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Pacific Forestry Centre

High Efficiency Boiler Upgrades

Project Specification

Project. No. 115.3

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PROVINCE OF BRITISH COLUMBIA
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Part 1 General

1.1 BUILDING DESCRIPTION

.1 This project involves controls upgrades and the installation of two new condensing boilers at the Pacific Forestry Centre (PFC). PFC is a multi-building complex set on an 8.4 hectare site, located approximately 4 Km north of downtown Victoria, B.C. The facility is comprised of a main office/lab complex and a variety of ancillary support buildings. The main complex, consisting of the original “A” Wing (including Library and Engineering wings) and the newer “B” Wing, provides a mix of office, lab and research facilities as well as a cafeteria and conference area. The outbuildings include the Headerhouse, two Glasshouses, three Shadehouses and several storage sheds.

.2 Building heating is currently supplied by one condensing boiler B1 (2245MBH) and three atmospheric boilers B2, B3 and B4 (1560MBH each) located in Wing A Mechanical Room and condensing boiler B5 (350MBH) located in Headerhouse mechanical room. A Delta Controls building automation system (BAS) is currently used to control Wing A heating plant as well as pumps and air handlers in the main office areas.

1.2 PROJECT DESCRIPTION

.1 This project is intended to continue the efforts to upgrade the PFC Boiler Plant which started in 2014. Two (2) new condensing boilers will be installed resulting in a boiler plant comprised of only condensing boilers.

.2 The project involves the removal of existing boilers B2, B3, and B4, and the installation of two new condensing boilers, its corresponding venting system, associated controls, as well as modification of piping to suit with new boiler connection points.

Part 2 Products

.1 Not Applicable

Part 3 Execution

3.1 GENERAL

.1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.

.2 The term "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.3 Documents in the drawings are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.4 Install equipment generally in locations and routes with minimum interference to other services, existing services or free space. Coordinate and provide installation drawings for Consultant approval prior to installation. Extras for improper coordination and removal of equipment to permit remedial work shall not be allowed.

.5 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise requested by the Consultant in writing.

.6 All work shall be in accordance with the Project Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

3.2 MECHANICAL WORK SCOPE

.1 Demolition – Remove and dispose of existing boilers B2, B3, and B4 and there corresponding vent, HW, gas, vent and drain piping, as shown in Drawing M1 Demolition Layout.

.2 Provide two (2) condensing boilers listed as approved model by Fortis BC for condensing boiler retrofit program. Refer to schedule of equipment in Appendix A and in Section 23 52 00 of this specification.

a. Provide all necessary hardware not included by manufacturer and required for proper functioning of boilers.

b. The mechanical contractor shall be responsible of ensuring that new boilers will fit through all doorways/corridors between front entrance and boiler room.

.3 Provide new boiler circulating pumps. Refer to equipment schedule in Appendix A and in Section 23 52 00 of this specification.

.4 Provide new 75 mm balance valves for boiler loops B2 and B3 to replace F300 but retain isolation valves.

.5 Provide boilers venting system as specified is Sections 23 52 00 and 23 51 00. Flue vent shall be routed to existing roof opening as shown in Detail 3 in Drawing M1.

.6 Rebuild existing boiler B1 Flue vent from Roof line upward to match new vents for B2 and B3 as per Detail 3 in drawing M1.

.7 Modify existing piping as shown in Drawings M1 and M2 to suit to new condensing boilers. The Contractor shall survey on site to determine the piping routing and shall re-route if necessary to fit with the equipment connection point.

.8 Provide balancing valves on B2 and B3 and piping as shown in drawings M1 and M2. Refer to equipment schedule in Appendix A.

.9 Pressure test, flush and chemical clean new piping installation and connections in accordance with standards and to Consultant’s satisfaction. Isolation valves connecting to existing heating plant shall only be opened upon approval by the Owner or by the Consultant.

.10 Dispose of all existing equipment, valves and piping deemed unusable.

.11 Rectify existing services that were temporarily removed or has been affected by this work.

.12 The Mechanical Contractor shall be responsible for processing Fortis Boiler program incentives as follows:

a. Complete application form and submit to Fortis BC within 90 days of the boiler in-service date.

b. Submit copies of Gas Notification of Completion, Installation or Alteration indicating in-service date, permit number, contractor's license number, gas fitter number to Fortis.

c. Provide proof of purchase indicating the make, model and serial number of the boiler(s) purchased and installed (paid invoice, and /or work order)

d. Submit Certification of Boiler Inspection from BC Safety Authority

3.3 CONTROLS AND ELECTRICAL WORK SCOPE

.1 Demolish/Disconnect existing boilers B2-B4 and pumps P-120-P140 control and electrical wiring.

.2 Provide control and electrical wiring to new boilers and new circulating pumps.

.3 Provide one new starter, and reuse existing spare starter for new circulating pumps.

.4 Provide new controls for pumps, boilers and control valves as detailed in the points list in Appendix E, the controls drawings C-01 and C-02, and Section 25 90 01.

.5 Provide new sequence of operations for Wing A boiler heating plant as specified in Section 25 90 01.

.6 Update Boiler System and Overall Heating Plant DDC graphics.

3.4 TESTING ADJUSTING AND BALANCING

.1 Refer to Section 23 05 93. Testing and balancing scope of work is defined. Perform testing under varying flow conditions as noted.

.2 New boiler startups and performance verification shall be performed by manufacturer's representative.

3.5 CODES AND STANDARDS

.1 Work, materials, and equipment shall comply with the most restrictive of local, provincial, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

a. Local Building Bylaws

b. Canadian Gas Association

c. Canadian Standards Association CSA B149.1 20. - Natural Gas Installation Code.

d. CSA Standard C22.1-2006 (or later), Canadian Electrical Code.

e. B.C. Code Amendments, Gas Safety Act & Regulations.

f. CAN/CGSB 24.3-92, Identification of Piping Systems

g. BC Insulation Contractor Association (BCICA): Quality Standards Manual for Mechanical Insulation (2005).

3.6 WORK SCHEDULE

.1 Work can commence upon award of contract and shall be coordinated with Owner.

.2 Boiler installation must be substantially complete by November 30, 2015.

.3 Contractor shall submit complete and realistic Construction Schedule. Taking into consideration the time for reviewing operating and maintenance manuals, equipment commissioning, verification of system operation, and demonstration and instruction to the Owner. The schedule shall include but not limited to the following items:

a. Installation and testing of piping systems and equipment.

b. Chemical cleaning and treatment of piping.

c. Water balancing

d. Connection of electrical services to equipment.

e. Start-up of mechanical equipment.

f. Commissioning of mechanical equipment and systems.

g. Control sequence validation

h. Demonstration to Owner.

i. Preparation of maintenance manuals and as-built drawings.

j. Submission of the various documents required prior to substantial completion.

END OF SECTION 23 00 00

Part 1 General

1.1 SUMMARY

.1 Section Includes.

a. Section include requirements for piping installation.

Part 2 Products

2.1 PIPING PRODUCTS

.1 Victaulic™ or approved equal are accepted.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated whichever is greater without interrupting operation of other system, equipment, and components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

.1 Install automatic air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

.1 General:

a. Compatible with system, to suit pressure rating of system.

.2 Locations:

a. Where dissimilar metals are joined.

.3 NPS 2 and under:

a. Isolating unions or bronze valves.

.4 Over NPS 2:

a. Isolating flanges.

3.6 PIPEWORK INSTALLATION

.1 Installation by certified journeyperson

.2 Hot Water Piping shall be screwed fitting with Teflon tape or Approved grooved fittings.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 Saddle type branch fittings may not be used

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines & existing services.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Valves:

a. Install in accessible locations.

b. Remove interior parts before soldering.

c. Install with stems above horizontal position unless otherwise indicated.

d. Valves accessible for maintenance without removing adjacent piping.

e. In mechanical rooms install valves where accessible.

.14 Check Valves:

a. Install silent check valves in vertical pipes with downward flow and elsewhere as indicated.

b. Install swing check valves in horizontal lines and elsewhere as indicated.

3.7 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant and Owner 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test pipe to 1.5 times the system maximum working pressure.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Divisions.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Consultant and Owner.

.6 Pay costs for repairs or replacement, retesting, and making good. Consultant shall determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by authorities.

END OF SECTION 23 05 05

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Materials and components for metering hot water including installation

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.2 ASME Fluid Meter's Handbook: Their Theory and Application, Sixth Edition 1971.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.4 Material Safety Data Sheets (MSDS)

1.3 SUBMITTALS

.1 Shop Drawings:

a. Submit drawings stamped and signed for approval by Owner's Representative.

.2 Closeout Submittals:

a. Submit maintenance data including monitoring requirements for incorporation into manuals in accordance with Section 01 77 00 - Closeout Procedure and 01 78 30 - Closeout Submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle in accordance with manufacturer's written instructions

Part 2 Products

2.1 PRESSURE GAUGES:

.1 Gauges shall be liquid filled type with 100 mm diameter, ±1% accuracy, fill liquid glycerin, brass internals, AISI 304 SS case and ring, phosphor bronze bourdon tube, OT 59 brass with under and overload stops movement,

.2 Dials shall read imperial (psig) and metric units (kPag).

.3 For gauges on liquid service provide a bronze pulsation damper and needle valve.

2.2 THERMOMETERS:

.1 Thermometers shall be 225 mm scale adjustable angle, cast aluminum case or ABS plastic case, red reading mercury, glass front and complete with 18 mm NPT brass separable well, Celsius scale.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION OF PRIMARY ELEMENT

.1 Follow manufacturer's instructions.

3.3 INSTALLATION OF DIFFERENTIAL PRESSURE TAPS AND PIPING

.1 Differential pressure taps horizontal and level with each other to within +/- 1.5 mm.

.2 Tubing shall be straight, supported throughout its length, sloped 5%-10% upward to main for drainage and venting, without air pockets, with blowdown valves at bottom.

3.4 INSTALLATION OF TRANSMITTERS NOT FORMING INTEGRAL PART OF PRIMARY ELEMENT

.1 Mount on pipe stand installed and located to ensure no damage by passing traffic.

3.5 INSTALLATION OF SIGNAL TRANSMISSION CABLE

.1 Ground shielding at one point only.

.2 Protect against RF interference.

.3 Cross electrical cables, conduits at 90 degrees leaving at least 150 mm space between.

3.6 INSTALLATION OF THERMOMETER, SENSOR WELLS AND GAUGES

.1 Provide temperature sensor wells in the water heating system as shown in the drawings.

.2 Provide pressure gauge taps in the boiler inlet and outlets and as shown in the drawings.

.3 Provide steam type thermometer in the boiler inlet and outlets and as shown in the drawings.

END OF SECTION 23 05 19

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Valves, gate, globe, and check.

.2 Related Sections:

a. 23 21 13 – Piping and Accessories

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

a. ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings

.2 American Society for Testing and Materials International (ASTM)

a. ASTM A49-01, Specification for Heat-Treated Carbon Steel Joint Bars

b. ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

c. ASTM B61-93, Specification for Steam or Valve Bronze Castings

d. ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings

e. ASTM B85-03, Specification for Aluminum-Alloy Die Castings

f. ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate

g. ASTM F-1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

a. MSS SP-67-2002, Butterfly Valves

b. MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends

c. MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends

d. MSS SP-82-1992, Valve Pressure Testing Methods

e. MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

1.3 QUALITY ASSURANCE

.1 To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by same manufacturer.

1.4 SUBMITTALS

.1 Shop drawings

a. Submit shop drawings stamped and signed for approval by Owner's Representative

Part 2 Products

2.1 MATERIAL

.1 Valves:

a. To be of single manufacturer except for specialty valves.

.2 Standard specifications:

a. Butterfly Valves: MSS SP-67

b. Gate valves: MSS SP-70.

c. Globe valves: MSS SP-85.

d. Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

a. Body, bonnet: cast iron to ASTM B209 Class B.

b. Connections: flanged ends plain face with 2 mm raised face with serrated finish to ANSI B16.1.

c. Connections: flanged ends plain face with 2 mm raised face with serrated finish to ANSI B16.1.

d. Inspection and pressure testing: to MSS SP-82.

e. Bonnet gasket: non-asbestos.

f. Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

g. Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

h. Gland packing: non-asbestos.

i. Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

j. Identification tag: with catalogue number, size, and other pertinent data.

.4 All products to have CRN registration numbers.

2.2 BUTTERFLY VALVES

.1 Construction

a. Body: Ductile iron wafer full lug body

b. Body Finish: Epoxy powder coated

c. Shaft: 416 Stainless steel

d. Disc: 304 Stainless steel

e. Seat: Renewable EPDM

2.3 GATE VALVES

.1 DN65 - 200, non-rising stem, inside screw, bronze trim, solid wedge disc:

a. Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 125.

b. Disc: solid offset taper wedge, bronze to ASTM B62.

c. Seat rings: renewable bronze to ASTM B62, screwed into body.

d. Stem: bronze to ASTM B62.

e. Operator: Handwheel

2.4 BALL VALVES

.1 40 mm (DN40) through 150 mm (DN150) sizes, ASTM A-536, Grade 65-45-12, ductile iron body, stainless steel ball and stem, TFE seats, Fluoroelastomer seals.

.2 Pressure Rating: 5515 kPa (800 psig)

.3 Type: Gruvlok Series 7500 or approved.

2.5 GLOBE VALVES

.1 NPS 2 1/2 - 10, OSY:

a. Body: with multiple-bolted bonnet.

b. Bonnet-yoke gasket: non-asbestos.

c. Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

d. Seat ring: renewable, regrindable, and screwed into body.

e. Stem: bronze to ASTM B62.

f. Operator: Handwheel and / or Motor: 2-10 VDC.

2.6 VALVE OPERATORS

.1 Install valve operators as follows:

a. Handwheel: on valves except as specified.

2.7 CHECK VALVES

.1 Swing check valves, Class 125:

a. Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.

i. Up to NPS 16: cast iron to ASTM A126 Class B.

ii. NPS 18 and over: cast iron to ASTM A126 Class C.

b. Ratings:

i. NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.

ii. NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.

iii. NPS 18 and over: 1.03 MPa CWP.

c. Disc: rotating for extended life.

i. Up to NPS 6: bronze to ASTM B 62.

ii. NPS 8 and over: bronze-faced cast iron.

d. Seat rings: renewable bronze to ASTM B62 screwed into body.

e. Hinge pin, bushings: renewable bronze to ASTM B62.

2.8 SILENT CHECK VALVES

.1 Construction:

a. Body: ductile iron with integral seat.

b. Pressure rating: class 125, WP = 860 kPa.

c. Connections: grooved ends.

d. Disc: bronze renewable rotating disc.

e. Seat: renewable, EPDM.

f. Stainless steel spring, heavy duty on vertical and downward applications.

Part 3 Execution

3.1 INSTALLATION

.1 Install valves with stem upright or horizontal, not inverted.

.2 Provide threaded lug type butterfly valves for equipment isolation services. Provide wafer or threaded lug type valves for zone shut off services.

.3 Provide drain valves at main shut off valves, low points of piping and in apparatus or terminal units.

.4 Size drain lines and drain valves equal to size of equipment drain connection.

.5 Minimum drain line shall be 20mm for pipe sizes of 20mm and over.

.6 Provide male NPT nipples with threaded pipe cap for drain sizes over 20mm where not piped directly to floor drains.

.7 Provide valved drain and hose connections off the bottom of all strainers.

END OF SECTION 23 05 23

Part 1 General

1.1 Summary

.1 Section includes:

a. Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 REFERENCES

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

a. ANSI/ASME B31.1, Power Piping, (SI Edition).

.2 American Society for Testing and Materials (ASTM)

a. ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.

b. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

c. ASTM A563, Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).

a. Materials Safety Data Sheets (MSDS).

.5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

a. MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.

b. ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.

c. MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

.1 Design Requirements

a. Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

b. Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.

c. Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

d. Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

e. Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.2 Performance Requirements

a. Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.4 SUBMITTALS

.1 Shop drawings: submit drawings stamped and signed for approval by the Consultant.

.2 Submit shop drawings and product data for following items as applicable:

a. Bases, hangers and supports.

b. Connections to equipment and structure.

c. Structural assemblies.

.3 Quality assurance submittals:

a. Instructions: submit manufacturer's installation instructions.

Part 2 Products

2.1 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:

a. Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.

b. Use electro-plating galvanizing process or hot dipped galvanizing process.

c. Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: Suspension from lower flange of I-Beam.

a. Cold piping DN50 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

b. Rod: 9 mm UL listed, 13 mm FM approved.

c. Cold piping DN65 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: Suspension from upper flange of I-Beam.

a. Cold piping DN50 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.

b. Cold piping DN65 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.

.4 Upper attachment to concrete.

a. Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

b. Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.

.5 Shop and field-fabricated assemblies.

a. Trapeze hanger assemblies: MSS SP-89.

b. Steel brackets: MSS SP-89.

c. Sway braces for seismic restraint systems: to MSS SP-89.

.6 Hanger rods: threaded rod material to MSS SP-58.

a. Ensure that hanger rods are subject to tensile loading only.

b. Provide linkages where lateral or axial movement of pipework is anticipated.

c. Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP-58.

a. Attachments for steel piping: carbon steel galvanized.

b. Attachments for copper piping: copper plated black steel.

c. Use insulation saddles for hot pipework.

d. Oversize pipe hangers and supports for insulated pipes.

.8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

a. Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.

.10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.

a. Finishes for steel pipework: galvanized.

b. Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.

.2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

a. 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

a. Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes DN300 and over, carbon steel to comply with MSS SP-69.

2.5 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.8 OTHER EQUIPMENT SUPPORTS

.1 Not required.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions and recommendations.

.2 Vibration Control Devices: Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.

.3 Clamps on riser piping:

a. Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

b. Bolt-tightening torques to be to industry standards.

c. Steel pipes: Install below coupling or shear lugs welded to pipe.

d. Cast iron pipes: Install below joint.

.4 Clevis plates:

a. Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

a. Vertical movement of pipework is 13 mm or more,

b. Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

a. Transfer of load to adjacent piping or to connected equipment is not critical.

b. Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code

.2 Gas and fuel oil piping: up to DN12: every 1.8 m.

.3 Copper piping: up to DN12: every 1.5 m.

.4 Hydronic, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.5 Within 300 mm of each elbow.

.6 Pipework greater than DN300 to MSS SP69.

Table 1-Vertical Pipe Support Distances

NOMINAL PIPE SIZE (mm)	DISTANCE BETWEEN SUPPORT (m)	HANGER ROD DIAMETER (mm)
90	3.6	16

Table 2- Horizontal Pipe Support Distances and hanger Rod Diameter

NOMINAL PIPE SIZE (mm)	DISTANCE BETWEEN SUPPORT (m)	HANGER ROD DIAMETER (mm)
12 -40	1.8	10
50-65	3.0	10
65	3.0	10
75	3.6	13
100	3.6	16
150	4.3	18

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

a. Ensure that rod is vertical under operating conditions.

b. Equalize loads.

.2 Adjustable clevis:

a. Tighten hanger load nut securely to ensure proper hanger performance.

b. Tighten upper nut after adjustment.

.3 C-clamps:

a. Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

a. Hammer jaw firmly against underside of beam.

END OF SECTION 23 05 29

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Materials and requirements for the identification of piping systems, ductwork, valves and controllers, including the installation and location of identification systems.

b. Level of quality shall be as minimum this specification or site conditions, whichever is more stringent.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES:

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include as appropriate:

a. Equipment: Manufacturer's Name, Model, Size, Serial Number, Capacity

b. Motor: Voltage, Hz, Phase, Power Factor, Duty, Frame Size

2.2 EQUIPMENT NAMEPLATES:

.1 Colours:

a. Hazardous: Red letters, white background

b. Elsewhere: Black letters, white background (except where required otherwise by applicable codes.

.2 Construction:

a. 3mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

a. Conform to the following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

b. Use maximum of 25 letters/numbers per line.

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

a. Natural gas: to CSA/CGA B149.1 2005 or latest edition

2.4 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Legend:

a. Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.3 Arrows showing direction of flow:

a. Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

b. Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.4 Extent of background colour marking:

a. To full circumference of pipe or insulation.

b. Length to accommodate pictogram, full length of legend and arrows.

.5 Materials for background colour marking, legend, arrows:

a. Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

b. Other pipes: pressure sensitive [plastic-coated cloth] [vinyl] with protective over-coating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.6 Colours and Legends:

a. Where not listed, obtain direction from Consultant.

b. Colours for legends, arrows conform to the following table:

Background colour	Legend, arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

c. Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Hot water heating supply	Match existing	MATCH EXISTING
Hot water heating return	Match existing	MATCH EXISTING
Natural gas	Match existing	MATCH EXISTING

2.5 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or coordinated with base colour to ensure strong contrast.

2.6 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

3.3 NAMEPLATES

.1 Locations: In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs: Provide for nameplates on hot and/or insulated surfaces.

.3 Protection: Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 Adjacent to each change in direction.

.2 At least once in each small room through which piping or ductwork passes.

.3 On either sides of visual obstruction or where run is difficult to follow.

.4 On both sides of separations such as walls, floors, partitions.

.5 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.6 At beginning and end points of each run and at each piece of equipment in run.

.7 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.8 Identification easily and accurately readable from usual operating areas and from access points.

a. Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number the valves in each system as per NRCan Pacific Forestry Centre Standard or as noted on drawings and specifications.

END OF SECTION 23 05 54

Part 1 General

1.1 SUMMARY

.1 Scope:

a. Balance, adjust, and test air and water systems and equipment and submit reports in identical units to those shown in the drawings and specifications.

b. Contractor shall prepare the facility for balancing.

.2 Related Sections

a. 23 00 00 Project Description and Scope of Work

b. 23 08 01 System Performance Verification

1.2 SUBMITTALS

.1 Post construction balancing report

.2 Closeout Submittals:

a. Submit final balancing report for incorporation into manual.

1.3 START OF TESTING ADJUSTING AND BALANCING (TAB)

.1 Begin balancing after balancing preparation and after systems have been completed and are in full working order.

.2 Notify consultant or site operations personnel 5 days prior to start of TAB.

Part 2 Products

2.1 INSTRUMENTS

.1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

Part 3 Execution

3.1 PREPARATION AND COORDINATION

.1 The Contractor shall bring the work to an operating state and ready for balancing after the following have been completed:

a. New equipment cleaned

b. Permanent instrumentation installed

c. "Start-up" of equipment completed

d. Ratings of overload heaters in motor starters have been verified.

e. Set control points of automatic apparatus, check-out sequence of operation.

f. Balancing Agency provided with a complete set of mechanical drawings and specifications.

.2 Coordinate the following with the Balancing Contractor:

a. Any major changes made to systems during construction and provide a complete set of record drawings for their use.

b. Corrections as required by Balancing Agency including installation of additional balancing valves and other materials necessary to properly adjust or correct the systems to design flows, without additional cost to Owner.

3.2 BALANCING PROCEDURE

.1 Permanently mark, by stick-on labels, settings on valves, and other adjustment devices.

.2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Balancing shall be performed to ±5% accuracy:

3.3 HYDRONIC SYSTEMS BALANCING

.1 Open all valves to fully open position including balancing valves, isolation valves, and control valves.

.2 Set pumps to deliver 10% excess flow if possible.

.3 Adjust flows to specified flowrates.

.4 Calibrate pressure and temperature gauges and sensors.

3.4 HYDRONIC SYSTEMS TESTING

.1 Provide data from the following tests:

a. Test 1

i. B1 Lead , P110 enabled,

ii. CBV 100 closed

iii. Wing A, Wing B, Penthouse, and Engineering in normal operation

Note: Repeat Test 1 for B2-P120 and B3-P130

b. Test 2

i. B1, P110, B2, P120 enabled,

ii. CBV100 closed

iii. Wing A, B, Penthouse, and Engineering in normal operation

c. Test 3

i. B1, P110, B2, P120, B3, P130 enabled,

ii. CBV100 closed

iii. Wing A, B, Penthouse, and Engineering in normal operation

d. Test 4
   i. B1, P110 enabled,
   ii. CBV100 open
   iii. Wing A, B, Penthouse, and Engineering in normal operation

3.5 BALANCING REPORT

.1 Include in the report the following

a. Equipment manufacturer and model (installed versus specified)
b. Pump suction and discharge pressures
c. Pump fluid flow rate
d. Motor (hp, rpm, amps, volts, phase)
e. CBV-100 flow rate

END OF SECTION 23 05 93

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Thermal insulation for piping and piping accessories in commercial type applications.

.2 Related Requirements

a. Section 23 00 00 Project Scope of Work

b. Section 23 21 13 Piping and Accessories

c. Section 23 52 00 Hot Water Boiler

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

a. ASHRAE Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

a. ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].

b. ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

c. ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

d. ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

e. ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

f. ASTM C547-2003, Mineral Fiber Pipe Insulation.

g. ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

h. ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

a. CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

b. CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus) Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

a. Canadian Environmental Protection Act (CEPA), 1999, c. 33.

b. Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

a. Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

a. Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)

a. CAN/ULC-S102- (03), Surface Burning Characteristics of Building Materials and Assemblies.

b. CAN/ULC-S701- (01), Thermal Insulation, Polystyrene, Boards and Pipe Covering.

c. CAN/ULC-S702- (1997), Thermal Insulation, Mineral Fibre, for Buildings

d. CAN/ULC-S702.2- (03), Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

a. "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

b. "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

a. CRF: Code Rectangular Finish.

b. CPF: Code Piping Finish.

1.4 QUALITY ASSURANCE

.1 Qualifications:

a. Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, and a member of BCICA.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

a. Maximum flame spread rating: 25.

b. Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

a. Maximum "k" factor: to CAN/ULC-S702.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

a. Air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 JACKETS

.1 Aluminum:

a. Roll Jacketing w polysurlyn moisture retarder
b. Manufactured from 3000 series aluminum alloys
c. Conform to ASTM B-209 designation,
d. Half-hard temper (H-14) minimum gauge
e. Quarter-hard (H-12) lock-forming quality.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with British Columbia Insulation Contractors Association (BCICA).

.2 Apply materials in accordance with manufacturer’s instructions and this specification. Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

a. Install hangers, supports outside vapour retarder jacket.

.4 Supports, Hangers:

a. Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1 Hot Piping

a. Securements: Bands at 200 mm on centre.

b. Seals: lap seal adhesive, lagging adhesive.

c. Installation: TIAC Code 1501-H.

.3 Thickness of insulation as listed in following table.

a. Run-outs to individual units and equipment not exceeding 4000 mm long.

b. Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Table 1- Insulation Thicknes as per Pipe Size and Application

Application	Temp-erature (°C)	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Hot Water Heating	60 - 94	A-1	25	38	38	38	38	38
Hot Water Heating	up to 59	A-1	25	25	25	25	38	38
Domestic HWS		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Domestic CWS with vapour retarder		C-2	25	25	25	25	25	25

.4 Finishes:

a. Exposed indoors: canvas / aluminum / SS / PVC jacket.

b. Exposed in mechanical rooms: canvas / aluminum / SS / PVC jacket.

c. Concealed, indoors: canvas on valves, fittings. No further finish.

d. Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

e. Outdoors: water-proof aluminum / SS / ABS jacket.

f. Finish attachments: SS screws / bands], at 150 mm on centre. Seals: wing / closed.

g. Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.5 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 23 07 15

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Detailed performance verification of Hydronic Boiler Heating System.

.2 Related Sections

a. 23 05 93 Testing and Balancing

1.2 HEATING SYSTEM - PERFORMANCE VERIFICATION

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 Boiler manufacturer representative shall be involved during start-up and performance verification.

.3 When systems are operational, perform following tests:

a. Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

b. Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

i. Pump operation.

ii. Boiler operation.

iii. Control pressure failure.

iv. Maximum heating demand.

v. Boiler failure.

vi. Outdoor reset. Re-check output supply temperature at 100% and 50% reset, maximum water temperature.

1.3 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:

a. TAB has been completed

b. Verification of operating, limit, safety controls.

c. Verification of primary and pump flow rate.

d. Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Heating system capacity test:

a. Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

i. Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or

ii. Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

b. Test procedures:

i. Open fully heat exchanger, heating coil and radiation control valves.

ii. With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

iii. Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.4 GASEOUS FUEL SYSTEMS

.1 Operation tests:

a. Measure gas pressure at gas meter outlet and at burner manifold.

b. Verify details of temperature and pressure compensation at meter.

c. Verify settings, operation, venting of high and low pressure cut-outs, alarms.

d. Check terminals of vents for gas pressure regulators.

1.5 REPORTS

.1 Provide the following:

a. Commissioning Report detailing actual sequences, setpoints and operating limits.

b. Testing and Balancing report detailing flowrates as well as balancing valve actual positions.

1.6 TRAINING

.1 Provide Training of new system to O&M Personnel in accordance with Owners Requirements.

END OF SECTION 23 08 01

Part 1 General

1.1 SUMMARY

.1 Section Includes.

a. Materials and installation for steel piping, valves and fittings for hydronic systems

.2 Related Sections

a. 23 00 00 Project Description and Scope of Work

b. 23 05 93 - Testing, Adjusting and Balancing

c. 23 05 23 - Valves

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

a. ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings

b. ASME B16.3-98, Malleable Iron Threaded Fittings

c. ASME B16.5-03, Pipe Flanges and Flanged Fittings

d. ASME B16.9-01, Factory-Made Wrought Butt welding Fittings

e. ASME B18.2.1-03, Square and Hex Bolts and Screws

f. ASME B18.2.2-87 (R1999), Square and Hex Nuts

.2 American Society for Testing and Materials International, (ASTM)

a. ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings

b. ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

c. ASTM A536-84 (1999)e1, Standard Specification for Ductile Iron Castings

d. ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings

e. ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings

f. ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols

.3 American Water Works Association (AWWA)

a. AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

.4 Canadian Standards Association (CSA International)

a. CSA B242-M1980 (R1998), Groove and Shoulder Type Mechanical Pipe Couplings

b. CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau)

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)

a. MSS-SP-67-025, Butterfly Valves
b. MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends
c. MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends
d. MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves
e. MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

1.3 SUBMITTALS

.1 Shop drawings

a. Submit shop drawings stamped and signed for approval by Owner's Representative

1.4 APPROVED MANUFACTURERS

.1 Victaulic or approved equal for grooved piping above 50mm

1.5 MAINTENANCE

.1 Provide following spare parts:

a. Valve seats: Minimum one or one for every ten valves, each size.
b. Discs: Minimum one or one for every ten valves, each size.
c. Stem packing: Minimum one or one for every ten valves, each size.
d. Valve handles: two of each size.
e. Gaskets for flanges: Minimum one or one for every ten flanges.

Part 2 Products

2.1 PIPE

.1 Hot Water Heating System

a. Steel pipe: to ASTM A53/A53M, Sch. 40, Grade B

.2 Domestic Hot Water System

a. Type "K" copper tubing

.3 Gas and Gas Regulator Vent Piping

a. Steel pipe: to ASTM A53, Sch. 40 Black Steel Pipe

.4 Drain Piping

a. Relief Drain: Type "L" copper tubing. Wrought copper or cast bronze sweat fittings

b. Condensate Drain: CPVC Pipe

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope

.2 NPS2-1/2 and over: welding fittings and flanges to CAN/CSA W48 or Roll Groove

.3 Roll grooved: rigid coupling to CSA B242

.4 Flanges: plain, slip-on to AWWA C111

.5 Orifice flanges: slip-on raised face, 2100 kPa

.6 Flange gaskets: to AWWA C111

.7 Pipe thread: taper

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2

.9 Roll grooved coupling gaskets: type EPDM

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150, Sch. 40

.2 Pipe flanges and flanged fittings:

a. Cast iron: to ASME B16.1, Class 125

b. Steel: to ASME B16.5

.3 Butt-welding fittings: steel, to ASME B16.9

.4 Unions: malleable iron, to ASTM A47/A47M

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M and ductile iron to ASTM A536

2.4 VALVES

.1 Connections:

a. NPS2 and smaller: screwed ends

b. NPS2.1/2 and larger: Flanged or grooved ends

.2 Gate valves: Application: Isolating equipment, control valves, pipelines:

a. NPS21/2 and over:

i. As specified Section 23 05 23 - Valves

.3 Globe valves: Application: Throttling, flow control, emergency bypass:

a. NPS21/2 and over:

i. As specified Section 23 05 23 - Valves

.4 Swing check valves:

a. NPS21/2 and over:

i. As specified Section 23 05 23 - Valves

.5 Silent check valves:

a. NPS21/2 and over:

i. As specified Section 23 05 23 - Valves

2.5 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A278M, Class 30, flanged connections.

.3 NPS 2 to 12: T type with ductile iron body to ASTM A536, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel with 1.19 mm perforations.

.6 Working pressure: 860 kPa.

Part 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

3.3 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.4 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.5 CLEANING, FLUSHING AND START-UP

.1 Refer to Related Sections

3.6 TESTING

.1 Refer to Related Sections

3.7 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION 23 21 13

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Materials, accessories and installation for breechings, chimneys and stacks

.2 Sustainable requirements for construction and verification

N/A

.3 Related Sections:

a. 23 00 00 Project Description and Scope of Work

b. 23 52 00 Hot Water Boiler

c. Mechanical Drawings M1 and M2

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

a. Material Safety Data Sheets (MSDS)

1.3 SUBMITTALS

.1 Shop Drawings:

a. Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.

b. Indicate in the submittal the following:

i. Methods of sealing sections

ii. Methods of expansion

iii. Details of thimbles

iv. Bases/Foundations

v. Supports

vi. Guy details

vii. Rain caps

.2 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 APPROVED MANUFACTURERS

.1 Flex-L International Inc., StaR 34 Vent

.2 Heat-Fab Inc., Saf-T Vent

.3 Z-Flex Z-Vent

.4 Protech System Inc., Fas N Seal Vent

.5 Metal-Fab Inc., Corr/Guard Vent

1.5 QUALITY ASSURANCE

.1 Work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial regulations.

Part 2 Products

2.1 BREECHINGS

.1 Fabricated of corrosion resistant material designed to meet a Category IV vented appliance for condensing boilers. Double wall c/w air gap.

.2 Refer to Related Sections.

2.2 ACCESSORIES

.1 Hangers and supports

a. In accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA).

.2 Exit Cones

.3 Rain Collar / Flashing

.4 Flue collector, gasket and exhaust connector kit

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL INSTALLATION

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at 1.2 m centers and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels.

.4 Provide sufficient clearances to openings as outlined in manufacturers recommendations Install rain caps and cleanouts.

.5 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.6 Install flashings on chimneys penetrating roofs.

.7 Install Exit Cone and cleanouts.

END OF SECTION 23 51 00

Part 1 General

1.1 SUMMARY

.1 Section Includes:

a. Condensing hot water boiler
b. Control panel
c. Installation
d. Commissioning

.2 Related Sections

a. 23 00 00 Project Description and Scope of Work
b. 23 51 00 Breeching, Chimneys and Stacks
c. 23 05 29 Hangers and Supports

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.2 CAN1-3.1-[77(R2001)], Industrial and Commercial Gas-Fired Package Boilers

.3 CAN/CSA-B149.1-[05], Natural Gas and Propane Installation Code

.4 Canadian Standards Association (CSA International)

.5 CSA B51-[03], Boiler, Pressure Vessel, and Pressure Piping Code

.6 ASME CSD-1 2009 Controls and Safety Devices for Automatically Fired Boilers

1.3 SUBMITTALS

.1 Submit shop drawings indicating the following:

a. General arrangement showing terminal points, instrumentation test connections
b. Clearances for operation, maintenance, servicing, tube cleaning, tube replacement
c. Foundations with loadings, anchor bolt arrangements
d. Piping hook-ups
e. Equipment electrical drawings
f. Burners and controls
g. All miscellaneous equipment
h. Flame safety control system
i. Breeching and stack configuration
j. Engineering data to include:

i. Boiler efficiency at 35%, 100%, of design capacity.

.2 Submit certificate signed by manufacturer certifying that material comply with specified performance characteristics and physical properties.

.3 Closeout Submittals:

a. Submit maintenance book for incorporation into manuals in accordance with Owners Requirements.

1.4 APPROVED MANUFACTURER

.1 Viessmann Vitocrossal 200 CM2 Series 620 with boiler controllers to be Vitotronic 300 GW5B or approved equal.

Part 2 Products

2.1 GENERAL

.1 Packaged Condensing Boiler:

a. Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA B140.7

b. Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code

c. CRN (Canadian Registration Number), to CSA B51

.2 Performance:

a. Refer to Equipment Schedule in Appendix A for heating capacity requirement.

b. Hot water: 99°C maximum supply temperature and shall have no minimum return temperature requirement.

c. Maximum allowable working pressure: 5 bar

d. Firing rate: See Appendix A

e. Boiler efficiency: 91% minimum at 100% firing rate, 40°C return temperature and 20°C temperature differential.

f. Flue gas temperature leaving boiler: condensing so no restriction.

.3 Electrical:

a. Power: 120 V, 1 phase, 60 Hz.

b. Controls: Part of boiler power feed

c. Electrical components: CSA approved

.4 Thermal insulation:

a. Fully insulated with a minimum of 50 mm of insulation, guaranteeing external convection and radiation heat losses to the boiler room from the boiler shall be less than 0.5% of the rated input.

.5 Jackets:

a. Encased in an 18 gauge metal cabinet with powder coated finish

.6 Mounting:

a. Structural steel stand

.7 Start-up, instruction, on-site performance tests

2.2 CONDENSING BOILER

.1 Boiler shall have a full three pass fire tube design to allow complete combustion of the fuel in the main combustion chamber. All flue side surfaces, including the main combustion chamber, second and third flue passages shall be constructed of 316Ti stainless steel designed to maximize condensate formation. All flue passages shall be fully water backed to minimize thermal stresses on the boiler vessel

.2 Boiler shall be suitable to operate under any return water temperature, boiler water flow rate and without any restrictions on temperature rise through the boiler vessel. It shall be able to operate at efficiencies up to 98% at suitably low return water temperatures.

.3 Boiler Module to include:

a. Combustion air inlet chamber

b. Pre-purge blower assembly

c. Air-gas fuel control valve

d. Combustion chamber

e. Sealed and completely enclosed combustion chamber, independent of the outer jacket assembly

f. A burner / flame observation port

g. House assembly in insulated jacket which includes boiler mounted electrical control panel enclosure with operation sequence indicator lights.

h. Condensate drain fitting complete with built in trap on exhaust chamber

i. Variable speed blower system

.4 Boiler Controls:

a. The boiler shall include a computerized boiler burner control which shall be an integrated, solid state digital micro-processing modulating device, complete with sequence indication, fault reset, mode selection, and parameter set-point. It shall be mounted at the front of the boiler panel for easy access and viewing.

b. Controller shall provide for both flame safeguard and boiler control through separate power supplied CPU's (to meet NFPA) and shall perform the following functions:

i. Burner sequencing with safe start check, pre-purge, Electronic direct spark ignition and post purge. Flame rod to prove combustion.

ii. Flame Supervision. The control shall provide pre-purge and post-purge and shall maintain a running history of operating hours, number of cycles, and the most recent six faults. The control shall be connected to a keyboard display module that will retrieve this information

iii. Safety Shutdown with display of error.

iv. Modulating control of the variable speed fan for fuel/air input relative to load requirements.

v. Gas pressure supervision, high and low.

vi. Combustion Air Proving Supervision.

vii. High Air Pressure [back draft too high] Supervision.

viii. The supply temperature and set-point temperature shall be displayed at all times on the display.

ix. Controller shall be equipped with remote temperature reset and enable for connection to the building DDC system or shall include ModBus or Bacnet communication capability to perform these functions.

c. All parameter input control set-points shall be factory downloaded with local site conditions programmed at the time of initial site operation.

d. All controls to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls and located to prevent possible water damage according to CSA requirements.

2.3 AUXILIARIES

.1 Provide auxiliaries to meet ANSI/ASME requirements.

.2 Hot water boilers:

a. Safety valve shall be ASME Section IV approved side outlet type mounted on the boiler air vent outlet. Size shall be in accordance with manufacturer`s recommendation.

b. Pressure gauge: Liquid filled, 90 mm diameter complete with shut-off cock range to 100 PSIG.

c. Thermometer: 115 mm diameter range 10 to 150 °C.

d. Solid State Low water cut-off probe with manual reset and test switch.

e. Manual Reset High Limit Temperature sensor; range not to exceed 110 °C and shall be an integral device of the Boiler Burner Control and UL recognized as a limit control.

f. Outlet water supply sensing probe for operating water limit setpoint

g. Return water-sensing probe for operating water limit setpoint

h. Isolating gate valves on supply and return connections

i. Drain valve

j. Stack thermometer; range 65 to 400 °C.

k. Condensate acid neutralizer kit

2.4 BOILER FLUE VENTING

.1 See Related Sections

.2 Vertical vent system with a vertical rooftop termination of the vent with the combustion air being drawn from the room. The flue shall be Stainless Steel Category IV sealed vent material terminating at the roof top with the manufacturers specified vent termination. The air inlet may be CPVC, Galvanized, or Stainless Steel sealed pipe. The BOILER's total combined exhaust venting length shall not exceed 25 equivalent meters.

2.5 GAS BURNERS

.1 Gas Burner Design:

a. Forced draft with built-in modulating blower to supply combustion air, complete with motor, silencer and damper

b. Minimum 5 to 1 turndown ratio

c. Flame observation port

d. Easy access to nozzles and electrodes

.2 Gas Pilot

a. To building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.

.3 Gas Train:

a. To building code and provincial regulations and shall include:

i. Low Gas Pressure Interlock, manual reset

ii. High Gas Pressure Interlock, manual reset

iii. Upstream and downstream manual test cocks

iv. Ball Type manual shutoff valve upstream of the main gas valve

v. Unibody double safety gas valve assembly

vi. Gas Pressure Regulator

vii. Union connection to permit burner servicing

.4 Emissions:

a. The equipment shall be guaranteed to limit NOx emissions to 30 PPM or less, as certified by an independent testing lab. NOx emission levels shall not be exceeded at full operating conditions and at designed turndown of the burner. Proof of such emissions certification shall be made available to the engineer and purchaser and demonstrated at the time of start-up. External flue gas recirculation shall not be accepted for emission control.

2.6 CONDENSATE ACID NEUTRALIZER

.1 The condensate acid neutralizers shall be designed to raise the PH of acidic liquid produced by condensing boiler to a safe level as recognized by the national plumbing code of 5.5-8.5 PH.

.2 The unit shall be a box type product designed to allow for installation with low condensate outlet drains for condensing boiler with input capacity of 2245 MBH and a flow rate of 25.3 GPH.

.3 The unit shall be field rechargeable and shall be provided with removable top clean out cover for the removal and replacement of charging agents.

2.7 BOILER CIRCULATING PUMP

.1 Boiler circulating pump shall be provided by Mechanical Contractor. Refer to Appendix A for pump capacity.

2.8 WARRANTY DATA

.1 The pressure vessel shall be guaranteed against thermal shock for 10 years when utilized in a closed loop hydronic heating system with a temperature differential of 120 °F or less. The boiler pressure vessel shall be guaranteed accordingly without a minimum flow rate or return water temperature requirement. The boiler shall not require the use of flow switches or other devices to ensure minimum flow.

.2 The pressure vessel, tubes and tube sheets (heat exchanger) shall be guaranteed against flue gas corrosion and materials/workmanship for a period of 10 years. The condensate collection box shall be guaranteed for 20 years. The burner cylinder shall be warranted for a period of 5 years.

.3 All parts not covered by the above warranties shall carry a 1 year warranty from startup, or 18 months from shipment, whichever occurs first. This shall include all electrical components and burner components.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTION

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

3.2 INSTALLATION

.1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers 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 Pipe hot water relief valves full size to nearest existing drain.

.5 LP gas fired installations - in accordance with CAN/CSA-B149.1.10

3.3 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves.

.2 Run separate discharge from each valve.

.3 Terminate discharge pipe as indicated.

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

3.4 FIELD TESTING AND QUALITY CONTROL

.1 General:

a. The boiler supplier's factory authorized service organization shall be responsible for performance of inspections, start up and testing of the package boiler, and accessory equipment and materials furnished under this Section.

b. A detailed written record of the startup performance, including burner setting data over the entire load range shall be furnished to the Engineer before final acceptance.

c. All labor, equipment, and test apparatus shall be furnished by the authorized service organization.

d. All equipment defects and malfunctioning parts discovered during the tests shall be rectified either by the service organization or boiler manufacturer without additional cost to the owner.

.1 Equipment inspection:

a. Boiler representative to provide 4 hours of jobsite assistance to inspect boilers and other equipment upon arrival, verifying completeness of equipment supplied and potential damages. All shipped loose components, such as casing, to be mounted on boiler by boiler provider after contractor has set boiler in building.

.2 Pre start-up walk through:

a. Boiler representative shall spend 2 hours at jobsite reviewing installation with mechanical contractor to be conducted approximately 1 week prior to startup.

.3 Start-up:

a. Demonstrate that boiler, burner, controls, and accessories comply with requirements of this Section as proposed by the boiler and accessories supplier. Pre-test all items prior to scheduling the final testing that will be witnessed by the test engineer.

b. Readings at different firing rates of load for the modulating burner shall be taken with a written report of the tests submitted to the Engineer. The reports shall include readings for each firing rate tested and include stack temperatures, O_2, CO, NOx, and overall boiler efficiency.

c. Auxiliary Equipment and Accessories:

i. Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects, and non-compliance with referenced standards or overloading as applicable.

d. Commissioning Requirements:

i. Fireside inspection

ii. Set up fuel train and combustion air system

iii. Set up operating set points

iv. Check all safeties, including Flame safeguard, LWCO, Airflow, Fuel pressures, High limits.

v. Set up and verify efficiencies at 20%, 50%, 75%, and 100%

vi. Set up and verify burner turndown

.4 Training:

a. Training shall include all safety, maintenance, control operations, and diagnostic procedures. It shall be provided in a single 4 hour continuous session to accommodate operator's availability on site.

END OF SECTION 23 52 00

PART 1. General

1.1 General Requirements

.1 Supply and install new controls as described in this specification, points list and control drawings.

.2 Provide new control graphics for each system modified. Graphics shall be consistent style with the existing site graphics.

.3 Provide programming for all systems modified or added to the BAS as per Sequence of Operations

.4 Table 1: Systems to be Systems in Table 1 shall modified as part of this contract:

Table 1: Systems to be modified as part of this project.

System Name	System Tag	System Description	Associated Equipment	Equipment Location	Service Area
Main Boiler Plant	PRC_BLR	Boiler plant serving Wing A and B buildings, engineering offices, corridor unit heaters, penthouse	BLR1, BLR2, BLR3	Wing A Boiler Room	Pacific Forestry Centre

1.2 Related Sections

.1 The following sections constitute related work:

Section 23 00 00 Project Description and Work Scope

Section 25 90 01 Sequences of Operation

Appendix D - Schematics, Appendix E – DDC Points Lists

1.3 Scope of Work

.1 See Section 23 00 00

1.4 Approved Control Systems

.1 System shall be Delta Controls Orcaview version 3.40.

1.5 Quality Assurance

.1 Installer and Manufacturer Qualifications

.a Installer shall have an established working relationship with Control System Manufacturer.

.b Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.6 **Codes and Standards**

.1 Work, materials, and equipment shall comply with the most restrictive of local, provincial, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the controls installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

.a Canadian Electric Code (CEC) CSA C22-1

.b BC Building Code

.c ANSI/ASHRAE Standard 135 (BACnet)

.d WorkSafe BC Reguations

.e Local Building Bylaws

1.7 System Performance

.1 Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

.2 Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.

.3 Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.

.4 Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.

.5 Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.

.6 Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 sec.

.7 Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.

.8 Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.

.9 Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.

.10 Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 2.

.11 Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 3.

Table 2: Reporting Accuracy

Measured Variable	**Reported Accuracy**	**Code**
Water Temperature	±0.5ºC	

Table 3: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Water Temperature	±0.5º	

1.8 **Submittals**

.1 Product Submittal Requirements: Provide three (2) hard copies and one (1) electronic copy of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide submittals within 4 weeks of contract award on the following:

.2 Direct Digital control System Hardware

.a Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

.b Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:

i. Direct digital controllers (controller panels)
ii. Transducers and transmitters
iii. Sensors (include accuracy data)
iv. Relays and switches
v. Control panels
vi. Power supplies
vii. Batteries
viii. Operator interface equipment
ix. Wiring

.c Wiring diagrams and layouts for each control panel. Show termination numbers.

.d Floor plan schematic diagrams indicating field sensor and controller locations.

.e Riser diagrams showing control network layout, communication protocol, and wire types.

.3 Central System Hardware and Software

.a Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.

.b Manufacturer's description and technical data such as product specifications and insallation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:

i. Central Processing Unit (CPU) or web server
ii. Power supplies
iii. Battery backups
iv. Interface equipment between CPU or server and control panels
v. Operator interface software

vi. Color graphic software

.4 Third-party software

.a Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

.b Network riser diagrams of wiring between central control unit and control panels.

.5 Controlled Systems

.a Riser diagrams showing control network layout, communication protocol, and wire types.

.b Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

.c Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.

.d Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.

.e Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in Section 25 90 01. Indicate alarmed and trended points.

.f BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

.6 Project Record Documents.

a. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

i. Testing and Commissioning Reports and Checklists.

b. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:

i. As-built versions of submittal product data.

ii. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

iii. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

iv. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

v. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

vi. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

vii. Graphic files, programs, and database on magnetic or optical media.

viii. List of recommended spare parts with part numbers and suppliers.

ix. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

x. Licenses, guarantees, and warranty documents for equipment and systems. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

.7 Training Materials: Provide instructions and demonstrations to owner’s representative and/or maintenance personal on the operations of the control system. This should include all common tasks such as navigating the GUI, viewing systems, setting up and viewing trend logs, changing set points, modifying and schedules.

1.9 **Warranty**

.1 Warrant work as follows:

.a Warrant labour and materials for specified control system free from defects for a period of **12 months** after final completion. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

.b Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

.c If consultant determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, consultant will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.

.d Provide updates to operator workstation, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

.e Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of project acceptance.

1.10 **Ownership of Proprietary Material**

.1 Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

.a Graphics
.b Record drawings
.c Database
.d Application programming code
.e Documentation

PART 2. Products

2.1 Materials

.1 DDC control hardware and software programming services shall be backward compatible with the existing Delta building automation system. Supplier shall provide a Bacnet compatible interface to the existing Orcaview 3.40 system.

.2 Any new panels shall include 25% spare capacity for I/O.

.3 Any new control points shall be added to spare capacity on existing panels wherever possible.

.4 Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

.5 Reuse of existing controls and devices is allowed where appropriate. Confirm with the consultant and PFC prior to reuse of existing panels and devices.

2.2 Graphics and Programming

.1 Revise and update the building graphics and programming to reflect the new systems installations and existing systems. Coordinate graphics updates with the PFC. A preliminary control schematic layout is provided in Appendix D of this section.

.2 The graphics shall adhere to NRCan and PFC (Pacific Forestry Centre) graphics standards for colours, layout, linking, and navigation.

.3 Provide a CD-ROM of all graphics (existing and new), including special BMP and JPG components.

2.3 Auxiliary Control Devices

.1 Temperature Sensors

.a Type Temperature sensors shall be 100 Ohm Resistance Temperature Device (RTD) or 10 k Ohm thermistor.

.b Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m^2(10 ft^2) of duct cross-section.

.c Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

.d Space Sensors. Space sensors shall have setpoint adjustment, display, and communication port where shown.

.2 Relays.

.a Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

.b Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

.3 Current Transmitters.

.a AC current transmitters shall be self-powered, combination split-core current transformer ype with built-in rectifier and high-gain servo amplifier with 4-20 mA or 0-10 VDC two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.

.b Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

.c Unit shall be split-core type for clamp-on installation on existing wiring.

.4 Current Transformers.

.a AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

.b Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.

.c Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

.5 Voltage Transformers.

.a AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

.b Transformers shall be suitable for ambient temperatures of 4°C-55°C and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

.c Windings (except for terminals) shall be completely enclosed with metal or plastic.

.6 Current Switches.

.a Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

.7 Differential Pressure Switches.

.a Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

.8 Electro-pneumatic (E/P) transducers.

.a Electronic/pneumatic transducer shall provide a proportional 20 to 100 kPa (3 to 15 psig) output signal from either a 4 to 20 mA or 0 to 10 VDC analog control input.

.b E/P transducer shall be equipped with the following features:

i. Separate span and zero adjustments
ii. Manual output adjustments
iii. Pressure gauge assembly
iv. Feedback loop control
v. Air consumption of 0.05 L/s (0.1 scfm) at mid-range.

.9 Local Control Panels.

.a Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

.b Pre-wire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.

.c Each local panel shall have a control power source power switch (on-off) with over-current protection.

2.4 **Wiring and Raceways**

.1 General: Provide copper wiring, plenum cable, raceways as specified that meet applicable codes and regulations.

.2 Insulated wire shall use copper conductors and shall be UL listed for 90°C minimum service.

2.5 **Actuators**

.1 Existing actuators for dampers may be reused and connected to new DDC system using E/P transducer. All reused valve and damper actuators are to be tested and re-commissioned. Provide documentation (end to end check sheets) to prove that each analog output and associated actuator has been operated 0 to 100% full-stroke operation was witnessed in the field.

.2 New Electronic Valve Actuators:

.a Manufactured, brand labeled or distributed by BELIMO or approved equal.

.b Size for torque required for valve close off at 150 percent of total system (head) pressure for two-way valves; and 100 percent of pressure differential across the valve or 100 percent of total system (pump) head differential pressure for three-way valves.

.c Coupling: Directly couple end mount to stem, shaft, or ISO-style direct-coupled mounting pad.

.d Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.

.e Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to deactivate the actuator at the end of rotation.

.f Fail-Safe Operation: Mechanical, spring-return mechanism. Internal chemical storage systems, capacitors, or other internal non-mechanical forms of fail-safe operation are not acceptable.

.g Power Requirements: Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

.h Maximum 1 VA at 24-V ac or 1 W at 24-V dc.

.i Temperature Rating: -30 to +50ºC

.j Housing: Minimum requirement NEMA type 2 / IP54 mounted in any orientation.

.k Agency Listing: ISO 9001, cULus, and CSA C22.2 No. 24-93.

.l The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

2.6 Automatic Control Valves

.1 Control Valves shall be as per selection in Div 23 Appendix A or approved equal.

PART 3. Execution

3.1 Examination

.1 Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
.2 Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.

3.2 Protection

.1 Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
.2 Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 Coordination

.1 Submittals. See Section Article 1.8
.2 Test and Balance.
  .a Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
  .b Train Test and Balance Contractor to use control system interface tools.
  .c Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
.3 Coordination with Other Controls. Integrate with and coordinate controls and control devices with all existing equipment to be reused.
  .a Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described in 25 90 01 regardless of where within the contract documents those products are described.

.b Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

.c Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 General Workmanship

.1 Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

.2 Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

.3 Install equipment in readily accessible locations as defined by Canadian Electrical Code (CEC).

.4 Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

.5 Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 Field Quality Control

.1 Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and national codes and ordinances as identified in Section 25 30 01 Article 1.6 (Codes and Standards).

.2 Continually monitor field installation for code compliance and workmanship quality.

.3 Contractor shall arrange for work inspection by local or provincial authorities having jurisdiction over the work.

3.6 Existing Equipment

.1 Wiring. Abandoned wires may be reused. Check wire integrity and ensure proper application to installation. Identify and test reused wires according to this specification. Properly identify unused or redundant wiring.

.2 Local Control Panels. Existing local control panels may be used to locate new equipment. Remove and deliver redundant and unused equipment to Owner. Patch panel face cover to fill holes caused by removal of unused equipment. Relocate panels as shown.

.3 ***Repair***. Unless otherwise directed, Contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Notify Engineer in writing immediately of existing equipment that requires maintenance.

.4 Temperature Sensor Wells: Existing temperature sensor wells in piping may be reused. Modify wells as required for proper fit of new sensors.

.5 Indicator Gauges: Ensure operation of and recalibrate for reasonable accuracy or replace existing gauges.

.6 Electronic Sensors and Transmitters: Existing sensors and transmitters may be reused unless specifically noted otherwise. Remove and deliver unnecessary sensors and transmitters to Owner.

.7 Controllers and Auxiliary Electronic Devices: Existing controllers and auxiliary electronic devices may be reused unless specifically noted otherwise. Remove unnecessary sensors and transmitters.

.8 Damper Actuators, Linkages, and Appurtenances: Existing damper actuators, linkages, and appurtenances may be reused unless specifically noted otherwise. Remove and deliver unnecessary equipment to Owner.

.9 Existing System Operating Schedule: Mechanical system shall remain in operation and shall maintain space comfort at all times. Modifications to the system shall not affect space comfort conditions or cause mechanical system to be shut down for more than 30 minutes. Perform cut-over of controls that cannot meet these conditions outside of operational hours.

.10 Modify existing starter control circuits if necessary to provide hand-off-auto control of each controlled starter. Furnish new starters or starter control packages as required.

.11 Patch holes and finish to match existing walls.

.12 At Owner's request, items to be delivered to Owner shall instead be properly disposed of. Hazardous materials shall be disposed as per local codes.

3.7 Electrical Wiring for Controls

.1 Ceiling Spaces and Mechanical Rooms: All control wiring above supended ceiling spaces and in mechanical rooms shall be in conduit.

.2 Tagging: Equipment tagging system to comply with PFC standards for the BAS.

.3 All electrical connections, other than control wiring for equipment, sensors and actuators shall be done by Controls Contractor.

.4 Coordination with Electrical Contractor:

- .a Mechanical Contractor shall coordinate equipment locations and power requirements with Electrical Contractor prior to installation.
- .b Mechanical Contractor shall coordinate wiring of equipment for testing and balancing purposes with the Electrical Contractor.

.5 Wiring for all controls shall be twisted shielded pair, #18 minimum. Provide relays if load is being controlled (not starter). No splices are permitted in these wires.

.6 Concealed Class 2 wires:

- .a All wiring shall be in conduit or cable tray.

.7 No Class 2 Wiring in Conduit with Class 1 wiring:

- .a Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

.8 Exposed Class 2 wiring:

.a All wiring shall be in conduit or cable tray.

.9 Wire-to-device connections:

.a All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

.10 Maximum allowable voltage for control wiring:

.a Maximum allowable voltage for control wiring shall be 120VAC.

.11 All wiring shall be installed as continuous lengths, where possible:

.a Any required splices shall be made only within an approved junction box or other approved protective device.

.12 Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.

.13 Warning Labels

.a Affix plastic labels on each starter and equipment automatically controlled through the Control System. Label shall indicate the following:

C A U T I O N

This equipment is operating under automatic control and may start at any time without warning.

3.8 Identification of Hardware and Wiring

.1 Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
.2 Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
.3 Permanently label or code each point of field terminal strips to show instrument or item served.
.4 Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
.5 Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
.6 Label room sensors related to terminal boxes or valves with nameplates.
.7 Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
.8 Label identifiers shall match record documents.

3.9 Programming

.1 Point Naming. Name points as shown on the DDC points list and Control Schematics. Name unique point in the following format:
    .a SITE_BUILDING_SYSTEM_TYPE_FUNCTION e.g. PFC_WA_B3_HWS_T would be the point name for Pacific Forestry Centre Wing A Boiler 3 Hot Water Supply Temperature.
.2 Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented. Text-based programs shall be modular, structured, and commented to clearly describe each section of the program.
.3 Application Programming. Provide application programming that adheres to sequences of operation specified in Section 25 90 01. Program documentation or comment statements shall reflect language used in sequences of operation.
.4 System Programming. Provide system programming necessary for system operation.
.5 Operator Interface.
    .a Standard Graphics. Provide graphics as specified in Article 2.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List in Appendix E. Point information on graphics shall dynamically update.
    .b Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in this Section.

3.10 Control System Demonstration and Acceptance

.1 Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation. Provide Consultant with log documenting completion of startup tests.

.2 Consultant will be present to observe and review system demonstration. Notify Consultant before system demonstration begins.

.3 Demonstration shall follow process submitted and approved under Article 1.7 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.

.4 Demonstrate actual field operation of each sequence of operation as specified in Section 25 90 01.

.5 Demonstrate calibration and response of any input and output points requested by Consultant.

.6 Provide and operate test equipment required to prove proper system operation.

.7 Demonstrate compliance with Part 1 (System Performance).

.8 Demonstrate compliance with sequences of operation through each operational mode.

.9 Demonstrate complete operation of operator interface.

.10 Demonstrate each of the following.

.a DDC PID loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Consultant will require further tuning of each loop that displays unreasonably under- or over-damped control.

.b Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 25 90 01. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified in its Sequence of Operations. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs.

.11 Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

.12 Acceptance.

.a After tests described in this specification are performed to the satisfaction of both Consultant and Owner, Consultant will accept control system as meeting completion requirements. Consultant may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control.

.b System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Article 1.8 (Submittals).

3.11 Cleaning

.1 Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.

.2 On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.

.3 On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 25 30 01

Table of Contents

PART 1. General

1.1 General Requirements

.1 Provide programming and graphics as per the sequences in this section and schedule in Appendix E.

.2 An attempt has been made to provide full cross referencing of the sequences in this section, the points lists, and schematics. No document will take precedence so the contractor is responsible for ensuring each is read and understood to be part of the contract.

.3 Abbreviations:

a. HWST – Hot Water Supply Temperature

b. HWRT - Hot Water Return Temperature

c. OAT – Outside Air Temperature

1.2 Related Sections

.1 The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

.2 The following sections constitute related work:

a. Section 23 00 00 Project Description and Scope

b. Section 25 30 01 Controls

PART 2. Products

Does not apply

PART 3. **Execution**

3.1 **Main Boiler Plant Operation**

.1 This sequence covers the heating water plant located in the Wing-A boiler room. The boiler plant consists of three existing atmospheric boilers and a recently installed condensing boiler. As a part of this project, the three existing atmospheric boilers are to be replaced with two condensing boilers. The system will include the following equipment to be controlled by the DDC system:

Table 1: Main Boiler Plant Equipment

Equipment Description	Equipment Tag	Serves
Boiler 1 (existing)	PFC_BLR _B1	PFC Heating Equipment
Boiler 2 (new)	PFC_BLR _B2	PFC Heating Equipment
Boiler 3 (new)	PFC_BLR _B3	PFC Heating Equipment
Pump 110	PFC_BLR_P110	Boiler 1 circulation
Pump 120	PFC_BLR_P120	Boiler 2 circulation
Pump 130	PFC_BLR_P130	Boiler 3 circulation
Isolation Valve 110	PFC_BLR_IISV110	Boiler 1
Isolation Valve 120	PFC_BLR_ISV120	Boiler 2
Isolation Valve 130	PFC_BLR_ISV130	Boiler 3

.2 The following setpoints and control strategies are recommended values. All setpoints shall be field adjusted during the re-commissioning period to meet the requirements of actual field conditions.

.3 Run Schedule

The hot water boiler system shall be enabled to run continuously. Boiler and pumps shall be enable based on boiler sequence as noted in sequences below. At least one boiler shall be available. Each boiler shall run subject to its own internal safeties and controls.

.3 Boiler Operation (Loading)

a. The condensing boilers are sequenced to maintain HWST setpoint in Table 2.

b. Before a boiler is to be enabled, its isolation valve must be commanded and proven open, then its circulation pump must be enabled and proven to be running.

c. Using a PID loop referencing the HWST setpoint and temperature and the boiler firing rate is > 95%, enable the lag boiler if the control loop is 100% for 10 minutes (adj.).

d. If the lag boiler is enabled and the control loop is 100% for 20 minutes (adj.) and both Lead and Lag firing rates are above 95% then enable the standby boiler.

Table 2: Loop HWST Reset (Condensing Boiler)

OAT (°C)	HWST(°C)	Notes
-10	82	Or as reset by load in building.
18	40	Subject to Radiant Panel minimum temperature requirement reset

.4 Boiler Operation (Unloading)

a. Disable the standby boiler if the control loop is less than 95% for 10 minutes (adj.) and the total firing rate for three boilers is less than 200%.

b. Disable the lag boiler if the control loop is less than 95% for 20 minutes (adj.) and the total firing rate for two boilers is less than 110%.

.5 Boiler Fault

a. A boiler shall be considered to be in fault if any of the following conditions are true:

i. Isolation valve has failed to remain open

ii. Circulation pump has failed to remain running

iii. Boiler status is in fault

iv. Boiler has failed to fire.

b. If the lead boiler is in fault the lag boiler shall be designated the lead, and the standby shall be designated the lag.

.6 Boiler Shutdown

a. When a boiler is disabled or in fault, the circulation pump shall remain running for 5 minutes (adj), then commanded off.

b. Once the circulation pump is proven to be off, the isolation valve shall be closed.

.7 Lead/Lag/Standby Rotation

a. Lead, lag, and standby boilers shall be rotated on a weekly basis, preferably every Tuesday at 9am.

b. Building operators shall have an option to choose lead boiler from the BAS graphics.

3.2 **Alarms**

.1 Alarms shall be provided to the BAS terminal as follows:

Condition
Pump command Failure
Boiler Command Failure
Isolation Valve End Switch not made
Boiler Temperature above threshold (93°C)

END OF SECTION 25 90 01

Appendix A – Equipment Schedule

Table A-1: Proposed Boiler Schedule

Eqpt. Tag No.	Type	Service	Manufacturer	Model	Input Capacity (MBH)	Remarks
B2	Condensing Boiler	Heating Water	Viessmann or Approved Equal	Vitocrossal 200	2245	Refer to 23 52 00
B3	Condensing Boiler	Heating Water	Viessmann or Approved Equal	Vitocrossal 200	2245	Refer to 23 52 00

Table A-2 Proposed Pump Schedule

Eqpt. Tag No.	Service	Manufacturer	Type	Model	Flowrate (l/s)	TDH (kPa)	Motor (kW)	RPM	Volts	Phase	HZ
P-120	B-2	Grundfos or Approved Equal	In-line	UPS 80-80F	8.5	45	1.05	-	208	3	60
P-130	B-3	Grundfos or Approved Equal	In-line	UPS 80-80F	8.5	45	1.05	-	208	3	60

Table A-3: Proposed Circuit Balancing Valve Schedule

Eqpt. Tag No.	Service	Manufacturer	Valve Part No.	Valve Size (mm)	HW Flow (l/s)	Valve CV*	kPa	Pattern	Type
CBV-120	Boiler 2	Victaulic or Approved Equal	TA Series 788	80	8.15	139	2065	Y	Globe
CBV-130	Boiler 3	Victaulic or Approved Equal	TA Series 788	80	8.15	139	2065	Y	Globe

*GPM at Delta P of 1 psi. Full open valve

Appendix B – Mechanical Drawings

.1 M0 – Title, Symbol and Legends, Drawing List

.2 M1 – Boiler Room Layout and Details

.3 M2 – Heating Water System Schematic Diagram

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PACIFIC FORESTRY CENTRE- HIGH EFFICIENCY BOILER UPGRADES
ISSUED FOR TENDER
MARCH 31, 2015

SYMBOLS AND LEGEND

HOT WATER RETURN	HWR	EXISTING PIPE/EQUIPMENT	
HOT WATER SUPPLY	HWS	NEW PIPE/EQUIPMENT	
CONNECT TO EXISTING	C.T.E.	PIPE/EQUIPMENT TO BE REMOVED	
FLOOR ABOVE	F/A	FLUID FLOW DIRECTION	
PRESSURE REGULATING VALVE	PRV	HOT WATER SUPPLY PIPE	HWS
KILOWATT	kW	HOT WATER RETURN PIPE	HWR
PHASE	PH	GAS SUPPLY PIPE	G
HERTZ	HZ	VENT PIPE	V
KILOPASCAL	kPa	PUMP	
EXPANSION TANK	ET	BALANCING VALVE	
AUTOMATIC AIR VENT	AAV	CHECK VALVE	
COMPLETE WITH	C/W	ISOLATION VALVE	
		STRAINER	
		UNION	
		SAFETY RELIEF VALVE	
		THERMOMETER	
		AUTOMATIC AIR VENT	
		FUNNEL DRAIN	
		PRESSURE REGULATING VALVE	
		DDC TEMP SENSOR AND WELL	
		MOTORIZED VALVE	
		PRESSURE GAUGE	

DRAWING LIST

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
Mar 31, 2015

Ressources naturelles Canada | Natural Resources Canada

No.	Revision/Issue	Date
1	ISSUED FOR TENDER	31/03/2015

Firm Name and Address

E-FACTOR ENGINEERING

201 – 1636 West 2nd Avenue
Vancouver, BC,
V6J 1H4

Project Name and Address

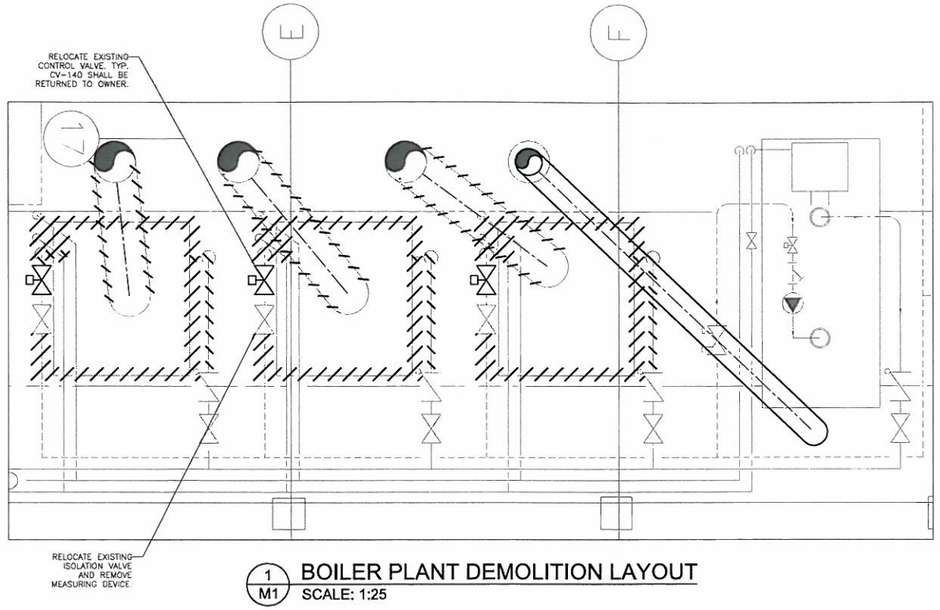
NATURAL RESOURCES CANADA
PACIFIC FORESTRY CENTRE

506 W BURNSIDE RD
VICTORIA BC
V8Z 1M5

Drawing Title

TITLE, SYMBOLS AND LEGEND, DRAWING LIST

Project Number: 115.3	Sheet: M0
Date: 16/03/2015	
Drawn: MDA	Checked: BDS
Scale: NTS	Revision: 0



1 M1 BOILER PLANT DEMOLITION LAYOUT
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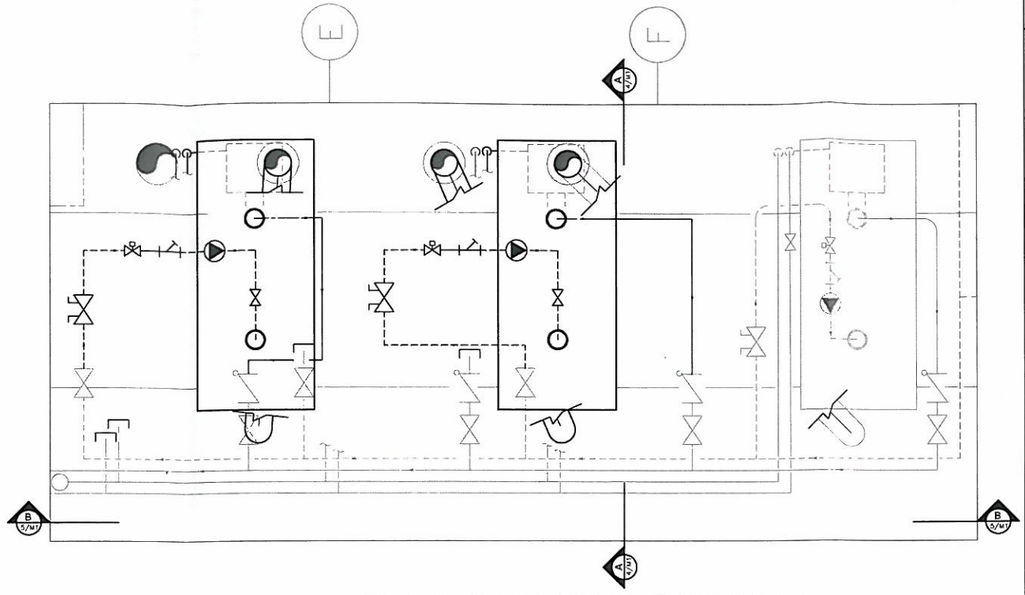

2 M1 NEW BOILER INSTALLATION LAYOUT
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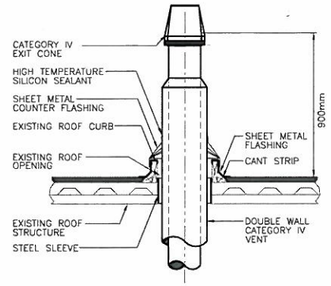

3 M1 BOILER FLUE VENT INSTALLATION
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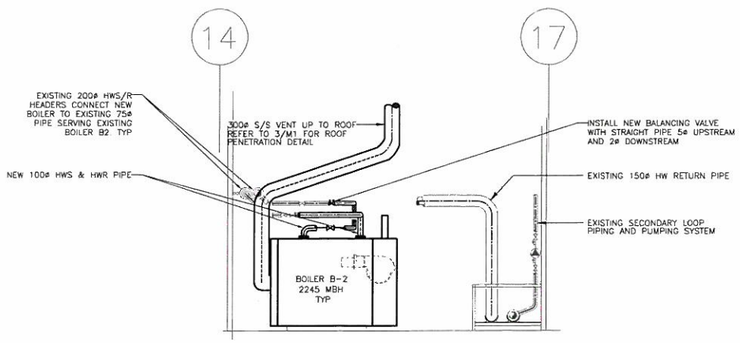

4 M1 SECTION A-A
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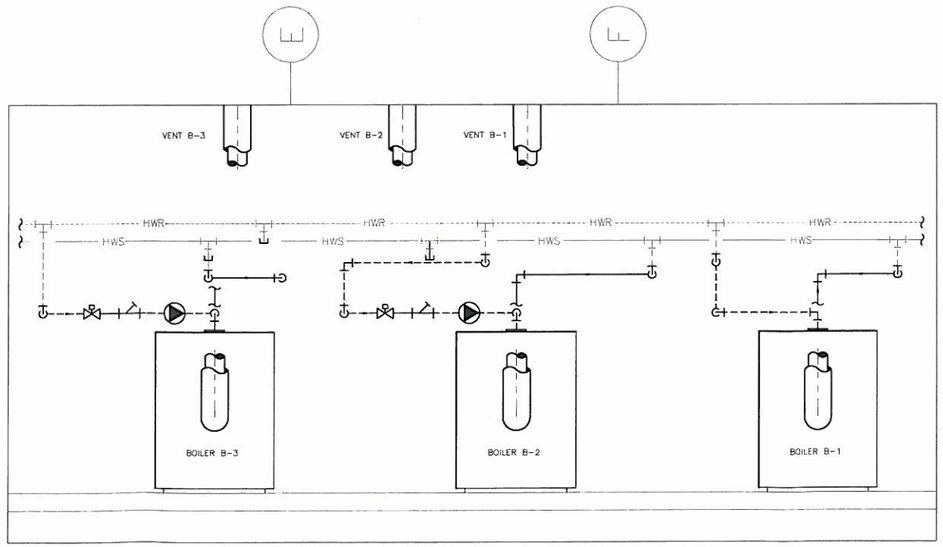

5 M1 SECTION B-B
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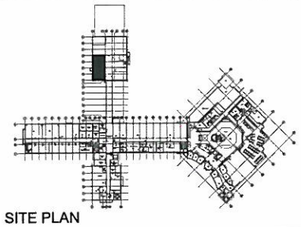

SITE PLAN

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
May 7, 2015

No.	Revision/Issue	Date
1	ISSUED FOR TENDER	30/03/2015

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201 – 1636 West 2nd Avenue
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Project Name and Address
NATURAL RESOURCES CANADA
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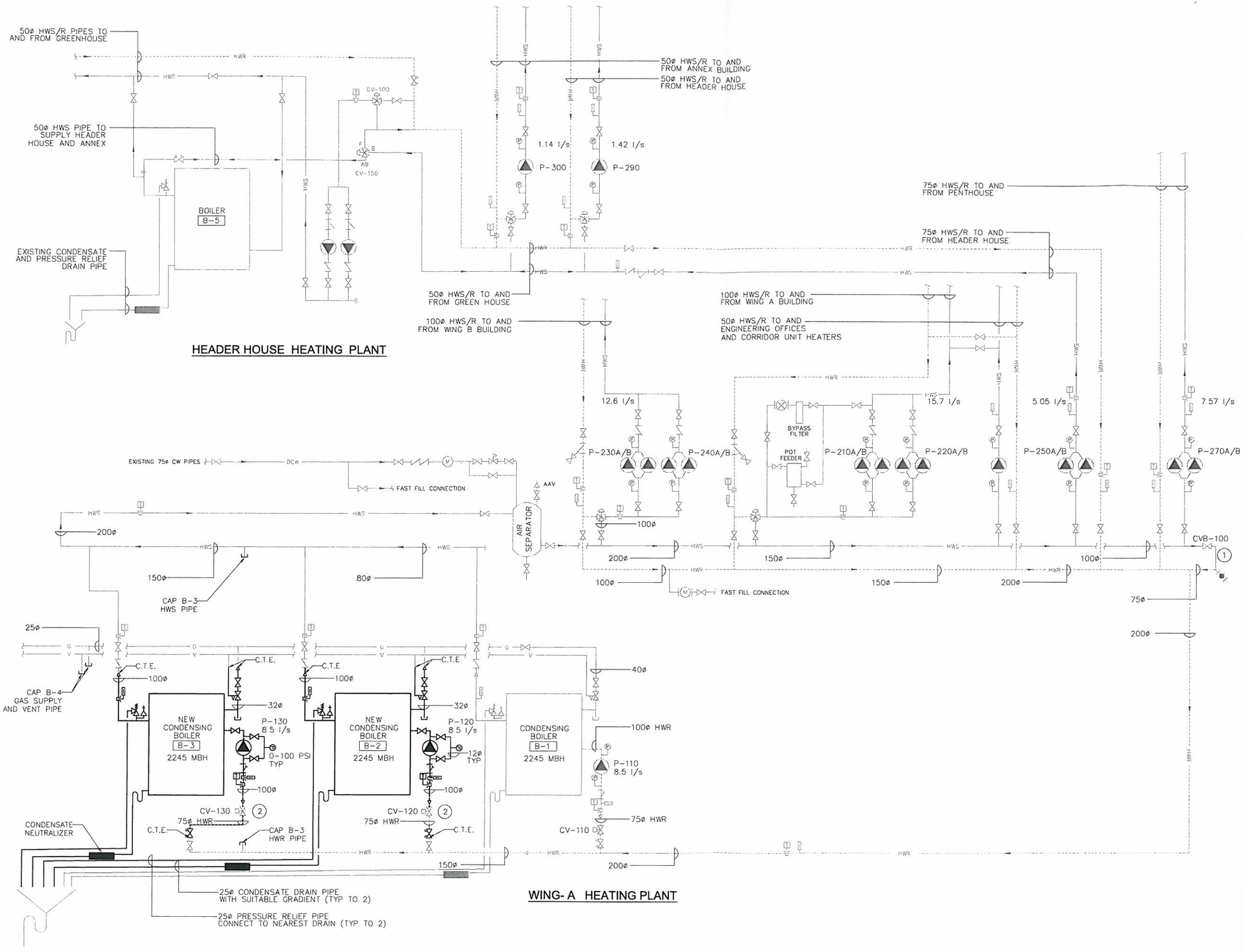
Drawing Title
PIPING LAYOUT AND DETAILS

Project Number	115.3
Date	16/03/2015
Drawn	RBF/MDA
Checked	BDS
Scale	AS SHOWN
Revision	0

Sheet
M1



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NOTES:

1. BY-PASS VALVE CBV-100 N/C
2. MOVE EXISTING VALVES CV 120 & CV 130 TO NEW LOCATIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
16/20/15

No.	Revision/Issue	Date
1	ISSUED FOR TENDER	30/03/2015

Firm
E-FACTOR ENGINEERING
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Project Name and Address
NATURAL RESOURCES CANADA
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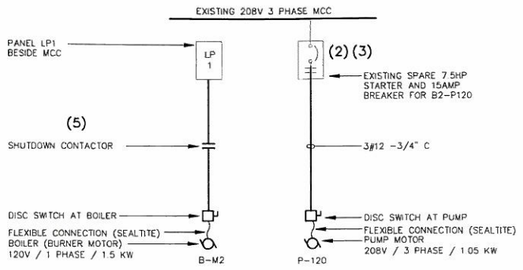
VICTORIA BC
V8Z 1M5

Drawing Title
HEATING WATER SYSTEM
SCHEMATIC DIAGRAM

Project Number	115.3
Date	16/03/2015
Drawn	RBF/MDA
Checked	BDS
Scale	NTS
Revision	0
Sheet	M2

Appendix C – Electrical Drawings

.1 E1 – Electrical Layout and Details



SINGLE LINE DIAGRAM TYPICAL B2 AND B3
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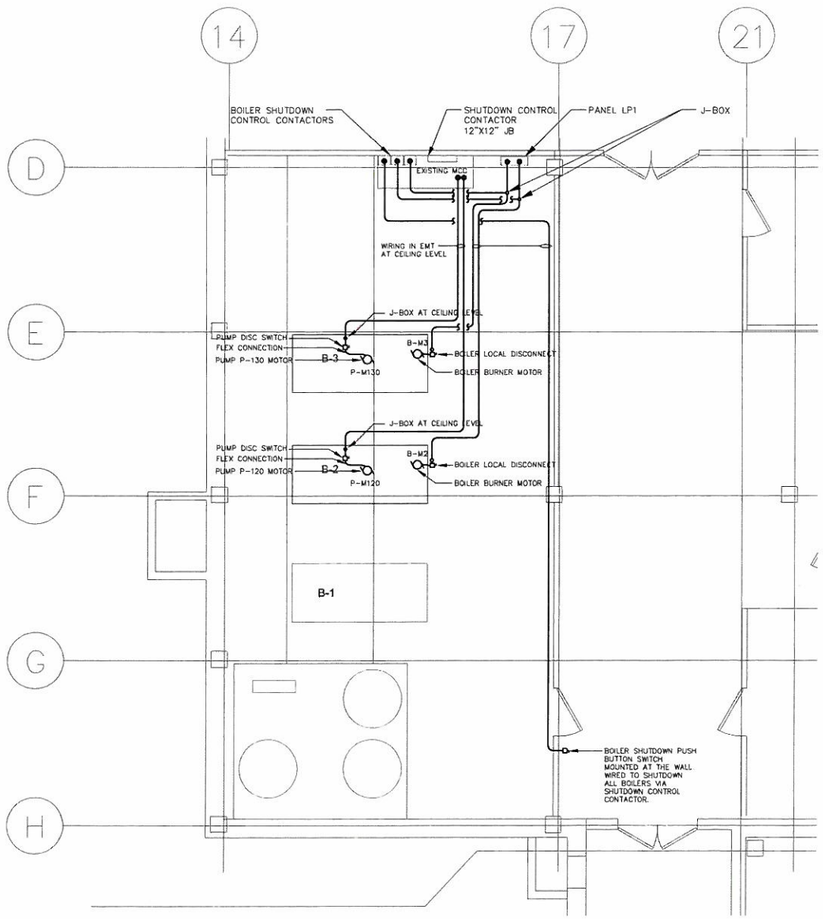


1 / E1 WING A BOILER PLANT PLAN
SCALE: 1:50

ELECTRICAL SPECIFICATION

1. GENERAL

1.1 ELECTRICAL CONTRACTOR SHALL CO-ORDINATE AND CO-OPERATE WITH OTHER TRADES IN MATTERS IN WHICH THEY ARE MUTUALLY ENGAGED.

1.2 THE WORK SHALL BE INSTALLED TO MEET THE REQUIREMENTS OF THE FOLLOWING STANDARDS AND/OR CODES:

1.2.1. CSA STANDARD C22.1-2012 (CANADIAN ELECTRICAL CODE)

1.2.2. LOCAL AMENDMENTS TO THE CURRENT EDITION OF THE CANADIAN ELECTRICAL CODE.

1.2.3. BULLETINS TO THE CANADIAN ELECTRICAL CODE AS ISSUED BY THE PROVINCIAL AUTHORITY HAVING JURISDICTION.

1.2.4. BCBC 2012.

1.3 ALL MATERIALS SHALL BE NEW AND BEAR APPROVAL LABELS AS REQUIRED BY CODE AND/OR INSPECTION AUTHORITIES.

1.4 ELECTRICAL CONTRACTOR SHALL OBTAIN AND PAY FOR ALL ELECTRICAL PERMITS AND INSPECTIONS.

1.5 ELECTRICAL CONTRACTOR SHALL PROVIDE CERTIFICATE OF ACCEPTANCE FROM ELECTRICAL INSPECTION DEPARTMENT UPON COMPLETION.

1.6 ELECTRICAL CONTRACTOR SHALL VISIT SITE PRIOR TO SUBMITTING PRICE TO ENSURE A COMPLETE UNDERSTANDING OF THE WORK REQUIRED PRICE ACCORDINGLY.

1.7 DRAWINGS ARE GENERALLY DIAGRAMMATIC AND ARE INTENDED TO INDICATE THE SCOPE AND GENERAL ARRANGEMENT OF WORK. DO NOT SCALE DRAWINGS. CONSULT THE MECHANICAL DRAWINGS AND DETAILS FOR EXACT LOCATIONS OF FIXTURES, EQUIPMENT, AND HEIGHT OF RECEPTACLES OBTAIN THIS INFORMATION FROM THE CONSULTANT WHERE DEFINITE LOCATIONS ARE NOT INDICATED.

1.8. PROVIDE AS-BUILT DRAWINGS. MARK A SET OF WHITE PRINTS IN RED PEN NEATLY TO SHOW EXACT LOCATIONS OF DEVICES, J-BOXES, WIRING SYSTEM AND ROUTINGS AS WELL AS CHANGES TO CIRCUITING. SUCH RECORDS SHALL BE FOR ALL WIRING INSTALLED UNDER THIS CONTRACT. MARK CHANGES NEATLY AS THEY OCCUR. KEEP DRAWINGS ON SITE FOR THIS PURPOSE. AT THE COMPLETION OF THE PROJECT ARRANGE AND PAY FOR THE AS-BUILT DRAWINGS TO BE TRANSFERRED TO CAD FORMAT. CONSULTANT WILL PROVIDE A CAD DISK FREE OF CHARGE. ALL CAD WORK MUST BE TO THE STANDARD OF THE CONTRACT DRAWINGS AND TO THE SATISFACTION OF THE CONSULTANT. COST TO HAVE CONSULTANT PRODUCE CAD AS-BUILTS FROM CONTRACTOR PROVIDED NEAT, LEGIBLE MARK-UPS IS $300.00.

1.9 EXCEPT AS INDICATED BELOW THE ELECTRICAL CONTRACTOR SHALL CORRECT PROMPTLY AT HIS OWN EXPENSE, ANY DEFECTS IN THE WORK DUE TO FAULTY PRODUCTS AND/OR WORKMANSHIP APPEARING WITHIN A PERIOD OF ONE YEAR FROM THE DATE OF SUBSTANTIAL PERFORMANCE OF THE WORK.

1.9.1. THE ELECTRICAL CONTRACTOR SHALL CORRECT AND/OR PAY FOR ANY DAMAGE TO OTHER WORK RESULTING FROM ANY WARRANTY CORRECTIONS REQUIRED.

1.9.2. PROVIDE WRITTEN CERTIFICATION OF WARRANTY.

1.10 PROVIDE ENGRAVED LAMICOID NAMEPLATES ON OR AT ALL PIECES OF ELECTRICAL EQUIPMENT INCLUDING THE FOLLOWING:

1.10.1. MOTOR STARTERS, AND DISCONNECT SWITCHES.

1.10.2. NAMEPLATES SHALL CLEARLY IDENTIFY THE ITEM SO LABELED.

1.11 ITEMS OF MATERIALS AND EQUIPMENT NOT SPECIFICALLY NOTED ON DRAWINGS OR MENTIONED IN SPECIFICATIONS, BUT WHICH ARE NECESSARY TO MAKE A COMPLETE AND OPERATING INSTALLATION, SHALL BE INCLUDED.

1.12 MATERIALS SHALL BEAR APPROVAL LABELS AS REQUIRED BY CODE AND/OR INSPECTION AUTHORITIES.

1.13. SUBMIT PRICE BASED ON EQUIPMENT AND MANUFACTURERS SPECIFIED. ALTERNATIVES MAY BE CONSIDERED ALTERNATE SUBMISSIONS TO BE PROVIDED FOR APPROVAL PRIOR TO TENDER CLOSING IN ACCORDANCE WITH DIVISION 1 REQUIREMENTS. NO SUBSTITUTIONS WILL BE PERMITTED AFTER CLOSING OF TENDERS.

2. WIRING REQUIREMENTS

2.1. ALL CONDUCTORS SHALL BE COPPER.

2.2 SINGLE CONDUCTORS FOR WIRING IN CONDUIT SHALL HAVE RW-90 X-LINK OR TW 75 INSULATION UNLESS SPECIFICALLY STATED ON THE DRAWINGS OR REQUIRED BY CODE THAT RSO (I.E. 90°C INSULATED WIRE) IS REQUIRED. DO NOT USE T90 INSULATED CONDUCTORS.

2.3 MINIMUM WIRING SIZE SHALL BE #12AWG.

2.4 INSTALL ALL WIRING IN EMT WITH STEEL FITTINGS.

2.5 INSTALL WIRING ON THE SQUARE PARALLEL OR AT RIGHT ANGLES TO BUILDING LINES.

2.6 A SHORT LENGTH OF FLEXIBLE CONDUIT SHALL BE USED FOR CONNECTION TO MOTORS OR MOTORIZED EQUIPMENT. USE WEATHERPROOF FLEX FOR EQUIPMENT.

2.7 PROVIDE GROUNDING AND BONDING AS REQUIRED BY CODE OR AS INDICATED.

2.8. APPLIANCES AND MECHANICAL EQUIPMENT WILL BE SUPPLIED AND SET IN PLACE BY OTHERS. CONTRACTOR UNDER THIS DIVISION SHALL PROVIDE WIRING AND MAKE CONNECTION TO SUCH EQUIPMENT. LEAVE ALL APPLIANCES AND AIR HANDLING EQUIPMENT IN COMPLETE OPERATING CONDITION.

3. SEISMIC

3.1 RETAIN SERVICES OF A STRUCTURAL ENGINEER REGISTERED IN BRITISH COLUMBIA WITH THE ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEO-SCIENTISTS TO DESIGN FIXINGS AS NECESSARY AND PROVIDE LETTER OF ASSURANCE SCHEDULE C-B WITH REGARD TO THE INSTALLATION OF UNISTRUTS SPANNING FLOOR TO CEILING FOR MOUNTING EQUIPMENT.

NOTES:

1. PROVIDE LAMICOID LABELS TO MATCH EXISTING LABELING OF BOILER INSTALLATIONS. LAMICOID LABELS SHALL BE FIXED WITH LOCTITE ADHESIVE. DO NOT USE PRE-GUMMED LABELS. MATCH EXISTING COLOURS AND LETTERING SIZE AND TYPE.
2. ONE SIZE 1 STARTER EXISTS IN MCC. USE THIS STARTER TO WIRE TO PUMP P-120. REPLACE OVERLOAD RELAYS TO SUIT MOTOR INSTALLED.
3. PROVIDE MINIMUM SIZE 0 STARTER IN EXISTING SPARE SPACE IN MCC. STARTER TO BE MAGNETIC WITH LINE SIDE DISCONNECT CONSISTING OF BREAKER OR MCP. STARTER TO HAVE ON/OFF PILOT LIGHTS AND H/O/A. EXISTING MCC IS WESTINGHOUSE 2100 SERIES. MATCH EXISTING PILOT LIGHT COLOURS. USE STARTER TO POWER PUMP P-M130.
4. REMOVE WIRING TO EXISTING BOILERS TO SOURCE.
5. PROVIDE SHUTDOWN OF TWO NEW BOILERS VIA EXISTING PUSH-BUTTON AT ENTRY. PROVIDE SHUTDOWN CONTACTORS AS NECESSARY AND WIRE CONTACTOR CONTROL CIRCUIT TO BE SHUTDOWN BY PUSH-BUTTON.

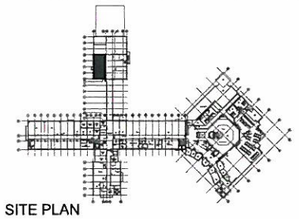
LEGEND

(N) REFER TO NOTE NUMBER N (TYPICAL)

DISCONNECT SWITCH. F = FUSED

MOTOR. NUMERAL=HP RATING. F=FRACTIONAL HORSEPOWER

Ressources naturelles Canada / Natural Resources Canada



SITE PLAN

L.P. GANDER & ASSOCIATES LTD.
CONSULTING ENGINEERS ELECTRICAL
#106-3855 HENNING DRIVE
BURNABY, BRITISH COLUMBIA, V5C 6N3
T:604-298-0939 F:604-298-9823
E-MAIL: lpge@uniserve.com

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
10 Dec/15

No.	Revision/Issue	Date
0	ISSUED FOR TENDER	23/03/2015

Firm Name and Address

E-FACTOR ENGINEERING
201 – 1636 West 2nd Avenue
Vancouver, BC,
V6J 1H4

Project Name and Address

NATURAL RESOURCES CANADA
PACIFIC FORESTRY CENTRE
506 W BURNSIDE RD
VICTORIA BC
V8Z 1M5

Drawing Title

ELECTRICAL DETAILS

Project Number		Sheet
115		E1
Date: 23/03/2015		
Drawn: RBF/MDA	Checked: LPG	
Scale: AS SHOWN	Revision: 0	

Appendix D – Controls Drawings

.1 C-00 – Title, Legend & Drawing List

.2 C-01 – Wing A Heating Plant

.3 C-02 – Overall Heating Plant

E-FACTOR ENGINEERING

Legend

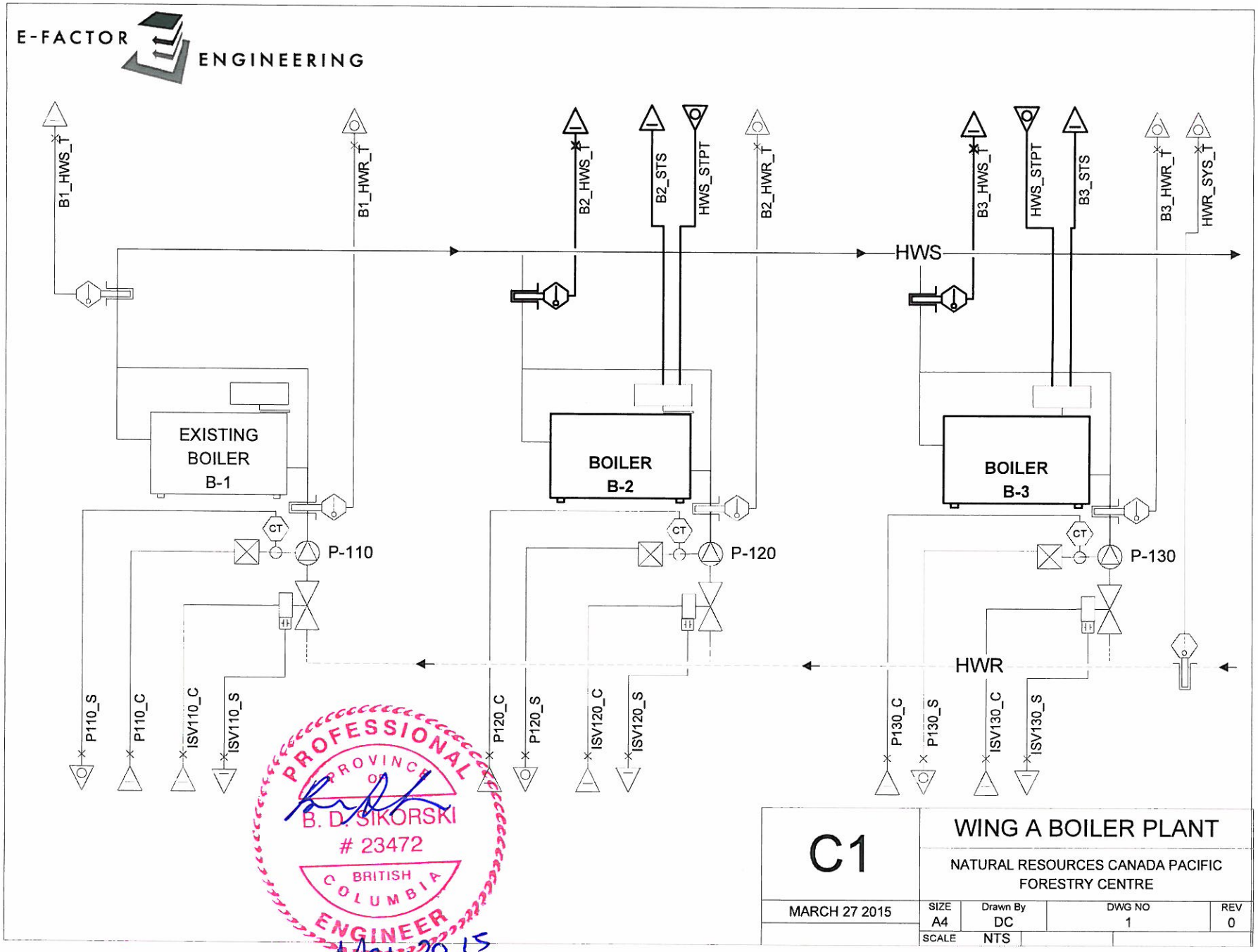
- 2 Way Valve
- 3 Way Valve
- Actuator-Electric
- Actuator-Pneumatic
- Cooling Coil
- Current Sensor (CT)
- Damper
- Differential Pressure Sensor
- DX Unit (D / X)
- Fan
- Filter
- Freeze Stat - Manual Reset
- Heat Recovery Coil
- Heating Coil
- Humidifier
- Pump
- RH Sensor
- RH Sensor - High Limit
- Starter
- Static Pressure Sensor (F)
- Temperature Sensor
- VSD
- Analog Input
- Analog Output
- Digital Input
- Digital Output Control Connector
- Pipe
- Break

DRAWING LIST:
C0 – TITLE, LEGEND & DRAWING LIST
C1 – WING A HEATING PLANT
C2 – OVERALL HEATING PLANT

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
May 20, 15

C0	TITLE, LEGEND & DRAWING LIST			
	Pacific Forestry Centre			
MARCH 26 2015	SIZE A4	Drawn By DC	DWG NO 0	REV 0
	SCALE NTS			

E-FACTOR ENGINEERING



PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
May 20, 15

C1	WING A BOILER PLANT			
	NATURAL RESOURCES CANADA PACIFIC FORESTRY CENTRE			
MARCH 27 2015	SIZE A4	Drawn By DC	DWG NO 1	REV 0
	SCALE NTS			

E-FACTOR ENGINEERING

P-130

Boiler 3
B-3

P-120

Boiler 2
B-2

P-110

Boiler 1
B-1

P-230A/B

TO/FROM WING B

P-240A/B

TO/FROM
WING A

P-210A/B

P-220A/B

TO/FROM ENGINEERING
OFFICES AND CORRIDOR

P-260

P-250A/B

TO/FROM PENTHOUSE

P-270A/B

TO/FROM ANNEX BUILDING

P-300

TO/FROM HEADER HOUSE

P-290

P-10

TO/FROM GREEN HOUSE

NO
C
NC

C
NC
NO

P-11

Boiler 5
B-5

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. D. SIKORSKI
23472
May 20, 15

c02 Overall Heating Plant

C-02

Overall Heating Plant

NATURAL RESOURCES CANADA PACIFIC FORESTRY CENTRE

MARCH 27 2015	SIZE	Drawn By	DWG NO	REV
	A3	DC	2	0
	SCALE	NTS		

Appendix E – DDC Points List

.1 DDC Points List

.2 DDC Systems List

DDC Points List

E-FACTOR ENGINEERING

Generated: 3/27/2015 16:30

Project: NRCan PFC Boiler Upgrades **Building: Wing A Heating Plant** **Site: NRCan - Pacific Forestry Ce**

System: HTG **Tag: HTG** **Location: Wing A** **Schematic** **Quantity 1**

Index	Point Description	Device	Point Name	AI	AO	BI	BO	Comments	Retrofit/New	Pnl.	I/O	Trend
1.	Boiler 2 Status	DDC	PFC_WA_HTG_BLR2_S	1	0	0	0	BACnet Gateway or 0-10Vdc	N			TP
2.	Boiler 3 Status	DDC	PFC_WA_HTG_BLR3_S	1	0	0	0	BACnet Gateway or 0-10Vdc	N			TP
3.	Heating Water Return _B1 Temp.	TSP1	PFC_WA_HTG_HWR_B1_T	1	0	0	0	Wire relocated sensor	R			TP
4.	Heating Water Return _B2 Temp.	TSP1	PFC_WA_HTG_HWR_B2_T	1	0	0	0	New HWRT sensor	N			TP
5.	Heating Water Return _B3 Temp.	TSP1	PFC_WA_HTG_HWR_B3_T	1	0	0	0	New HWRT sensor	N			TP
6.	Heating Water Supply _B1 Temp.	TSP1	PFC_WA_HTG_HWS_B1_T	1	0	0	0	Wire relocated sensor	R			TP
7.	Heating Water Supply _B2 Setpoint	DDC	PFC_WA_HTG_HWS_B2_SP	0	1	0	0	BACnet Gateway or 0-10Vdc	R			TP
8.	Heating Water Supply _B2 Temp.	TSP1	PFC_WA_HTG_HWS_B2_T	1	0	0	0	Wire relocated sensor	R			TP
9.	Heating Water Supply _B3 Setpoint	DDC	PFC_WA_HTG_HWS_B3_SP	0	1	0	0	BACnet Gateway or 0-10Vdc	R			TP
10.	Heating Water Supply _B3 Temp.	TSP1	PFC_WA_HTG_HWS_B3_T	1	0	0	0	Wire relocated sensor	R			TP
11.	Pump 110 Control - Digital	CR1/2	PFC_WA_HTG_P110_C	0	0	0	1	Recommission	R			TC
12.	Pump 110 Status	CS1	PFC_WA_HTG_P110_S	1	0	0	0	Recommission	R			TP
13.	Pump 120 Control - Digital	CR1/2	PFC_WA_HTG_P120_C	0	0	0	1	Retrofit new circulation pump	R			TC
14.	Pump 120 Status	CS1	PFC_WA_HTG_P120_S	1	0	0	0	Retrofit new circulation pump	R			TP
15.	Pump 130 Control - Digital	CR1/2	PFC_WA_HTG_P130_C	0	0	0	1	Retrofit new circulation pump	R			TC
16.	Pump 130 Status	CS1	PFC_WA_HTG_P130_S	1	0	0	0	Retrofit new circulation pump	R			TP
17.	Valve 110 Control - Digital	CR1/2	PFC_WA_HTG_V110_C	0	0	0	1	Wire relocated valve	R			TC
18.	Valve 110 Status	ESV	PFC_WA_HTG_V110_S	0	0	1	0	Wire relocated valve	R			TC
19.	Valve 120 Control - Digital	CR1/2	PFC_WA_HTG_V120_C	0	0	0	1	Wire relocated valve	R			TC
20.	Valve 120 Status	ESV	PFC_WA_HTG_V120_S	0	0	1	0	Wire relocated valve	R			TC
21.	Valve 130 Control - Digital	CR1/2	PFC_WA_HTG_V130_C	0	0	0	1	Wire relocated valve	R			TC
22.	Valve 130 Status	ESV	PFC_WA_HTG_V130_S	0	0	1	0	Wire relocated valve	R			TC
	Total Points for System: HTG 22			11	2	3	6					

AT: Analog Totalizer BT: Binary Totalizer ET: Event Log TC: Trend COV TP: Trend Polling

DDC Points List Summary Device Descriptions

	AI	AO	BI	BO	Total
New Points:	4	0	0	0	4
Retrofit Points:	7	2	3	6	18
Total:	11	2	3	6	22

Project: **Building**

	Device T	Device Description
1.	CR1/2	Control Relay (Solid State or Dry contact electro-mechanic
2.	CS1	Current Sensor (analog)
3.	DDC	Point Type DDC
4.	ESV	End Switch - Valve
5.	TSP1	Temperature Sensor - Pipe Immersion