NRC·CNRC

Addendum / Addenda

No./No
2

Project Description / Description de projet		
CHCP - Pyrolysis Bio-Fuel Boiler		
Solicitation No./N° de solicitation	Project No./N° de projet	W.O. No./N° d'ordre de travail
17-22021	A1-011349-01	
Contracting Authority/Services d'approvisionnement		Date
Collin Long		June 22, 2017

Notice:	**Nota**:
This addendum shall form part of the tender documents and all conditions shall apply and be read in conjunction with the original plans and specifications.	Cet addenda fait partie intégrale des dossiers d'appel; toutes les conditions énoncées doivent être lues et appliquées en conjonction avec les plans et les devis originaux.

1 Additional Performance Specs Div. 25, Div. 40 and Div. 26

2 Replacement of Sections 4.3 Performance Testing/Warranty, 4.3.1 Conditional Acceptance Test, 4.3.2 Final Acceptance Test and 4.3.3 Performance Test and Performance Guarantee

Part 1 General

1.1 DESIGNATED CONTRACTOR

.1 Designated Contractor

.1 Hire the services of a qualified controls systems integrator that has industrial heating plant experience in plants who are a recognized representative of ABB Automation and Control to complete the work on the existing ABB DCS (Digital Control System) installed and operating in the Confederation Heights CHCP.

.2 Materials

.1 There is an existing ABB 800XA DCS system presently installed in the Confederation Heights CHCP that must be reused for this project. All materials and installations must be selected to ensure compatibility with the existing DCS system.

1.2 RELATED SECTIONS BUT NOT LIMITED TO

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 29 - Health and Safety Requirements.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 91 13 – General commissioning (CX) Requirements.

.5 Section 25 05 02 - DCS: Submittals and Review Process.

.6 Section 25 05 54 - DCS: Identification.

.7 Section 25 90 01 - DCS: Site Requirements Applications and Systems Sequences of Operation.

.8 Section 26 05 00 – Common Work Results for Electrical

1.3 REFERENCES

Use the latest applicable edition of the following references.

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).

.1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.

.4 Consumer Electronics Association (CEA).

.1 CEA-709.1, Control Network Protocol Specification.

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

.1 Material Safety Data Sheets (MSDS).

1.4 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in DCS:

.1 AEL - Average Effectiveness Level.
.2 AI - Analog Input.
.3 AO - Analog Output.
.4 CDL - Control Description Logic.
.5 CDS - Control Design Schematic.
.6 COSV - Change of State or Value.
.7 CPU - Central Processing Unit.
.8 DI - Digital Input.
.9 DO - Digital Output.
.10 DP - Differential Pressure.
.11 DCS – Distributed Control System.
.12 IDE - Interface Device Equipment.
.13 I/O - Input/Output.
.14 ISA - Industry Standard Architecture.
.15 LAN - Local Area Network.
.16 MCU - Master Control Unit.
.17 NC - Normally Closed.
.18 NO - Normally Open.
.19 OS - Operating System.
.20 O&M - Operation and Maintenance.
.21 PID - Proportional, Integral and Derivative.
.22 SP - Static Pressure.
.23 VAV - Variable Air Volume.

1.5 SYSTEM DESCRIPTION

.1 Work covered by sections referred to above consists of fully operational modified existing DCS, including, but not limited to, following:

.1 Control devices and associated I/O point summary tables.
.2 Data communications equipment necessary to effect DCS data transmission system.
.3 Full documentation.
.4 Complete operating and maintenance manuals.
.5 Training of personnel.
.6 Acceptance tests, technical support during commissioning, full documentation.
.7 Wiring interface co-ordination of equipment supplied by others.
.8 Miscellaneous work as specified in these sections and as required.

.3 Design Requirements:

.1 Design and provide conduit and wiring linking elements of system.

1.6 SUBMITTALS

.1 Make submittals in accordance with 25 05 02 - DCS: Submittals and Review Process.

.2 Submit for review:

.1 Equipment list and systems manufacturers at time of tender.

.3 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - DCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by the Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to the Departmental Representative.

Part 2 Products

2.1 EQUIPMENT

.1 Acceptable materials.

.1 There is an existing XXX control system presently installed in the heating plant. Equipment installed under this contract must be XXX or material with the same functionality and able to connect to the existing XXX DCS.

Part 3 Execution, but not limited to:

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 INTERVENTIONS REQUIRED

.1 The removal of any existing control wiring of equipment to be dismantle.

.2 Remove any existing field devices prior to demolition that PSPC will keep as spare parts.

.3 Provide all control device or interface device to control the boiler and all ancillary equipments listed and/or required for the operation of the boiler plant. These equipment includes I/O cards, controller, communication, etc.

.4 Provide all field instrumentation for the new boilers and ancillary equipment that has not been provided.

.5 Complete all tagging and termination of all field instrumentation at both the transmitter end and the I/O Cabinets.

.6 Complete all programming and graphic work in the existing DCS system to accept the new Boilers and provide all the same functionality of the existing boilers.

.7 Complete all calibration testing and provide calibration data sheets.

.8 Assist the Boiler supplier with commissioning of boilers as per the commission section of the spec.

END OF SECTION

Part 1 General

.1 Related Sections but not limited to.

.1 Section 25 05 01 - DCS: General Requirements.

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - DCS: General Requirements.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following Contractor and systems information.

.1 Location of office.
.2 Description and location of installing and servicing technical staff.
.3 Location and qualifications of programming design and programming support staff.
.4 List of spare parts.
.5 Names of sub-contractors and site-specific key personnel.
.6 Sketch of site-specific system architecture.
.7 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
.8 Sample CDL and graphics (systems schematics).
.9 Response time for each type of command and report.
.10 Item-by-item statement of compliance.
.11 Proof of demonstrated ability of system to communicate.

1.4 PRELIMINARY SHOP DRAWING REVIEW

.1 Contractor’s Engineer to submit to Departmental Representative preliminary shop drawings within thirty (30) working days of award of contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
.2 Detailed system architecture showing all points associated with each controller including signal levels, pressures where new DCS ties into existing control equipment.
.3 Spare point capacity of each controller by number and type.
.4 Controller locations.
.5 Auxiliary control cabinet locations.
.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

1.5 DETAIL SHOP DRAWING REVIEW

.1 Contractor’s Engineer to submit to Departmental Representative detailed shop drawings within sixty (60) working days after award of contract and before start of installation and include following:

- .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
- .2 Wiring diagrams.
- .3 Piping diagrams and hook-ups.
- .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
- .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
  - .1 Associated field wiring schematics, schedules and terminations.
  - .2 Complete Point Name Lists.
  - .3 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
  - .4 Software and programming details associated with each point.
  - .5 Manufacturer's recommended installation instructions and procedures.
  - .6 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of DCS.
- .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system and typical floor plans.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control location of control equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures.

1.6 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:

- .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
- .2 Review interface requirements of materials supplied by others.

.3 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Sections but not limited to.

.1 Section 25 05 01 - DCS: General Requirements.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - DCS: General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.5 SUBMITTALS

.1 Submit to the Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of DCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of DCS" as reviewed by the Departmental Representative's.

2.3 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each DCS panel.

2.4 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.5 CONDUIT

.1 Colour code DCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with the Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; DCS System architectural diagram, Control Design Schematic for each system, System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2 SEQUENCING

.1 Present sequencing of operations for systems, in accordance with ISA-5.2-1976.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Provide control systems in accordance with applicable codes. Design control systems so that the loss of the control medium (e.g. air, electricity, or other) will leave the controls in a fail-safe position.

1.2 CONTROL LOCATION

.1 Locate instrument control in the boiler room as much as practical. Provide local control panels where they are required for equipment start-up and where constant attendance is not required.

1.3 TURNDOWN

.1 Instruments have to cover normal operating as well as upset conditions. Several instruments might have to be provided to cover all of the ranges. It is important that all instruments be reviewed for covering all operating as well as upset conditions during the plant design stage.

1.4 INSTRUMENT RANGES

.1 Size flow instruments based on a normal operating flow of approximately 70 percent of full scale. For all other instruments set the normal operating point at 50 percent of full scale. Use the following scales:

.1 Flow – Direct reading.

.2 Pressure – Direct reading.

.3 Temperature – Direct reading.

.4 Level – 0-100% linear.

.5 Analysers – Direct reading.

.2 Suppressed ranges for temperature and pressure may be used as long as they cover startup and upset conditions.

1.5 HARDWARE

.1 Hardware standards are defined by NEMA-ICS 2, Standards for Industrial Control and System Controllers, Contractors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.

1.6 EQUIPMENT RATING AND CLASSIFICATION

.1 Provide instruments that are rated for the environment. Electrical components must be designed for the anticipated temperature and humidity inside of the enclosure, fungus proofing where required, and vibration. Refer to NEMA-ICS 1.1, *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* for additional information.

.1 Enclosures

.1 Enclosures must be certified by the National Electrical Manufacturers Association (NEMA) for the environment where they will be used. NEMA 4 enclosures must be used for indoor locations near the boiler.

.2 Hazardous Locations

.1 Hazardous locations are defined by NFPA-70, *National Electric Code.* Enclosures must be rated for the location in which they will be installed. Cost savings may be achieved by relocating an enclosure from a hazardous location to a non-hazardous one.

1.7 POWER SUPPLIES

.1 Furnish a power supply that provides c1ean power to the instruments. That is one that is free of disturbances and nuisance shutdowns. The manufacturer should be able to provide equipment specifications and recommend safeguards against severe power disturbances. Refer to NEMA ICS 1.1, *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* for additional information. lnclude the following:

.1 Provide power supplies that enable the controls, including combustion safeguard systems and other control devices, to operate through an electric power interruption of 20 milliseconds without affecting the operation of the plant.

.2 Provide an uninterruptible power supply (UPS) system to keep the electronic instrumentation on line in case of a power interruption. The required time depends on the plant and instrumentation, but 30 minutes is often specified. The UPS system must provide a safe plant shutdown in case of a longer power outage. Small UPSs located inside of control panels should be equipped with ventilation fans to remove unwanted heat.

.3 Connect all trip circuits to the UPS system.

.2 UPS system standards are defined by NEMA-PE 1, *Uninterruptible Power Systems.*

1.8 INSTRUMENT AIR

.1 Provide c1ean, dry instrument air as defined by ANSI/ISA-S7.0.01, *Quality Standard for Instrument Air.* Test that the instrument air control circuits are free of leaks per the same standard.

1.9 WIRING AND CONDUITS

.1 Wiring must conform to NFPA 70, *National Electric Code.* Run signal, thermocouple, and power wiring in separate conduits. Wiring for alarm, shutdown, and interlock circuits of the same voltage as the power wiring may be run in the same conduit as the power wiring.

.2 Cable and thermocouple wire must conform to NEMA-WC55, *Instrumentation Cables and Thermocouple Wire.* Provide high point vents and low point drains for all conduits. Recommended practices for control centers are defined by ISA-RP60.8, *Electrical Guide for Control Centers.*

1.10 INSTRUMENT TUBING AND PIPING

.1 Do not bring lines containing process fluids such as water and steam into the control room, control panels or control boards.

.2 Keep pneumatic signals in and out of the control room to a minimum. Use electronic signals instead. Avoid pneumatic signals in controlled pressure sensitive areas. Certain pneumatic local instruments "bleed" air to their environment.

.3 Use recommended practices for installation of piping and tubing in control centers as defined by ISA-RP60.9, *Piping for Control Centers.*

1.11 IDENTIFICATION

.1 Identify all instruments and controls with a stainless steel metal tag permanently mounted on the instrument. Include the instrument number and service in the identification.

.2 Nameplates

.1 Provide nameplates for all panel instruments on both the front and the rear of the panel. Minimum front panel information must include instrument number, service, scale factors, and units. The rear of panel only requires the instrument number. Use recommended practices on panel nameplates as defined by ISA-RP60.6, *Nameplates, Labels and Tags for Control Centers.*

.3 Terminations

.1 Identify each electrical and tubing terminal with the instrument item number to which it connects. Tag and number all terminals and the ends of all wires. Identify all electrical conduits as to type of wiring (power, thermocouple, DC signals, or other).

.4 Instruments

.1 Identify all local instruments such as valves and switches with the item number of the instrument with which it operates.

1.12 INSTRUMENT SPECIFICATION FORMS

.1 Use instrument specification forms when ordering instruments. Forms and specification checklists for a number of instruments are provided in ISA-S20, *Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.* Obtain complete information on the instrument from the manufacturer before ordering. Sources of information include manufacturer catalogs, data sheets and other literature. Provide all data required for ordering the instrument. Specify all items including optional selections and deviations from the manufacturers standard.

1.13 DRAWINGS

.1 Use standard symbols. For standard symbols, presentation, and terminology refer to the following industry standards.

.1 ANSI/ISA-S5.1, *Instrumentation Symbols and Identification*.

.2 ISA-S5.3, *Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems*.

.3 ANSI/ISA-S5.4, *Instrument Loop Diagrams*.

.2 Provide control schematic diagrams, logic diagrams, and instrument loop diagrams.

1.14 CODE REQUIREMENTS

.1 Where local or provincial code requirements differ from the ASME, ANSI, and NFPA codes, the more stringent code requirements shall prevail. The following codes apply.

.1 ASME, Boiler and Pressure Vessel Code, Section l, Rules for the Construction of Power Boilers, and Section IV, Rules for the Construction of Heating Boilers.

.2 ASME B16.5, Pipe Flanges and Flanged Fittings.

.3 ASME B31.1, ASME Code for Pressure Piping Power Piping.

.4 NFPA-70, National Electric Code.

.5 NFPA-8501, Standard for Single Burner Boiler Operation.

.6 NFPA-8502, Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boilers.

.7 NFPA-8503, Standard for Pulverized Fuel System.

.8 Provincial, Local, and Utility Boiler Codes.

.9 All other required.

1.15 STANDARDIZATION

.1 Standardize all instrumentation in the boiler plant. Specify that all like instruments, such as all control valves, be provided from the same manufacturer. Avoid having two control valves in identical service from two different manufacturers or from the same manufacturer but of two different model numbers.

.2 Multiple Manufacturers

.1 Multiple manufacturers are acceptable for different types of instruments. Instruments of the same type, however, must be standardized. For example, controllers can be obtained from one manufacturer, control valves from a second manufacturer, and pressure gauges from a third manufacturer.

.3 Packaged Equipment

.1 Packaged equipment, which is often furnished with instrumentation included, does not always lead to standardization. Buying the package manufacturers standard, however, might result in considerable cost savings. Even with packaged equipment, however, the instruments should conform to the plant standards whenever practical.

.4 Special Considerations

.1 Also standardize the following for the boiler plant.

.5 Signal Amplitude

.1 Use standard signals. These are 4-20 mA DC for transmitters and control valves, 120 volts AC for switches, and 0.21-1.03 bar (3-15 psig) for pneumatic signals.

.6 Connections

.1 Use standard types of connections and connections sizes. Avoid non-standard connections.

1.16 ENVIRONMENTAL CONCERNS

.1 The Environmental Protection Agency (EPA) regulates the maximum allowed emissions from all external combustion sources including boilers. EPA-AP-42, *The Compilation* of *Air Pollutant Emission Factors* contains information associated with the types and quality of emissions and methods used to control them. Allowable emission limits varies by local, provincial and federal regulations.

Part 2 Products

2.1 GENERAL

.1 This chapter covers local instruments. Panel instruments are not included. Instruments that are usually located on panels, such as controllers, are covered in chapter 4.

.2 Instruments should be located where they are accessible. Instruments that must be operated during the start-up or shutdown of equipment should be located as close to the equipment as practical. Some instruments must be accessed continuously for operation, others only during startup and shutdown. All instruments must be accessible for calibration and maintenance. Locate instruments using the following order of access preference.

.1 Grade.
.2 Platform.
.3 Stairs.
.4 Ladder.
.5 Portable ladder.

2.2 INDIVIDUAL ITEM REQUIREMENTS

.1 Valves

.1 This paragraph covers control valves, pressure regulators and solenoid valves. Each type is discussed below.

.2 Control Valves

.1 Common types of flow characteristics for control valves include quick opening, linear, and equal percentage. Control valves with equal percentage flow characteristics are specified for most applications. Control valves with linear flow characteristics are hard to tune at low flow and should be avoided. Select the flow characteristic to suit the application. Tolerance criteria for control valves are defined by ISA-S75.11, *Inherent Flow Characteristics and Rangeability of Control Valves.*

.3 Design Checklist

.1 There are many items to be considered in control valve selection. Checklists are provided in most manufacturer catalogs. Critical items that are sometimes overlooked include type of shutoff, shutoff pressure, line hydrotest pressure and controllability at turndown conditions. Review all pertinent sizing and selection information including accessories when selecting a control valve.

.4 Construction

.1 Use carbon steel body with stainless steel trim. Other materials may be specified when required by unique conditions.

.5 Sizing

.1 Size control valves to absorb 30 to 50 percent of the total system pressure drop.

.6 Location

.1 Locate control valves at grade where practical. Install the control valve near the operating equipment that has to be observed while in local manual control.

.7 Solenoid Valves

.1 Common uses for solenoid valves in a boiler plant include the routing of instrument air to control devices and shutoff service.

.2 Verify solenoid valve sizing to ensure that the valve or damper will open or close within the specified amount of time. Port size might have to be increased to ensure the proper actuation time.

.3 Verify that the proper solenoid valve is used for the intended service. An example of a critical service application is a pilot gas shutoff solenoid valve. Most manufacturer catalogs include checklists on items to be specified. Critical items sometimes overlooked include type of fluid, shutoff and opening pressures, and line test pressure.

.8 Actuators

.1 Use spring-loaded diaphragm type actuators where practical. Springless operators and cylinder operators are acceptable only when spring-loaded diaphragm type actuators cannot provide the desired performance.

.2 Select the actuator so that the valve or damper that it controls will fail safe. Fail safe is defined as lock in position or take a position (either open or c1osed) that will result in the least upset.

.3 Furnish a pressure gauge to show diaphragm loading pressure on actuators that do not have a positioner. Furnish positioners for all automatically operated dampers. Furnish positioners for all control valves in critical service and where the variable, such as f1ow, has to be c10sely controlled. Specify that the positioner be furnished with the control valve or damper instead of separate procurement. Provide bypass switches and 3 pressure gauges (air supply, instrument loading, and diaphragm pressure) for all positioners.

.9 Current to Pneumatic Converters

.1 Control valves and dampers require current to pneumatic converters (I/Ps) for pneumatic actuators with electronic control signals. It is important that the I/P be matched to the valve or damper, as applicable. To avoid possible mismatch have the I/P furnished with the valve or damper instead of separate procurement.

.10 Pressure Relief Valves

.1 Provide pressure relief valves in accordance with the applicable codes. Refer to paragraph 3-15 for applicable codes.

.11 Rupture disks

.1 Use reverse buckling type rupture disks at the inlet of the relief valve in corrosive services.

.12 Level Instruments

.1 Provide level instruments in accordance with applicable codes. In general, provide separate vessel connections for each level instrument. Provide 12.7 millimeter (½-inch) minimum vent and drain valves with plugs for all level instruments.

.13 Gauge Glasses

.1 Complete coverage of total liquid range is not always required. Consult the applicable codes for requirements. Also consider lil operating conditions and upsets. Provide gauge glasses to cover and overlap a minimum of 5.08 centimeters (2 inches) beyond the ranges of displacers and switches.

.2 Gauge glasses should only cover the critical range zone such as high, low, and normal levels when the range is also covered by differential pressure type level transmitters.

.3 Provide illuminators for transparent gauge glasses.

.14 Capacitance Level

.1 Avoid the use of capacitance type level instruments in boiler plants.

.15 Flow Instruments

.1 Use magnetic flowmeters for water and vortex flowmeters for gas and steam.

.16 Straightening Vanes

.1 Avoid the use of straightening vanes due to their cost. Use them only when meter runs without them are not practical.

.17 Thermowells

.1 Thermowells are used to protect the temperature element from the environment and for personnel protection. Thermowell design varies depending on the application. Items affecting design include temperature, pressure, type of f1uid and f1uid velocity. In general, thermowells can be c1assified into two types. These are pressure service and non-pressure service. Thermowells used in non-pressure service are commonly referred to as protective tubes.

.2 Provide thermowells for all temperature elements in pressure service. Use 304 SS material as a minimum. Use the material best suited for the application of protective tubes.

.18 Thermocouples

.1 In general, use the following thermocouples for the different temperature ranges:

.1 Type T, Copper constantan - Below-17.77 to 371 degrees C (0 to 700 degrees F).

.2 Type J, Iron constantan - 17.77 to 593 degrees C (0 to 1,100 degrees F).

.3 Type K, Chromel alumel - 315 to 1093 degrees C (600 to 2,000 degrees F).

.2 Thermocouple assemblies can be single (one thermocouple) or duplex (two thermocouples). Provide duplex thermocouples for all temperature control loops. Use one thermocouple for control and the other for indication. Thermocouple and thermocouple extension wire specifications are defined in ANSIIISA-MC96.1, *Temperature Measurement Thermocouples,* and NEMA-WC55, *Instrumentation Cable and Thermocouple Wire*.

.19 Resistance-Temperature Detectors

.1 Resistance-temperature detectors (RTDs) are used where accurate temperature or temperature difference measurements are required.

.20 Gauges

.1 Provide blowout discs for pressure gauges in services with pressures greater than 1.03 bar (15 psig). Provide a safety wall between the dial and the bourdon for service pressures above 68.9 bar (1000 psig). Provide pigtail siphons for all gauges in steam service. Pigtail siphons should be installed perpendicular to the gauge. Provide pulsation dampers and diaphragm seals where required by service conditions and for all gauges in steam and condensate service. Provide a gauge isolation valve for each gauge.

.2 Pressure gauges are usually direct connected and field mounted. The size and range is specified by the user. Locate local gauges so that they are visible from the operating area and are readable from grade or a platform. Local mounted gauges give a "backup" reading and also help operators in determining if equipment or pressure systems are working satisfactorily. Pressure gauges should conform to ASME 840.100, *Pressure Gauges and Gauge Attachments*.

.21 Switches

.1 Pressure switches are used for monitoring alarm conditions and providing safety shutdowns. They are typically mounted directly to the process pipe.

.22 Transmitters

.1 Pressure transmitters convert the measured pressure to an analog or digital signal that is monitored by the control system (e.g. DCS). Provide a three-valve manifold to accomplish block, drain, and test functions for all pressure transmitters. Provide a five-valve manifold to accomplish block, equalize, drain, and test functions for all differential-pressure transmitters.

.23 Draft

.1 Pressure instruments for the measurement of draft in furnaces require careful attention as to range and sizing. Note that the draft in a balanced draft boiler furnace is slightly negative, around -2.54 millimeter (-0.1 inch) WC, at the top of the furnace. Too wide an instrument range will result in the loss of accuracy. Too narrow a range will not cover all operating conditions.

.2 Verify that the connections and sensing lines are adequately sized for the low negative pressures. Use larger sizes than for lines sensing positive and high pressures.

.25 Electrical Instrument Switches

.1 Typical applications for electrical instrument switches are alarms and shutdowns. Contacts should open to alarm or shut down for fail safe operation. Provide switches that are suited for the environment. Provide switches that are dust tight and vibration proof for all locations. Provide NEMA 4 rated switches for outdoor locations with non-corrosive atmospheres and NEMA 4X rated switches for corrosive atmospheres. Provide SPDT contacts as a minimum.

.26 Analyzers

.1 Include all analyzers necessary to meet federal, provincial, and local environmental monitoring requirements. Analyzers used in a boiler plant include the following:

.1 Sample diverted from the stream to the analyzer and then returned to the stream (oxygen or CO analyzers).

.2 Sample diverted from the stream to the analyzer and then discharged to the atmosphere or a drain (conductivity).

.27 General Guidelines

.1 Use in-line analyzers where practical except for CO and O_2 analyzer as this is to be an aspirating unit. As a second choice use an analyzer where the sample is diverted to the analyzer and then returned to the stream. Use an analyzer where the sample is discharged to the atmosphere or drain as a last choice. Provide a relatively constant differential pressure device, such as a pump, as a bypass to divert a sample that is to be returned to the stream. Avoid bypassing around a control valve.

.28 Oxygen Analyzer

.1 Oxygen analyzers to provide an indication of excess air in the flue gas. Use the analyzer for alarms and trim. Do not use it as the sole instrument for the control of combustion air.

.2 The equipment must be UL and CSA approved. The manufacturer must be ISO 9001 approved.

.3 Measurement range : 0.2 to 20.9%.

.4 Repeatability : 0.1% or better, Accuracy : +- 0.1% or better.

.5 Output signal : 4-20mA and alarm contacts.

.6 Remote display for configuration and diagnostic.

.7 All port and accessories must be included for manual calibration.

.29 Carbon Monoxide Analyzer

.1 Carbon monoxide (CO) analyzers used in a boiler plant may utilize a catalytic element, wet electrochemical cell, or non-dispersive infrared absorption.

.2 Install the CO analyzer in a clean gas stream that is downstream of the particulate removal system.

.3 The equipment must be UL and CSA approved. The manufacturer must be ISO 9001 approved.

.4 Measurement range : 0 to 9 999 PPM.

.5 Resolution : 1 PPM.

.6 Accuracy : +- 10 PPM or better

.7 Output signal : 4-20mA and alarm contacts.

.30 Conductivity Analyzers

.1 Conductivity analyzers are used in boiler plants to monitor dissolved solids in the boiler drum. Use a conductivity analyzer for adjusting boiler blowdown. Do not use it as the sole device for boiler blowdown control.

.2 Analyzer to have temperature compensation for the range of operation.

.3 The equipment must be UL and CSA approved. The manufacturer must be ISO 9001 approved.

.4 Output signal : 4-20mA and alarm contacts.

.31 Flame Detectors

.1 Provide the flame detector best suited for the fuel and flame. For gas fired boilers

always use an ultraviolet (UV) self-checking flame scanner.

.2 Do not use a flame detector that is activated by hot refractory.

.3 Provide a separate flame detector for each burner. Locate the flame detector so that it will be activated only by its own burner and not by an adjacent burner or hot refractory.

.32 Continuous Emission Monitoring (CEM)

.1 Provide all necessary equipment to meet federal, provincial, and local environmental analysis and documentation requirements.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 – Fire stopping. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Refer to electrical control schematics included as part of control design. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by the Departmental Representative before beginning Work.

.3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.4 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels.

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.5 Do not run exposed conduits in normally occupied spaces unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

.7 Pneumatic: provide Pneumatic tubing, valves and fittings for field control devices in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.

3.2 TEMPERATURE SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.3 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.4 AIR PRESSURE GAUGES

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.5 IDENTIFICATION

.1 Identify field devices in accordance with this section.

3.6 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with the documents.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Sections but not limited to.

.1 Section 40 05 01 - General Requirements.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1, The Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.5 SUBMITTALS

.1 Submit to the Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of DCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of DCS" as reviewed by the Departmental Representative.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each DCS panel.

2.6 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT

.1 Colour code DCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with the Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section covers instruments usually located on panels.

.2 Types of Control Panels

.1 Boiler panels include combustion safeguards.

.3 Panel Location

.1 Panels may be located locally.

.4 Boiler Plant Panel

.1 The boiler control and the ancillary equipments in the boiler room will be in the "DCS" panel. The control of the plant will be done remotely or locally through HMI. Only the combustion safeguarding will be done by a local panel.

.5 Local Panels

.1 Local panels are located in the vicinity of the equipment that they control. Local panels should be minimized since more time and effort is required to access and monitor a large number of local panels than a centrally located one.

.2 Restrict local panels to instrumentation that does not require continuous attention and is used extensively for start-up and shutdown of the local equipment. Locate the panel as close to the equipment as practical. Do not locate local panels in front of any access panels or inspection plates where an operator may interfere with boiler inspections or where an explosion may injure an operator.

.3 Provide a panel designed for the environment. Avoid local wall mounted panels which are mounted flush with the wall. The panel should be a self-supporting box type if it is not mounted integrally with the local equipment.

.6 Layout

.1 Good panel layout requires experienced personnel in panel design and user drawing review. For best results both the user and the designer should agree on instrumentation arrangement on the various panels prior to start of panel fabrication.

.2 Provide a minimum of 10 percent spare panel space for the future expansion. Provide 1.52 to 1.83 meters access clearance between the panel and the wall behind it when possible. Recommended practices on control room and panel layout are defined by ISA-RP60.3, Human Engineering for Control Centers.

.7 Displays

.1 Use displays that are readily visible to the operator. This might entail specifying LED instead of LCD.

.8 Lighting

.1 Provide switched vapor tight lights to illuminate the front of the panel. Provide additional switched lights to illuminate the inside of the panel enclosure.

.9 Service Outlets

.1 Provide ground fault interrupt (GFI) protected 120 VAC duplex outlets within each panel enclosure section. Locate outlets not more than 1800mm apart within each section.

.10 Steelwork

.1 Fabricate enclosure panels from 3.04 millimeter (11 gauge (0.1196-inch)) or 3.18 millimeter (1/8-inch) steel plate. Reinforce the panels as required for stiffness. Use 1.52 millimeter (16 gauge (0.0598-inch)) minimum steel plate for doors. Slightly bevel or round all exposed edges. Make all joints vertical. Horizontal panel joints are not acceptable. Use angle iron at each end of a section to make up vertical butt joints. Preassemble the complete panel in the shop to check for accurate alignment and surface matching. Panel joints passing through an instrument are not acceptable.

.11 Prefabrication

.1 Specify panels to be complete with all instruments installed, piped, and wired. The only actions that should be necessary to place the panel in service are to connect power, instrument signals, and instrument air supply.

1.2 INDIVIDUAL ITEM REQUIREMENTS

.1 Boilers controllers must be microprocessor type.

.1 Use the type of controller that is the most economical and reliable.

.2 Recommended practices on tests to be conducted on digital controllers are defined by ISA-RP55.1, Hardware Testing of Digital Process Computers.

.3 Provide the following minimum alarms.

.1 Controller failure.

.2 High-high alarm.

.3 High alarm.

.4 Low alarm.

.5 Low-low alarm.

.4 Provide each control station with the following minimum displays.

.1 Process reading.

.2 Set point.

.3 Output signal.

.4 Input signal.

.5 Automatic/Manual indication.

.6 Controller failure indication.

.7 High-high alarm.

.8 High alarm.

.9 Low alarm.

.10 Low-low alarm.

Part 2 Products

2.1 ALARMS AND SHUTDOWNS

.1 The new boilers must meet all requirement of NFPA and TSSA regarding alarm and shutdowns.

2.2 ANNUNCIATION PANEL

.1 A local alarms and status annunciation panel must be installing near each boiler. All alarms and status must be also displayed in control room.

2.3 TRENDING

.1 All points and values should be recorded (trending capacity) and all flows and energies data shall be capable of being totalised.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General requirement

.2 Division 23 – Heating, ventilating and air conditioning (HVAC)

.3 Division 25 – Integrated automation

.4 Division 40 – Process integration

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1, Canadian Electrical Code, Part 1 (latest edition), Safety Standard for Electrical Installations.
- .2 CAN/CSA-C22.3 No. 1, Overhead Systems.
- .3 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

- .1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.

.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

- .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels in English and French. All emergency power system and life safety system must be identified with red nameplates.

.4 Use one nameplate or label for both languages.

.5 Utilization Voltage.

.1 Utilization voltage level for equipment shall be as follows:

Motor rated 1/4 hp to 200 hp	575 V, 3 phase, 60 Hz	600 V, 3 phase, 60 Hz, 3 wires, high resistance grounded
Motor rated less than 1/4	115 V, 1 phase, 60 Hz	208 V/120 V, 3 phase, 4 wires or 240/120 V, 1 phase, 60 Hz, solid grounded
Plant lighting	As existing	As existing
Small loads	120 V, 1 phase, 60 Hz	208 V/120 V, 3 phase, 4 wires or 240/120 V, 1 phase, 60 Hz, solid grounded
Control voltage	120 V, 1 phase, 60 Hz	240/120 V, 1 phase, 60 Hz, solid grounded

.6 Voltage drop limitation

.1 Transient voltage drop due to motor starting shall be limited to 10% of motor-name plate voltage at motor terminal. Steady state voltage drop in feeder and branch circuit shall not exceed 3% for lighting and 5% for other loads.

.7 Motor control

.1 All motors greater than 23 HP must be controlled by a Variable Frequency Drive (VFD). Full voltage starter can be used for lower motors.

.8 Power Factor

.1 The power factor for the entire plant incoming service shall be 92% to 97% all the time whatever the electrical load. The bidder must perform a study and do all modifications required to the existing equipment to meet the requirements. See NRC Plant Historic Power Factor in Appendix G for power factor survey.

.9 Equipment Enclosures

.1 Equipment located in hazardous areas shall have their enclosure CSA approved for the classification. The following types of enclosures will be used.

.1 NEMA 12 for general location.

.2 NEMA 1 for electrical room.

.3 NEMA 4X for outdoor.

.4 All equipments installed in sprinkled area must be sprinkler proof.

.10 Electrical Boiler Supply

.1 The boilers must be fully operational during electrical outage. All boiler equipment and auxiliary equipments must be connected to emergency power switch

.11 Seismic Mounting

.1 Design, supply and install a complete system for seismic mounting electrical equipment against vibration and related systems.

.2 The mounting system must be seismic fully functional and compatible with systems to reduce noise and vibration required or equipment installed on the premises.

.3 The elements of seismic protection must meet the latest National Building Code 2005.

.12 Electrical Safety Authority

.1 Obtain electrical safety authority (ESA) inspection certificate for the complete work and provide a copy to the Departmental Representative.

1.5 SUBMITTALS

.1 Contractor's Engineer to submit to Departmental Representative for review updated single line electrical diagrams.

.2 Submit shop drawings, upon approval by Contractor's Engineer to Departmental Representative:

.1 Submit shop drawings for all electrical and control equipment.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item on equipment and interconnection between each item of equipment.

.4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Submit copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, obtain ESA special inspection approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described.

.6 Submit all certificates of acceptance from authorities having jurisdiction upon completion of Work to the Departmental Representative.

.4 Manufacturer's Field Reports: submit to the Departmental Representative manufacturer's written report, within five (5) days of review, verifying compliance of all work specified herein, instrumentation, testing and commissioning.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Before performing manufacturing tests for all equipments, provide test schedule 2 weeks in advance. Departmental Representative will decide to witness or not each factory test.

.3 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.4 Site Meetings:

.1 In accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).

.2 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

.5 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.8 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

1.9 ELECTRICAL INSTRUMENTATION AND CONTROL ENGINEERING SERVICES

.1 Electrical Engineering

.1 All documents submitted must be stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Drawings

.1 Preparation of detailed engineering/construction drawings and document, including:

.1 Preliminary

.1 Description of proposed changes to the electrical systems (normal and emergency) with sufficient information to allow evaluation of the design concept.

.2 Electrical equipment layout at 80%.

.3 Instrument layout at 80%.

.4 Distribution single line diagram with rating cables, equipments etc. at 80%.

.5 Control philosophy at 95%.

.2 For review and Construction

.1 Electrical equipment layout.

.2 Instrument layout.

.3 Single line diagram.

.4 Control panel layout.

.5 Motor starter diagram and variable frequency drive diagram.

.6 Installation details.

.7 Tags and name plate list.

.4 Documents

.1 Preparation of documents, including:

.1 Equipment lists.

.2 Instrument lists.

.3 Equipment specifications sheet.

.4 Instrument specifications sheet.

.5 User and maintenance manual.

.6 Spare part lists.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 N/A

2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from ESA before delivery to site and submit such approval as described.

.3 Factory assembles control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as required.

.2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoïd 3 mm thick plastic engraving sheet, black matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by the Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO." as directed by the Departmental Representative.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

.10 Nameplates for fire alarm and emergency power must be in red color.

.11 All lighting switches and 120V services outlets must have panelboard and circuit number identification.

.12 All 600V devices, switches, MCC, troughs, splitter box, etc, must have identification as per existing PWGSC numbering format.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Wall receptacles:

.1 General: 450 mm.

.2 In mechanical rooms: 1200 mm.

.3 Panelboards: as required by Code or as indicated.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

- .1 Circuits originating from branch distribution panels.
- .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.2 Carry out tests in presence of the Contractor's Engineer and Departmental Representative.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

- .1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .2 CSA C22.2No.65, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

- .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to NEMA to consist of:

- .1 Connector body and stud clamp for copper conductors.
- .2 Clamp for copper conductors bar.
- .3 Stud clamp bolts.
- .4 Sized for conductors as required.

.4 Clamps or connectors for armoured cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 N/A.

1.2 REFERENCES

.1 N/A.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, RWU90 XLPE, jacketted.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:

- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.

.3 Insulation:

- .1 Cross-linked polyethylene XLPE.
- .2 Rating: 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project, FT-4 minimum and FT-6 for plenum application.

.7 Fastenings:

- .1 One hole malleable iron steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at 1200 mm centers.
- .3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:

- .1 Approved for TECK cable.

2.3 ARMOURED CABLES

.1 Type: AC90 not permitted.

2.4 CONTROL CABLES

.1 Type: low energy 300 V control cable: solid stranded annealed copper conductors sized as indicated LVT: soft annealed copper conductors, sized as indicated:

.1 Insulation: PVC 40 degrees C.

.2 Shielding: braid over each pair.

.3 Overall covering: PVC jackets interlocked armour of aluminum strip.

.2 Type: 600 V stranded annealed copper, conductors, sizes as indicated:

.1 Insulation: R90, polyethylene.

.2 Shielding: over conductors.

.3 Overall covering: thermoplastic jacket with sheath of aluminum interlocked armour.

2.5 NON-METALLIC SHEATHED CABLE

.1 Not permitted NMD90.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform all tests using method appropriate to site conditions and to approval of Contractor's Engineer and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.3 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.

.4 Conductor length for parallel feeders to be identical.

.5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed, securely supported by hangers.

3.5 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit.

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

.3 CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive on existing grounding system.

.2 Grounding conductors: bare stranded copper, tinned, soft annealed.

.3 Insulated grounding conductors: green, type.

.4 Ground bus: copper, size as required, complete with insulated supports, fastenings, connectors.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install separate ground conductor to outdoor lighting standards.

.9 Connect building structural steel and metal siding to ground by welding copper to steel.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.2 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral for all systems.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, frames of motors, motor control centres, starters, control panels, building steel work, generators, distribution panels, outdoor lighting transfer switch, cable tray, VFD, etc.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of authorities having jurisdiction over installation and Contractor’s Engineer.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 N/A.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1 (Latest edition).

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.3 CONDUIT BOXES

.1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.4 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 N/A.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
- .2 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
- .5 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.

.2 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

.4 Electrical metallic tubing (EMT): not permitted.

2.2 CONDUIT FASTENINGS

.1 One hole malleable iron straps to secure surface conduits 50 mm and smaller.

- .1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.0 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

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 datasheets.

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 Surface mount conduits.

.4 Use rigid hot dipped galvanized steel threaded conduit.

.5 Use rigid pvc conduit underground.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.

.7 Use explosion proof flexible connection for connection to explosion proof motors.

.8 Install conduit sealing fittings in hazardous areas.

.1 Fill with compound.

.9 Minimum conduit size for lighting and power circuits: 19 mm.

.10 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.11 Mechanically bend steel conduit over 19 mm diameter.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 All empty conduits to be provided with fish cord and nylon bushings at each end of conduits.

.14 Remove and replace blocked conduit sections.

.15 Dry conduits out before installing wire.

.16 Install liquid-tight flexible metal conduit for final connections only, not to exceed 2.5m at each connection.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended channels.

.5 Do not pass conduits through structural members.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel.

.1 Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.

.1 Use cold mastic between sleeve and conduit.

.5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 23 05 13 – Common motor requirement for HVAC equipment.

.2 Section 03 30 00 – Cast-in-Place Concrete.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

- .1 CSA C22.2 No. 100, Motors and Generators.
- .2 CSA C22.2 No. 145, Motors and Generators for Use in Hazardous Locations.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

- .1 EEMAC M1-7, Standard for Motors and Generators.
- .2 EEMAC M2-1, Standard for Lead Marking and Connections for Single-Phase and Polyphase Induction Motors.

.3 National Electrical Manufacturers Association (NEMA)

- .1 NMEA MG1, Motors and Generators.

1.3 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedures.

.2 Shop drawings:

- .1 Submit shop drawings, signed and stamped, upon approval by Contractor's Engineer to Departmental Representative.
- .2 Indicate:
  - .1 Overall dimensions of motor.
  - .2 Shaft centreline to base dimension.
  - .3 Shaft extension diameter and keyway, coupling dimensions and details.
  - .4 Fixing support dimensions.
  - .5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.
  - .6 Terminal box location and size of terminals.
  - .7 Arrangement and dimensions of accessories.
  - .8 Diagram of connections.
  - .9 Starting current and relative data necessary for use in design of motor starting equipment.
  - .10 Speed/torque characteristic.
  - .11 Weight.

.12 Installation data.

.3 Closeout Submittals:

.1 Provide maintenance data for motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Data necessary for maintenance of motors.

.3 Manufacturer's recommended list of spare parts.

.4 Quality Assurance:

.1 Departmental Representative reserves the right to witness factory testing of motors 50 hp and above.

.2 Submit factory and site tests results of installed electrical systems and instrumentation.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

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

.3 Handle motors with suitable lifting equipment.

.4 Store motors in heated, dry, weather-protected enclosure.

1.5 EXTRA MATERIALS

.1 Provide maintenance materials and spare parts in accordance with manufacturer’s recommended list of spare parts and Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

.1 Motors:

.1 Non-hazardous locations: to CSA C22.2 No. 100 and EEMAC M1-7.

.2 Hazardous locations: to CSA C22.2 No. 145.

.2 Lead markings: to EEMAC M2-1.

2.2 CORROSION PREVENTION AND FINISH PAINTING

.1 Provide equipment resistant to corrosion from severe moisture conditions.

2.3 RATING

.1 Motor:

.1 Single speed.

.2 Motors controlled by variable frequency drives shall be derated to account for reduced torque and increased heating due to the harmonics in the drive output.

.3 All motors used with a VDF must be inverter duty rated.

.4 Motors capable of starting and accelerating the driven equipment at 80% of the nameplate voltage rating.

.5 Speed, full load.

2.4 MOTOR TYPE

.1 Squirrel cage induction, asynchronous unless requirements dictate otherwise.

2.5 DESIGN LETTERS

.1 Polyphase squirrel cage induction motors design B unless requirements dictate otherwise.

2.6 ENCLOSURE

.1 Totally enclosed fan cooled.

.2 Explosion proof for designated areas as per applicable codes.

2.7 SERVICE CONDITIONS

.1 1.15 service factor.

.2 Continuous duty.

2.8 APPLICATION

.1 Motor suitable for driving pump, fan, compressor, etc.

2.9 PERFORMANCE CHARACTERISTICS

.1 Premium efficiency.

.2 Rotor bars and end rings shall be copper.

2.10 INSULATION

.1 Class: F.

.2 Ambient temperature: 46 degree Celsius.

2.11 BEARINGS

.1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

2.12 THERMAL PROTECTION

.1 Factory installed platinum RTD, one in each phase, wired to identified terminals in motor terminal box for 50 Hp and above.

2.13 STARTING METHOD

.1 Terminate winding connection necessary for appropriate starting method and identify in motor terminal box.

2.14 ACCESSORIES

.1 Space heater for 50 Hp and above.

.2 Include anchor devices and setting templates.

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 datasheets.

3.2 INSTALLATION

.1 Dry out motor if dampness present in accordance with manufacturer's instructions.

.2 Install motor on concrete base, ensuring it has fully cured before installation rigid plumb and square, using only lifting facilities provided.

.3 Make wiring connections.

.1 Use liquid tight flexible metal conduit between rigid conduit and motor.

.4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.

.5 Check for correct direction of rotation, with motor uncoupled from driven equipment.

.6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

- .1 CSA-C22.2 No.42-99, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA-C22.2 No.55-M1986, Special Use Switches.
- .4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

Part 2 Products

2.1 SWITCHES

.1 120 V, as required switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:

- .1 Terminal holes approved for No. 10 AWG wire.
- .2 Silver alloy contacts.
- .3 Urea or melamine moulding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 Ivory toggle.

.4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.5 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Ivory urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Eight back wired entrances, four side wiring screws.
.5 Triple wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Ivory urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

.1 Special wiring devices:

.1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.4 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices.

.4 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.
.2 Install switches in gang type outlet box when more than one switch is required in one location.
.3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
.2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Install identification as per section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.5 Circuit breakers with sufficient symmetrical rms interrupting capacity rating,to be confirmed by calculation.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 OPTIONAL FEATURES

.1 Include:

.1 Shunt trip (if required).
.2 Auxiliary switch (if required).
.3 Motor-operated mechanism (if required).
.4 Under-voltage release (if required).
.5 On-off locking device.
.6 Handle mechanism.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-M89, Enclosed Switches.
.2 CSA C22.2 No.39-M89, Fuseholder Assemblies.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure to CAN/CSA C22.2 No. 4 size as requested.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuseholders: to CSA C22.2 No. 39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.5 Quick-make, quick-break action.

.6 ON-OFF switch position indication on switch enclosure cover.

.7 Sprinkler proof protection.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

.2 One disconnect switch shall be installed at all equipments for maintenance.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCES

Use the latest applicable edition of the following references.

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14-95, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

1.4 QUALITY ASSURANCE

.1 Submit to Departmental Representative two (2) copies of test results.

Part 2 Products

2.1 AC CONTROL RELAYS

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Fixed contact plug-in type: heavy duty with coil rating: 120 V, contact rating: 120 V, 10 A.

2.2 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 SEALED CONTACT OILTIGHT LIMIT SWITCHES

.1 Lever type switches: operated double pole, double throw.

2.4 OPERATOR CONTROL STATIONS

.1 Enclosure: CSA Type 4, surface mounting:

2.5 PUSHBUTTONS

.1 Heavy duty oil tight. Operator flush type with 2-NO and 2-NC contacts rated at 10 A, labels as indicated. Stop pushbuttons coloured red, start pushbuttons coloured green.

2.6 SELECTOR SWITCHES

.1 Heavy duty oil tight, operators contact arrangement as required.

2.7 INDICATING LIGHTS

.1 Heavy duty oil tight, LED type.

.1 Motor On: Red Color.

.2 Hand Test: Yellow Color.

.3 Motor Off: Green Color.

2.8 CONTROL AND RELAY PANELS

.1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, factory installed and wired to identify terminals.

2.9 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 600 V, 60 Hz ac.

.3 Secondary: 120 V, AC.

.4 Rating: as required.

.5 Secondary fuse: as required.

.6 Close voltage regulation as required by magnet coils and solenoid valves.

2.10 THERMOSTAT (LINE VOLTAGE)

.1 Wall mounted.

.2 Full load rating: as required.

.3 Thermometer Range: degrees C.

.4 Markings in 5 degrees increments.

Part 3 Execution

3.1 INSTALLATION

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 N/A

1.2 REFERENCES

Use the latest applicable edition of the following references.

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1, Part 4: Electromechanical contactors and motor-starters.

1.3 CLOSEOUT SUBMITTALS

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

.2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.

.3 Extra Materials:

.1 Provide listed spare parts for each different size and type of starter.

.1 Contacts, stationary (3).
.2 Contacts, movable (3).
.3 Contacts, auxiliary (3).
.4 Control transformer (1).
.5 Operating coil (1).
.6 Fuses. (4)
.7 Indicating lamps (4).

Part 2 Products

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 FULL VOLTAGE MAGNETIC STARTERS

.1 Combination magnetic starters of size, type, rating and enclosure type as required with components as follows:

.1 Contactor solenoid operated, rapid action type.
.2 Motor overload protective device in each phase, manually reset from outside enclosure.
.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons and selector switches: Heavy duty oil tight labelled required.

.2 Indicating lights: Heavy duty oil tight type.

.3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

2.3 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Three overload relays with heater elements, manual reset.

.2 Accessories:

.1 Pushbuttons and selector switches: Heavy duty oil tight labelled as required.

.2 Indicating lights: Heavy duty oil tight type and color as indicated.

.3 Auxiliary control devices as indicated.

2.4 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 ACCESSORIES

.1 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: Hand-Off-Auto, heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.6 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, engraved as requested.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed as per section 26 28 13.01.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as required and per manufacturer’s instructions and recommendations.

END OF SECTION

Pyrolysis Boiler Installation

The following is intended to replace the following sections

4.3 Performance Testing/Warranty

4.3.1 Conditional Acceptance Test

4.3.2 Final Acceptance Test

4.3.3 Performance Test and Performance Guarantee

Functional and Performance Testing

The Contractor shall be required to complete two (2) test procedures:

(a) Functional Test
(b) Performance Test

The bid shall indicate the maximum length of time to be allowed between the award of a contract and each of the two (2) test procedures. The EASR Compliant Installation Test shall be included within these test procedures.

Functional Test

The Functional Test shall demonstrate the ability of the system to run continuously for a period of fourteen (14) consecutive days and during such period (and while in compliance with all environmental conditions), distribute hot water within acceptable pressure and temperature drops.

Performance Test

The Performance Test shall demonstrate the ability of the system to perform, at a maximum continuous rating (MCR), for a period of 48 consecutive hours

The 48 -hour Performance Test, may be run concurrently with the 14 day Functional Test if there is sufficient load available at the time of the Functional Test,

For both the Functional and Performance Test

The operating status of the subsystems shall be monitored and recorded by the Owner's Representation. The original data sheets shall be property of Owner, copies shall be furnished to the Contractor for its records.

Normal plant operating procedures and configurations shall be employed during the Test. This requirement shall mean that during the Test, redundant subsystems shall not be operated simultaneously and that only the normal operating and maintenance personnel shall be

operating and maintaining the facility. Only the normal contingent of spare parts shall be on hand.

The Contractor shall prepare and submit to Owner at least sixty (60) days prior to the expected date of each Test, a detailed description of the test procedures including proposed test report format for review and approval.

The Contractor shall prepare and submit to Owner a detailed test report including the test data sheets and calculated results.

All non-fuel and non-operator costs incurred in the performance of the Performance Test, including but not limited to, equipment maintenance, expendables, special test equipment, etc., shall be the sole responsibility of the Contractor.

Promptly after completion (whether or not successful) of the Performance Test (or any return of such Test), the Contractor shall advise Owner in writing of any defects and/or deficiencies in the facility which were discovered or occurred during the Performance Test.

Owner shall promptly notify Contractor in writing of any defects and/or deficiencies in the facility that NRC/PSPC personnel noted or determined from the test reports. If Contractor is notified of such defects and/or deficiencies, Contractor shall immediately commence and promptly complete corrective measures to remove such defects and/or deficiencies (including replacement of any defective parts at the Contractor's sole cost and expense).

Contractor shall then promptly provide notice to NRC/PSPC in writing that corrective measures have been completed and shall specify in such notice the date on which the facility shall be ready for the Performance Test (or any part thereof) to be rerun by the Contractor where said defects or deficiencies are of such a nature as to warrant retesting.

Upon approval by NRC/PSPC, the Contractor shall promptly re-perform the Performance Test, with NRC/PSPC personnel in attendance, and advise NRC/PSPC in writing of any additional remaining defects and/or deficiencies that shall be corrected by Contractor as a condition to completion of the facility.

In addition to the foregoing, NRC/PSPC shall promptly notify Contractor of any continuing defects or deficiencies which were noted in the Retest.

Final Completion

Substantial Completion of the project shall be deemed to have occurred when all of the following have occurred:

(a) The new boiler plant installation has successfully completed both Functional and Performance Testing and an EASR compliant Installation Test.

(b) The Contractor has notified Owner in writing that Contractor knows of no defects and/or deficiencies related to the new Boiler Plant installation that affects the performance of the new Boiler Plant installation.

(c) The Contractor has satisfied all Owner requirements to correct defects and/or deficiencies related to the new Boiler Plant installation which may have been identified during the performance testing.

(d) Owner has received all as-built drawings of the new Boiler Plant installation, test data, and other technical information required hereunder for Owner to operate and maintain the new Boiler Plant installation.

(e) Owner has received all manuals and instruction books necessary to operate the new Boiler Plant installation in a safe, efficient, and effective manner.

(f) All special tools and spare parts purchased by the Contractor as provided herein have been delivered to Owner.

(g) All Contractor's and subcontractors' personnel, supplies, equipment, waste materials, rubbish, and temporary facilities have been removed from the jobsite.

(h) Owner has received from Contractor (i) any waivers of liens and claims relating to the work which were not previously delivered by Contractor, and (ii) a final certificate of waivers of all liens and claims by Contractor, subcontractors, vendors relating to the work have been obtained by Contractor and delivered to NRC/PSPC.

(i) Contractor has performed all other provisions, if any, and delivered all items required by the contract in a manner reasonably satisfactory to Owner.

(j) Owner has received from Contractor an executed copy of a completion certificate, such completion certificate to be in form and substance satisfactory to Owner.