with accurate pressure control, of size and capacity as required by the application. Valve shall have stainless steel trim, soft composition discs for complete shut-off and synthetic rubber diaphragms, as manufactured by Fisher.

U. Accessories and Trim:

1. Provide accessories and trim for boiler as specified and as required by all applicable codes.
2. Plugged Cross Fittings: provide piping 1-1/4 inches and smaller, from boiler accessories to boiler, with plugged crosses at each change of direction. This piping shall include, but not be limited to, continuous blowdown piping, water column piping, low water cut-off piping and chemical feed piping.

3. Soot Blowers: Provide steam operated, valve-in-head type complete with wall sleeves, clamps, hangers, supports, operating chains and other appurtenances required for a complete installation. The number of valve and element units required to effectively clean the boiler shall be as recommended by the soot blower manufacturer. Those elements exposed in the first pass shall be an alloy of 18 to 28 percent chromium content. Those exposed in the second pass shall be calorized. The remaining shall be of extra heavy steel. Bearings shall be of like grade to the elements with which they are used. Elements shall not exceed 20 ft in length and shall be of such length, diameter and total nozzle area for the operating pressure involved, so that there will be no significant difference in the cleaning effect of the nozzle nearest the inlet and that farthest from the inlet of the element. Operating heads shall be single chain, valve-in-head type with cam actuated poppet valves. Valve seats, discs, and stems with all parts exposed to steam shall be of stainless steel, alloy or monel metal as approved. Heads must be supported and equipped with a floating wall sleeve to allow for expansion between the boiler and setting without binding the element. Wall sleeves shall have an air seal to prevent infiltration of air. Drain bottom of each soot blower supply header to suitable point of waste through a 3/4 inch connection. Provide a 3/4 inch valve with a 3/16 inch hole drilled in valve seat in the 3/4 inch drain connection.
4. Safety Valves: Provide safety valves as required by the ASME Code, but in no case less than 2 valves. Provide valves with settings as required by the code. Provide one gag for each safety valve, plus additional gags as required to permit running a hydrostatic test on one boiler.
5. Steam Pressure Gage: Provide minimum 8 inch diameter dial size. Refer to Section 232003.
6. Adjustable Dial Type Thermometers: provide ASME approved type. Refer to Section 232003.
7. Drum Blow-off Valves: Provide every boiler blow-off connection with 2 blow-off valves or with one tandem type blow-off valve. Provide continuous blow-down pipe with 2 valves incorporated in piping arrangement.
8. High Steam Pressure Limit Switch: Provide Honeywell L404C switch, with manual reset switch, to stop fuel flow at excess pressure, wired through the flame safeguard control.
9. Provide water column and gage glass with a high and low water alarm and primary low water cut-off in compliance with the applicable requirements of the ASME Boiler and Pressure Vessel Code.
    a. Fabricate unit designed for a working pressure of psig minimum. Provide completely piped water column, which shall include an inclined pyrex gage glass 3/4 inch OD. Provide water column Model No. W-25 as manufactured by Magnetrol. Equip water column with separate chain operated blow-down valve for water column and gage glass; switches for high and low water alarm and primary low water cut off; 2 stainless steel floats and an electric gage glass illuminator.
10. Provide the water column with the following water level safeguards:

a. A low water alarm, set to energize the alarm bell when the water level is 2 inches above the lowest permissible level.
b. A high water alarm, set to energize the alarm bell when the water level is 2 inches below the highest permissible level.
c. A primary low water cut off to shut off the flow of oil when the water reaches the lowest permissible level. Wire low water cut off through the flame safeguard control.
d. A secondary low water cut off, physically independent of the primary low water cut off. Fabricate chamber designed for a working pressure of _____ psig, with a stainless steel float stem and enclosing tube. Provide Model No. W25, as manufactured by Magnetrol.
e. Function of both the primary and the secondary low water cut off is to close the fuel feed valve in the event of low water. Provide an automatic reset for each cut off.
f. Provide a remote instantaneous type of switch to shunt the 2 cut off switches. Purpose of this switch is to eliminate the closing of the fuel valve, when blowing down the water column or gage glass.
g. Provide shut off valves in the piping arrangement between boiler and water column or between boiler and the shut off valves required for the gage glass. Provide valves of the OS&Y or lever lifting type gate valves. Valves shall indicate by the position of the operating mechanism whether they are in open or closed position and shall be locked or sealed open.

11. Feed Water Level Control:
a. Control feed to boiler by means of a 2 element control valve. The steam flow transmitter shall transmit a signal to a controller which will activate the feed water valve to the position that is directly proportional to the steam flow. Drum level transmitter shall transmit any variation from the drum level set point to the controller. Variation signal which is proportional to drum level shall combine with the steam flow signal and bias the final output of the controller to effectively reset the drum level to the set point. Control station shall have set point, proportional band reset adjustment and auto-manual station.
b. Feedwater flow control system shall maintain the water level in the boiler drum within plus or minus one inch of normal operating level, exclusive of excessive shrink or swell. Provide pneumatic or electronically operated system within the same control range as the combustion controls.
c. Provide a valved by-pass arrangement around each feedwater regulator including shut-off gate valves on each side of feedwater regulator and a globe valve in the by-pass piping.

V. Forced Draft Fan and Windbox:
1. General Design: Provide a factory installed electric motor driven forced draft fan and air flow system for boiler consisting of fan, fan drive, fan inlet damper and necessary controllers, integrally mounted in a shell type windbox of such a physical size, so as to allow for the factory mounting

of all required devices. Provide windbox of the boiler manufacturer's standard design, welded directly to furnace front mounting plate and covering a minimum of 50 percent of the firing wall. Total static pressure of fan shall include losses due to boiler, breeching, stack, dust collector, ducts and all appurtenances. Total fan capacity shall include, in addition to the maximum continuous load of the boiler, a 15 percent excess air requirement and a safety factor of 20 percent of the total volume. Total static pressure required shall include a minimum safety factor of 25 percent above the total required.

2. Windbox: Fabricate from minimum 1/4 inch thick sheet steel, with internal bracing to prevent buckling and vibration. Frame all corners with angle iron and render the entire windbox airtight.
3. Fan: Provide an all welded, single width, single inlet, centrifugal type fan complying with Class II or greater construction as defined by AMCA. Reinforce fan housing with structural steel members to prevent buckling and vibration at the designed operating speed of fan. Provide fan wheel of the backward curved non-overloading type. Balance fan statically and dynamically at factory. Provide fan shafts of ample size, accurately turned so as to prevent whipping under all operating conditions. Shaft bearings shall be heavy duty ball or sleeve type. Provide sight glass oiler, when oil type bearings are used. Protect air inlet openings with easily removable heavy duty corrosion resistant steel mesh guards with 3/4 inch openings.
4. Fan Mounting: When the fan is mounted other than at the front of the boiler, provide a suitable air duct and connections between the fan the boiler windbox.
5. Variable Inlet Vanes: Provide a control, at the center of the inlet vanes of the fan inlet damper, arranged for operation by the combustion control system.
6. Electric Motor Drive:
   a. Direct Drive: Provide drive with fan wheel mounted directly on the motor shaft by the fan manufacturer.
   b. Belt Drive: Provide drive with fan wheel shaft driven by means of V-belts. Provide belts with a service factor 50 percent greater than the rated horsepower of the motor; sheaves of cast iron or steel with interchangeable tapered hubs; motor rails for adjustment of belt tension and belt guards in compliance with the New York State Labor Code.
7. Steam Turbine Drive:
   a. Couple fan wheel shaft to the output shaft of a speed reducer having an output speed or not over 1750 rpm. Furnish speed reducer integral with the steam turbine or coupled thereto by means of a flexible coupling.
   b. Furnish gear reducer with helical or herringbone gears, splash lubrication and oil reservoir equipped with a protected glass oil level indicator.
   c. Furnish metallic self-aligning couplings fabricated of forged steel with properly hardened cut teeth; dust and moisture proof, with provision for internal lubrication. Provide "Fast" coupling, as manufactured by Koppers Co.

d. Refer to Section _____ for steam turbines.

W. Motor Controllers: Refer to Section 260221.

2.02 TUBE CLEANING EQUIPMENT

A. General:

1. Furnish tube cleaning apparatus of the air driven type, sized and arranged for proper operation in curved boiler tubes of size and length as required by the approved boilers.
2. Furnish the following items of air driven tube cleaning equipment:

QUANTITY	ITEM
1 or more	Air motor or motors, as approved
1	Rotor wrench
1	Spare set of rotor blades
1	Universal joint
2	Spare pins for universal joints
2	Drill heads
1	Cutter head complete with universal joint
4	Spare sets of cutters
2	Spare sets of cutter pins
1	Spare set of hinge pins
1	Expanding wire brush
12	Spare sets of brush refills
2	Flexible brush holders
75 ft	One 50 ft length and one 25 ft length of heavy duty armored air hose with couplings and necessary attachments to connect air hose to air piping outlets.
1	Air valve for installation between air hose and air motor.
1	Automatic air line lubricator
1	Tool box
4	Copies of instruction sheet(s)
1	Replacement parts list
1	Wire buffing brush complete with air motor to be attached to air hose for cleaning drums.

3. Furnish 2 key extractors if the approved boilers have key caps in lieu of manholes.

2.03 TUBE ROLLING EQUIPMENT

A. General:

1. Furnish the following equipment for each size boiler tube required by the approved boilers:

QUANTITY	ITEM
1	Expander
1	Short series mandrel
1	Drum mandrel
1	Header mandrel
1	Universal joint
1	Reversible ratchet wrench
1	Extension shaft - 4 inches long
1	Extension shaft - 12 inches long
1	Extension shaft - 24 inches long
1	Parallel gear drive - if required by the boiler furnished.
1	Right angle gear drive - if required by the boiler furnished.

2. Drives: Furnish proper size drives for all ratchets, mandrels, extension shafts and miscellaneous equipment designed for the service intended.
3. Manufacture: Furnish Type "M" expander equipment for tube sizes 1 inch thru 1-1/2 inch OD and Type "K" for tube sizes 2 inches and larger, all as manufactured by Elliott Division of the Carrier Corporation.

PART 3 EXECUTION

3.01 PREPARATORY WORK

A. Temporary Piping and Equipment:
   1. Provide a means for exhausting steam to the atmosphere during boiler testing. The following equipment to be used for testing will be furnished by the State and made available to the Contractor at the site for installation:
      a. Steam flow recorder and controller, including a pneumatic transmitter.
      b. Control valve.
      c. Exhaust muffler.
   2. Provide all piping and connections in addition to the equipment furnished by the State, and indicated on the drawings, including an air set for supplying 20 psig air.
   3. Upon completion of boiler tests, disconnect and remove piping and equipment used for temporary steam exhaust. Turn over the steam recorder, control valve and exhaust muffler to the Director's Representative at the Site. All other temporary equipment and piping shall remain the property of the Contractor.

B. Provide framed glass holder for NYS Department of Labor certificate of inspection, and post near the boiler prior to operation of the boiler.

C. Fasten two inch high metal identification numbers corresponding to numbers assigned by NYS Department of Labor Commissioner to a metal mounting plate and securely attach to the front of the boiler or front of boiler settings.

3.02 FIELD QUALITY CONTROL

A. Department of Labor Inspection: Arrange with NYS Department of Labor for inspection of boiler upon completion of installation.
   1. Do not operate boilers until NYS Department of Labor inspection is made and a Certificate of Inspection is received.
   2. Pay application and inspection fees required by NYS Department of Labor.
   3. Preparation of Boiler for Inspection: Prepare boiler for internal inspection or hydrostatic pressure test on the date specified by the Department of Labor inspector.
      a. Remove manhole and handhole plates, and washout plugs in the water column connection.
      b. Remove grates of internally fired boilers.
      c. Remove as directed by the NYS Department of Labor inspector, brick work and insulation.
      d. Remove steam gage for testing if required by NYS Department of Labor inspector.
      e. Stop leaks of steam or hot water into the boiler being inspected from the other components.
      f. Provide to the NYS Department of Labor inspector a competent person to be placed under the inspector's supervision to disassemble, reassemble, test adjust, operate or forcible handling any part of the boiler.

B. Supervisory Personnel: Engage the services of a Company Field Advisor representing the boiler manufacturer, for a period of not less than days (8 hours per day). If more than one Company Field Advisor is required, include them as part of this contract. In the event the entire _____ days of supervisory time, required under the Work of this Contract are not expended, the State shall receive a suitable credit. Supervisory services shall include the following:
   1. Boiler installation.
   2. Boiler pre-start-up: Inspect installations, make required adjustments on fuel burning equipment and boiler controls, inform the Director's Representative of any Work which must be completed or modified prior to firing boilers.
   3. Boiler boil-out and dry-out.
   4. Initial boiler start-up and adjustment: Do not fire boilers unless the Company Field Advisor is present.
   5. Boiler testing: Do not conduct testing unless the Company Field Advisor is present.
   6. Training of State personnel.
   7. Service.

C. Drying Out: Dry out boiler refractory and breeching insulation by means of slow burning wood fires, for a period of not less than 24 hours. If at the end of this time additional drying is required, continue the slow burning wood fires until such time as directed.

D. Boiler Field Testing:

1. Perform an inspection and field hydrostatic test on each boiler and all piping within the jurisdiction of the ASME Boiler Code, when installed in their permanent locations.
   a. To obtain official certification of the internal field inspection and the field hydrostatic test, the Contractor shall have the NYS Department of Labor inspector make the inspection, witness and certify the test.
   b. If the Contractor has a contract with an inspection agency, which is authorized to inspect, test and fill out the required "P" forms, he may have that agency certify the field inspection and hydrostatic test.
2. Hydrostatic Test Requirements:
   a. Before starting field hydrostatic test, check test pressure gage for accuracy by means of a dead-weight gage tester.
   b. If the piping covered by the Code and attached to the boiler is not fabricated and installed by the boiler manufacturer, it shall be fabricated and installed by a firm authorized to use the appropriate ASME stamps.
   c. Water used for field hydrostatic test may be the same temperature as the surrounding air, but in no case less than 70 degrees F.
   d. Remove safety valves or secure valve discs to seats by means of test clamps during hydrostatic test. Do not secure discs to seats by turning down compression screws upon springs.
   e. Subject each boiler to a field hydrostatic test pressure of 1-1/2 times the maximum allowable working pressure. Maintain pressure under proper control so that in no case shall the required test pressure be exceeded by more than 6 percent.
   f. Notify NYS Department of Labor to make the required internal inspection and hydrostatic test.
3. Pneumatic Test: Perform a pneumatic test on each boiler, when installed in its permanent location. Seal tight all air openings and flue gas outlets and test with pressure developed by the forced draft fan. Introduce smoke into the furnace through the boiler inlet. Make visual inspection for smoke leakage in the presence of the Director's Representative. Seal all leaks. Supply all equipment required to perform the test.

E. Boiler Acceptance Test: Install and test all auxiliary equipment for the boilers such as controls, instruments, fuel burning equipment, heaters, pumps, soot blowers, etc., in complete accordance with the manufacturer's instructions. Operate and adjust the aforementioned auxiliary equipment, so that when the final acceptance test is started, there should be little chance for interruptions.

1. Provide fuel for start-up, preliminary and acceptance tests. Fuel remaining after testing shall become the property of the State. Soon after fuel delivery, have an ultimate analysis of the test fuel performed, which may be used for preliminary efficiency calculations. Do not use the above analysis in determining the efficiency for the final acceptance test.

2. Do not fire any boiler unless the refractories and breeching insulation have been thoroughly dried out to the satisfaction of the Director's Representative.
3. Conduct boiler tests in strict accordance with the ASME Power Test Code PTC 4.1, using the ASME Test Form for Abbreviated Efficiency Test bound therein. Use the heat loss method to determine the Actual Gross Efficiency. Approximate, Line 69 of the Test Form ("Heat Loss Due to Radiation") by use of the ABMA Standard Radiation Loss Chart, bound in PTC 4.1. Assume Line 70 of the Test Form ("Unmeasured Losses") to be _____ percent. (1.5 percent solid fuel; 1.0 percent oil or gas).
4. Test Code Modifications: Strictly adhere to the ASME Power Test Code, with such minor modifications as the field conditions require and with agreements made with Contractor and Company Field Advisor before the start of the test.
5. Do not use permanent installed gages for hydrostatic pressure tests.
6. Control instruments installed under this Contract may be used for tests.
7. Provide all necessary connections, labor materials and instruments (in addition to those specified under Section entitled "Controls and Instrumentation") required in conducting tests without additional cost to the State. This includes all chemicals required for boiler water treatment during all boiler testing.
8. Do not operate soot blowers during boiler tests.

F. Preliminary Tests:
1. The purpose of the preliminary tests is to ensure that all power plant equipment is in working order; properly adjusted and in complete readiness for the acceptance test. Complete preliminary tests on all boilers before starting acceptance test.
2. During preliminary tests the Director's Representative will be present. Approval for satisfactory performance of the preliminary tests, in accordance with these specifications, will be made by the Director's Representative.
3. Due to the preliminary nature of the tests, interruptions to readjust or recheck equipment are expected and several starts or stops may be necessary before the continuous full load can be obtained.
4. Operate each of the boilers for a minimum of 2 continuous hours at its maximum continuous load. During the preliminary test, take all fuel, steam and other readings, that are required by the acceptance test.
5. The preliminary test shall be considered satisfactory when the equipment has performed properly and the readings for 2 continuous hours indicate an efficiency within 3 percentage points of the predicted Guaranteed Gross Efficiency.

G. Acceptance Test: Upon successful completion of preliminary tests, a minimum period of 2 days shall elapse before the acceptance tests may be conducted. This period is for the purpose of: Assembling the required personnel at the site; setting up the test equipment and permitting the Contractor to make any and all adjustments and changes required. Run the acceptance test on one of the boilers.

Selection of the boiler for testing, as well as the time for the test, will be made by the Director's Representative.

1. Pre-Test Requirements: Prior to the start of the acceptance test, the following shall have been performed:
   a. Preliminary tests on all boilers installed under this Contract.
   b. Adjustments and changes indicated as a result of the preliminary tests.
   c. Installation of apparatus required for the acceptance test.
   d. Assembly at the site of all required personnel required for conducting and observing test.
2. Test Personnel:
   a. Tests will be conducted by the State in the presence of and with the assistance of the Contractor and the Company Field Advisors. In addition to Company Field Advisors representing the boiler manufacturer, Company Field Advisors from the manufacturers of the fuel burning equipment, combustion control and boiler water treatment are required to be present during the test.
   b. The Test Chief charged with the responsibility of conducting the acceptance test will be a Director's Representative. The Test Chief will be responsible for verifying that all meters and instruments, (including plant instruments required to be used for acceptance test), are accurately set, calibrated and adjusted in his presence. Any additional instruments required shall be furnished by the Contractor. Test direct reading gages with a dead weight tester. The Test Chief is responsible for the complete and accurate recording of all data.
3. Adjustments of Equipment: Upon the start of the acceptance test, no adjustments of any kind will be permitted without the approval of the Test Chief, with the exception that maintenance of a constant load on the boiler shall be accomplished by manual adjustment of the master with the combustion control in "automatic" operation. When permission for an adjustment is granted, make adjustment in the presence of the Test Chief or a person delegated by him. Note the reason and the magnitude of all adjustments in the test log. Unauthorized adjustment or tampering with any appurtenances or controls shall be regarded as sufficient reason for voiding the test. If test is voided, conduct another test as directed.
4. Length of Tests: The boiler acceptance test shall consist of 2 runs, totaling 8 hours, at as near _____ lbs/hr (at 75 percent load) as field conditions permit. Run test for verification of the Guaranteed Gross Efficiency of the unit.
5. Test Fuel Samples: During the test, periodically take fuel samples and turn them over to the Test Chief. The State will forward a representative fuel sample to a testing laboratory for analysis. This analysis will be used to determine the Actual Gross Efficiency. Fuel analysis shall be Ultimate Analysis.
6. Efficiency Computations: The State will calculate the Actual Gross Efficiency from the official test data by making arithmetic averages of the readings and using the ASME Calculation Sheet for Abbreviated

Efficiency Test. Heat losses will not be adjusted for variations in fuel or changes in inlet air temperatures.

7. Failure to Attain Guaranteed Efficiency: Should the boiler fail to attain the guaranteed efficiency required, corrective measures shall be made at no expense to the State and as approved by the State. When these corrective measures have been made, perform an unofficial test to determine the results of the corrective measures. When the unit meets the guaranteed efficiency, notify the Director's Representative who will designate a time for a new acceptance test, which shall be in strict accordance with all of the aforementioned specified requirements. Proven corrective measures made on one unit shall then be made on all other units.
8. No approval of the heating plant will be given until the test data has been completed, recorded, computed and conclusions written.
9. In addition to the acceptance test above, run a 2 hour test at maximum continuous load.

H. Boiler Operation Test:

1. General: Perform operational tests on each boiler, all auxiliary equipment and appurtenances to demonstrate the satisfactory overall performance and operation of the plant. Perform operational tests firing boilers with No. 6 fuel oil. In the event No. 6 fuel is not available for test purposes and No. 2 or 4 is utilized, adjust the efficiency accordingly for the fuel utilized.
2. Prior to the start of each test, thoroughly clean the boiler heating surfaces. Before the start of the actual operational test, operate the boiler at the test load for a sufficient length of time to establish equilibrium, as indicated by not less than 4 consecutive instrument readings at 15 minute intervals.
3. Test each boiler for a minimum of 2 hours at the Gross Output Capacity. During the test period record instrument readings every 15 minutes.
4. Conduct boiler tests in strict accordance with the ASME Power Test Code PTC 4.1 using the ASME Test Form for Abbreviated Efficiency Test bound therein. Use the heat loss method to determine the Actual Gross Efficiency. Approximate, Line 69 of the Test Form ("Heat Loss Due to Radiation") by use of the ABMA Standard Radiation Loss Chart, bound in PTC 4.1. Assume, Line 70 of the Test Form ("Unmeasured Losses") to be _____ percent. (1.5 percent solid fuel; 1.0 percent oil or gas).
5. Tests will be conducted by the State in the presence of and with the assistance of the Contractor. Operate the boiler and heating plant equipment connected to the boiler under test. In addition to a Company Field Advisor representing the boiler manufacturer, engage a Company Field Advisor from the boiler water treatment company who shall be present to supervise the operation of the water treatment equipment.
6. Perform test utilizing installed instruments. Any other instruments will be provided by others.
7. Fuel for start-up, preliminary and operational test will be provided by others.

8. Installation and testing of fuel burning equipment shall be as approved by the boiler manufacturer's Company Field Advisor.
9. Installation and testing controls and instruments shall be as approved by the boiler manufacturer's Company Field Advisor.
10. Approval of boilers will not be given until the test data has been completed, recorded, computed, and conclusions written.

I. Training of State Personnel: The Company Field Advisor shall instruct duly authorized State personnel in the operation and maintenance of the boilers and all appurtenant accessories. Provide a period of day (8 hours per day), not to include travel time, for on-site instruction of State personnel. The time shall be exclusive of all prestart-up, start-up and service call time. The Company Field Advisor shall be capable of instruction in all phases of boiler construction, operation and accessories. If more than one Advisor is required to adequately cover the overall subject (boilers, burners, controls and accessories), the instruction time shall be consecutive not concurrent.

END OF SECTION