PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

1.2 REFERENCES

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2014.

.2 CSA Group

.1 CSA B149.1-10, Natural Gas and Propane Installation Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate on drawings:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Foundations with loadings, anchor bolt arrangements.

.4 Piping hook-ups.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 All miscellaneous equipment.

.8 Flame safety control system.

.9 Breeching and stack configuration.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, and 100% of design capacity.

.2 Radiant heat loss at 100% design capacity.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance applicable Provincial regulations.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra materials:

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.1 Special tools for burners, access opening, handholes and Operation and Maintenance.

.2 Spare parts for 1 year of operation.

.3 Spare gaskets.

.4 Spare gauge glass inserts.

.5 Probes and sealants for electronic indication.

.6 Spare burner tips.

.7 Spare burner gun.

.8 Safety valve test gauge.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect boiler and equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 LOW WATER VOLUME BOILER

.1 The steam generators shall be (1) 300BHP Low Water Volume Boiler.

.2 The steam generator shall be ASME approved and shall be field approved by TSSA.

.3 The steam generator shall be of recirculating, forced circulation, low volume watertube, skid mounted type. Each unit shall be capable of achieving full rated output within five (5) minutes from a cold start without the possibility of thermal shock. Low fire hold controls are not an acceptable alternate.

.4 The steam generator shall incorporate a fully modulating, forced draft burner with 10:I turndown ratio on natural gas firing. There shall be no difference in steam quality across the entire operating range of the steam generator.

.5 NOx emissions of the steam generator shall not exceed 49.6 ppm corrected to 3% O2 when firing natural gas.

.6 The steam generator shall be recirculated through the steam generator without returning to the deaerator or feedwater source.

.7 The steam generator shall be installed within an air casing pressurized by the combustion air blower. All combustion air shall be preheated by double wall casing running the complete length of the boiler casing. Feedwater, fuel, and air will be metered to the steam generator as a function of steam PID pressure sensor.

.8 The steam generator will be equipped with an electronic excess steam pressure control, burner, and automatic ignition. The steam generating section will be removable from the back of the unit. The saturated steam generator, auxiliaries, and controls will be mounted on a common base. All components on the base will be piped and wired. Components furnished include the circulating pump, forced draft blower, steam drum, pressure control instruments, temperature control instruments, pressure gauges, motor starters and push-buttons, control transformer, modulating feedwater controls, steam safety valves, thermocouple, and other components required for a complete steam generator.

.9 Components:

.1 Steam Generator:

.1 The steam generator will consist of a water-cooled combustion chamber, the steaming coils, convection type heat transfer section, and steam drum.

.2 The water-cooled combustion chamber shall be a seal welded helical coil that prevents combustion gases from bypassing the convection heat transfer section.

.3 Tube materials in the heat transfer sections will be in accordance with ASME specifications. The boiler water wall shall be internally insulted. This insulation is in addition to combustion air preheating space.

.4 Coils shall be designed such that individual coils may be replaced without the requirements of code welding.

.5 Finned tubing shall not be utilized.

.2 Pressure control:

.1 The pressure control will automatically adjust fuel and air to suit steam demand. The accuracy of this control shall be plus or minus one percent (1%) of the pressure adjustment range.

.3 Steam components:

.1 All features of the design will be such as to ensure safe and reliable operation. Installed controls will shut off the fire if temperature, pressure, or both exceed preset limits. The steam

generator will fail-safe in the event of power failure. Fuel and combustion air systems will be electrically interlocked to shut fuel to the burner in case of combustion air failure.

.2 The steam generator will have an electronic steam temperature control, which requires a manual reset located on the boiler control panel. This steam temperature control will extinguish the fire in the steam generator in the event that steam temperature reaches a preset point.

.3 Each individual coil in the convection heat transfer section shall have overheat protection. This shall consist of a thermocouple, which, due to its placement, directly monitors the maximum possible outlet temperature of each coil. Each thermocouple must have continuous digital readout on the control panel. This coil temperature control will extinguish the fire in the steam generator in the event that coil temperature reaches a preset point.

.4 The steam generator will have an electronic stack temperature control, which requires a manual reset located on the boiler control panel. The stack thermocouple must have continuous digital readout on the control panel. This stack temperature control will extinguish the fire in the steam generator in the event that stack temperature reaches a preset point.

.4 Piping:

.1 All pressure piping will be designed and constructed in accordance with applicable provisions of the ASME Boiler and Pressure Vessel Code for Power Boilers.

.5 Recirculating pump:

.1 The pump shall have a pumping capacity of at least two (2) times the maximum steaming rate.

.2 Pump must be air cooled design. No cooling water required.

.6 Combustion air blower:

.1 The steam generator is equipped with a motor driven centrifugal combustion air blower. The blower will be of the non-overloading, backward curve type.

.2 Noise level shall be less than 85 dBA. If noise levels are greater than 85 dBA, then a silencer shall be provided.

.3 Blower shall be located at the left side of the boiler shell at floor level for ease of inspection and maintenance.

.4 Blower motor shall have VFD drive.

.7 Burners:

.1 The steam generator will be equipped with a forced draft burner for combination natural gas firing.

.1 The natural gas burner will be multi-nozzle, gas pilot ignited burner, fully modulating.

.2 Burner control system shall include automatic burner sequencing, flame supervision, status indication, first-out annunciation, and self-diagnosis.

.3 Flame safeguard system shall incorporate a linkageless combustion control system

.4 A flame detector shall be used to monitor the flame in the combustion chamber of the steam generator.

.5 A sight glass shall also be supplied to view the flame from the front of the unit.

.8 Steam drum:

.1 The steam drum will be constructed in accordance with the latest AMSE requirements. The drum will be designed in such a manner as to separate water from steam so that the steam quality will be ninety-nine and one half percent (99.5%) or greater. The drum will be insulated and covered with metal sheathing.

.2 The steam drum shall sufficiently large to maximize steaming space and minimize potential for wet steam carryover during periods of fluctuating loads. Multiple baffle plates shall be incorporated into the steam drum interior to further ensure dry steam.

.9 Safety valves.

.1 The safety valves shall comply with ASME code.

.10 Steam drum blowdown:

.1 The steam drum shall be equipped with automatic drum bottom blowdown and automatic drum surface blowdown.

.11 Feedwater control valve:

.1 The modulating feedwater control valve shall be a fully modulating control valve with associated differential steam drum water level control.

.12 Water level indication:

.1 Gauge glass to be flat glass type.

.2 Means of level indication shall be independent of any make-up level control device.

.13 Low water level protection:

.1 Low-low water level burner cutoff switch shall be a probe type low-low water level cutoff switch wired into the burner control circuit preventing burner operation if boiler water falls below designated safe level and will require manual resetting of burner flame safeguard control before allowing restart and further automatic operation.

.2 A secondary high water level burner cutoff switch shall be a probe type high water level cutoff switch wired into the burner control circuit preventing burner operation if boiler water rises above designated safe level and will require manual resetting of burner flame safeguard control before allowing restart and further automatic operation.

.3 High level probe shall shut off automatic feedwater shutoff valve on high water.

.14 Control panel:

.1 All electrical components shall comply with CSA and CGA requirements.

.2 **All alarms must be tied back to existing pager system in control room.**

.3 **New control panel to include provision for interlock with existing make-up air handler.**

.4 Mounted in/on a NEMA 4 control panel shall be motor starters.

.5 Separate Nema 4 panel for Flame safeguard controller, control switches, control voltage transformer, control circuit fuse, terminal strips for all entering and/or leaving wiring, operating and alarm lights, single point auxiliary contact for remote alarm indication of

combustion safety failure, single point 120 volt auxiliary contact for proof of boiler operation.

.15 Combustion safeguard & burner control system:

.1 The fully modulating combustion control system shall be microprocessor based and mechanical linkages must not be used. Individual parallel positioning motors shall be supplied for the combustion air blower damper control, gas control valve, and FGR damper control.

.2 The combustion control system shall provide independent fuel/air ratio curves for each fuel and shall be programmable from the panel mounted display module or via laptop/PC.

.3 The system shall have a fuel/air ratio controller. The manufacturer shall provide any software and/or passwords required for programming.

.4 An operator touch screen interface with PLC shall be provided. The touch screen shall include display of all boiler data and alarm conditions.

.5 All data from the combustion control system and operator touch screen shall be available for monitoring and control from a remote location.

.6 The fuel trains are to consist of the following controls and devices at a minimum:

.1 Pilot gas train:

.1 Pilot gas pressure regulator

.2 Pilot gas solenoid valve

.3 Test connection

.2 Main gas train:

.1 Main gas pressure regulator

.2 Double block and bleed valves, fully automatic with proof of closure

.3 High and low gas pressure switches with manual or automatic resets

.4 Manual gas shutoff lubricated plug valve

.5 Fuel metering valve

.16 Flue Gas Economizer

.1 A flue gas economizer shall be provided for the steam generator.

.2 Economizers shall be integral to the steam generator, factory mounted and pre-piped.

.3 The heat recovery surface in the economizer shall be finned tubing in order to maximize heat recovery from the exiting flue gasses. Bare tube designs shall not be accepted.

.4 Economizer tubing shall be carbon steel fin tubing with key fins paced at six fins per inch.

.5 Supply with economizer one pressure relief valve rated for economizer design pressure.

.17 Disconnect

.1 Supply with non-fused disconnect at boiler.

.18 **Boiler Performance**

.1	**Thermal Input**	**3678.9 kW**
.2	**Thermal Output**	**2943.3 kW**
.3	**Equivalent Output**	**4693.7 kg/hr from and at 100 °C**
.4	**Design Pressure**	**1723.7 kPa**
.5	**Operating Pressure**	**861.8 kPa**
.6	**Safety Valve(s) Setting**	**1034 kPa**
.7	**Main Voltage**	**575/3/60**
.8	**Natural Gas Input**	**355.5 m^3/hr**
.9	**Natual Gas Inlet Pressure**	**35-70 kPa**
.10	**Burner Modulation**	**10:1 turndown**
.11	**System Efficiency**	**83% Minimum**

2.2 CONTROL PANEL FOR EXISTING BOILER B-1

.1 All electrical components shall comply with CSA and CGA requirements

.2 **All alarms must be tied back to existing pager system in control room.**

.3 **Refer to drawing M500 for controls schematic.**

.4 Construction:

.1 Body and doors fabricated from 14 gauge steel

.2 Continuously welded seams ground smooth, without knockouts, holes, or cutouts.

.3 3-point keylocking handle provided on front-mounted door.

.4 Main door on console raised above bottom of control panel.

.5 Door stops provided to hold control panel open.

.6 Print pocket is provided.

.7 Closed cell neoprene gasket.

.8 Grounding provisions provided.

.9 NEMA 12 classification.

.5 Finish:

.1 ANSI-61 gray polyester powder coat inside and out over phosphatized surfaces.

.6 **Sequence of Operation:**

.1 **Power on to unit,**

.2 **Gas selector switch to gas**

.3 **Power on to water controller,**

.4 **Low water cut off control satisfied**

.5 **High water cut off satisfied**

.6 **High pressure limit controller not satisfied**

.7 **High pressure manual limit controller not satisfied**

.8 **High and Low Water level controller in Condensate tank satisfied**

.9 **Low pressure Gas at burner switch made**

.10 **High pressure gas at burner switch open**

.11 **Low and high level in Deaerator satisfied**

.12 **High main gas pressure open**

.13 **Low thermal fluid rate switch made**

.14 **Low level thermal fluid expansion switch made**

.15 **High thermal fluid temperature switch open**

.16 **High flue gas temperature switch open**

.17 **Burner start button pressed.**

.18 **Limits satisfied, call for heat lit.**

.19 **Burner starts, purge starts**

.20 **Timer initiates, purge in progress**

.21 **Timer finishes purge complete**

.22 **Damper motor closes, end switch makes indicating Low Fire.**

.23 **Fyreye motor advances,**

.24 **Pilot solenoid energizes**

.25 **Pilot transformer energizes**

.26 **Pilot lights**

.27 **Fyreye confirms pilot flame**

.28 **Main maxim valves energize, lights energize**

.29 **Gas cock manually opens**

.30 **Main flame established**

.31 **Fyreye confirms main flame and holds Maxim valves open**

.32 **After main flame established gas valve and air valve open to set levels,**

.33 **Fyreye control rotates to flame on status.**

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for heating boiler installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 INSTALLATION

.1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of Province having jurisdiction, except where specified otherwise, and manufacturer’s recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.5 Pipe steam relief valve through roof with drip pan elbow piped to nearest drain.

.6 Pipe blowdown/drain to blowdown tank/floor drain.

.7 Natural gas fired installations: in accordance with CSA B149.1.

3.4 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves:

.1 Run separate discharge from each valve.

.2 Terminate discharge pipe as indicated.

.3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

.2 Blowdown valves:

.1 Run discharge to terminate as indicated.

3.5 FIELD QUALITY CONTROL

.1 Commissioning:

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

.2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION