1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

.2 CSA-C22.3 No. 1-15, Overhead Systems.

.3 CSA C22.3 No.7-15, Underground Systems.

.4 CSA CAN3-C235-83 (R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE SP1122 (2007), The Authoritative Dictionary of IEEE Standards Terms.

.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 City of Winnipeg

.1 Identification Standard-510276-0000-40ER-0002

.2 Tag Naming Standard-612620-0014-40ER-0001

1.2 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.

1.3 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 for control items in English.

1.4 Submittals

.1 Shop Drawings:

.1 In accordance with Section E4 – Shop Drawings.

.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 coordinated installation.

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

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

.5 If changes are required, notify Contract Administrator of these changes before they are made.

.6 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor's drawings.

.2 Quality Control:

.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material inspection authorities for special acceptance approval before delivery to Site.

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

.3 Permits and fees: in accordance with General Conditions of Contract.

.4 Submit, upon completion of Work, load balance report as described in Part 3.13.1 - Load Balance

.5 Submit certificate of acceptance from Authority Having Jurisdiction upon completion of Work to Contract Administrator.

.3 Manufacturer's Field Reports: submit to Contract Administrator Manufacturer's written report, within three (3) days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in Part 3.13 Field Quality Control.

1.5 Quality Assurance

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid license in accordance with Authorities Having Jurisdiction.

1.6 System Start-up

.1 Instruct Contract Administrator 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 Contract Administrator to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Arrange and pay for services of an instrumentation technician to check, adjust, balance and calibrate components and instruct operating personnel.

.4 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.

1.7 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 as per Section 01 78 00 – Closeout Submittals 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.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

2. PRODUCTS

2.1 Materials and Equipment

.1 Material and equipment to be CSA Certified. Where CSA Certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in Section E4 – Shop Drawings.

.2 Factory assemble control panels and component assemblies.

2.2 Electric Motors, Equipment and Controls

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

.2 Control wiring and conduit: in accordance with Section 26 05 21 - Wire and Cables (0-1000V) and Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

2.3 Warning Signs

.1 Warning Signs: in accordance with requirements of Authority Having Jurisdiction, inspection authorities, and Contract Administrator.

.2 Lamacoid, red with white lettering, minimum size 175 x 250 mm.

2.4 Wiring Terminations

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

2.5 Equipment Identification

.1 All equipment identification must follow the City of Winnipeg Water and Waste Identification Standard- 510276-0000-40ER-0002.

2.6 Wiring Identification

.1 Identify conductors and cables in accordance with Identification Standard – 510276-0000-40ER-0002.

2.7 Cable Name/Number Identification

.1 Identify cables at all pull boxes, junction boxes, and outlet boxes for all systems.

.2 Identify each conductor as to panel and circuit, terminal, terminal numbers, system number scheme, and polarization, as applicable.

2.8 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint outdoor ad idoor electrical equipment light gray finish.

2.9 Electrical Single Line Diagrams

.1 Provide electrical single line diagrams under plexiglass as follows:

.1 Electrical distribution system: locate in main electrical room

.2 Drawings: 11 X 17 size.

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 except where specified otherwise.

3.2 Grounding

.1 All circuits shall be installed with dedicated green insulated ground wire.

3.3 Dedicated Neutrals

.1 Each circuit shall have its own dedicated neutral wire. Shared neutral for more than 1 circuit shall not be permitted.

3.4 Area Category and Classifications

.1 The Pumping Station building areas have the following electrical categories and classifications as defined in the CEC:

.1	Electrical Room:	General
.2	Generator Room:	General
.3	Below Ground:	Zone 1, Category 1

3.5 Enclosures

.1	Dry/General	NEMA 250-2014, Type 1
.2	Wet/Outdoor/Corrosive	NEMA 250-2014, Type 4X
.3	Hazardous	NEMA 250-2014, Rated for hazardous location

3.6 Nameplates and Labels

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

3.7 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.

.4 Do not mix wiring and/or cables from different panels within the same conduit runs or pull boxes. Provide equipment barriers where acceptable and where applicable.

3.8 Location of Outlets and Luminaires

.1 Electrical Drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural Drawings.

.2 Outlet and equipment locations shown on the Drawings are approximate. Locations may be revised up to 3 m to suit construction and equipment arrangements without additional cost, provided that the Contractor is notified prior to the installation of the outlets, or equipment.

.3 Maintain luminaire locations wherever possible. Notify the Contract Administrator of conflicts with other services.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturer’s.

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

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

.7 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.8 Locate light switches on latch side of doors.

3.9 Separation of Services

.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Contract Administrator and the ceiling installer, and approved clips or hangers are used.

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

.1 Local switches: 1400 mm.

.2 Wall receptacles:

.1 In electrical mechanical rooms: 1400 mm.

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

.4 Telephone and LAN outlets:

.1 General: 300 mm.

.2 Above top of counters or desk: 175 mm.

.5 Wall mounted telephone outlets: 1500 mm.

.6 Fire alarm stations: 1200 mm.

.7 Fire alarm bells: 2100 mm.

.8 Horn/Strobe: 2100 mm

3.11 Housekeeping Pads

.1 All floor mounted electrical equipment installed by this Division shall be mounted on concrete housekeeping pads which, unless otherwise noted, shall be the responsibility of the Contractor.

.2 The Contractor shall determine the extent of the housekeeping pads required and supply all information and details as to size and locations to the Contract Administrator within thirty (30) days after the award of the Contract.

3.12 Sleeves

.1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.

.2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 4" above finished floor level.

.3 The space between the sleeve and the conduit shall be filled with Dow Corning silicone RTV foam for fire stop and caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.

.4 Locate and position sleeves exactly prior to construction of walls, floors.

3.13 Coordination of Protective Devices

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

3.14 Field Quality Control

.1 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in Section E4 – Shop Drawings: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests:

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of the Contract Administrator.

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

.5 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 Section E4 – Shop Drawings.

.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 Section 1.5 - Quality Assurance.

4. MEASUREMENT AND PAYMENT

4.1 Measurement and Payment

.1 Common Work Results for Electrical

.1 Common Work Results for Electrical as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

.1 Supply and install all material, equipment, wiring, and labour necessary for the installation of the systems detailed on the Drawings in accordance with the latest edition of the Manitoba Electrical Code.

1.2 Work Included

.1 General Requirements

.1 General clean-up.

.2 All inspections and obtaining all permits, licenses required by various Inspection Agencies and local regulations related to Electrical Trade.

.3 Scaffolding.

.4 All necessary tools, equipment, and supplies.

.5 Shop Drawings.

.6 Project Record Documents (As-constructed Drawings).

.7 Operating and Maintenance Data, where specified.

.2 Specific Requirements Included but not Limited to Scope of Work

.1 Electrical equipment in the new Pumping Station building, including site underground and above ground services and cabling.

.3 Additional Requirements

.1 Provision of all necessary testing, detailed wiring continuity checks, wiring completion checks, installation integrity checks, functional equipment operation checks and written system verification reports to provide a complete system that is ready for commissioning and start-up (refer also to Section 01 91 13 – General Commissioning Requirements).

.2 Provision of commissioning and start-up of all systems included in the Scope of Work as per Section.

.3 Pumping Station

.1 Supply and install electrical equipment as described and as shown on Drawings.

.2 Install and terminate cables; Provide electrical connections and connect to all equipment including equipment supplied by other divisions.

.3 All devices mounted below ground shall be rated Class 1 Zone 1 as defined in Section 18 in the Canadian electrical code.

.4 General

.1 Provide as indicated, install and connect all luminaries, receptacles and other devices as indicated.

.2 Provide all cabling required making a complete and operational facility. Provide raceway systems to allow complete installation for all cables.

.3 Provide complete grounding as herein specified and indicated on the Drawings. All grounding shall comply with the Canadian Electrical Code and local amendments to this code.

.4 Provide Customer Service Termination Enclosure (CSTE) with Breaker Section as shown on Drawings.

.5 Provide electrical wiring, conduit and other appurtenances required to provide power connections as required from the Customer Service Termination Enclosure to the MCC.

.6 Provide power connections from the MCC to the various items of electrical equipment, motors, instrumentation and control equipment.

.7 All devices mounted in wet areas, Category 2 areas or outdoors shall be Nema 4X rated or as shown on Drawings.

1.3 Materials

.1 Bus systems including all forms of buses integral with the electrical power system, together with their associated insulation, supports, bus ducts and protective devices.

.2 Conductors, including all types of wires, conductors, cables, which form an integral part of the electrical power system.

.3 Cables and bus support systems which are intended to enclose or support all forms of electrical conductors used for any purpose covered by this scope. This includes cable trays, raceways and all forms of rigid, flexible, metallic and non-metallic conduit, and including conduit for communication systems or others, which may be installed at a later date, or buried conduit for wiring work by others, only when such buried conduit is indicated in the Contract .

.4 Control panels associated with any electrical equipment covered under this Section of Work unless otherwise noted.

.5 Circuit breakers of all types and for all applications associated with electrical equipment, which receives its power supply from the main, auxiliary or emergency (including battery) system.

.6 Grounding systems, as required by the Canadian Electrical Code, or as otherwise specified in the Contract.

.7 Control and instrumentation systems - electrical or electronic instrumentation systems, with auxiliary equipment and components, unless specified otherwise.

.8 Transformers of various types, dry, encapsulated etc., and for all applications, except control transformers supplied with Mechanical Equipment included in Division 23.

.9 Electronic data processing and transmission systems, including auxiliary equipment, interface and components.

1.4 Units of Measure

.1 The following three (3) conversion methods were used in product and location dimensions:

.1 Hard Conversion: industry available products which are manufactured in metric measurements.

.2 Soft Conversion: products which are still manufactured in Imperial units and are converted in Specifications using arithmetic conversion factors.

.3 Rationalized Conversion: dimensions which are soft converted and rounded off for ease of measurements.

.2 In cases where measurements may be open for interpretation, dual dimensions have been incorporated until hard conversions can be used exclusively.

1.5 Definitions

.1 All terminologies, abbreviations, and acronyms used in this Document are as listed in the various Standards, Codes, Rules, and Bulletins used herein.

.2 Where the word *install* is used, unless specifically specified, is also meant to include the supply of the equipment.

1.6 Measurement and Payment

.1 Scope of Electrical Work

.1 Scope of Electrical Work as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Requirements

.1 Wiring provided by all Divisions shall meet the requirements of Division 26.

.2 Provide a complete system of wiring to HVAC, motors and controls as specified herein and as shown on the Drawings.

.3 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under all Contracts related to this project. Examine the Drawings and Shop Drawings of all Divisions for the extent of electrically operated equipment supplied under other Contracts.

.4 All control-wiring diagrams shown on the Drawings illustrate typical control circuits applicable to the equipment. Control circuits may vary with different Manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required.

.5 Unless specifically noted otherwise, supply all pushbuttons, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

.6 Do not operate motors and controls until approval is obtained from the trade providing equipment.

.7 Examine Drawings and Shop Drawings of other Divisions to obtain exact location of motors and equipment shown on Drawings. Where necessary, obtain conduit locations from other trades' drawings and Shop Drawings.

.8 Assist in placing in operation all mechanical equipment having electrical connections.

.9 Provide all power wiring for all motors and control wiring as indicated on the Drawings.

.10 Where 120 V power is required for mechanical equipment, i.e., roll type filters, refrigerated aftercoolers, control cabinets, etc., wiring to the equipment terminals is the Work of this Division.

1.2 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures

2. PRODUCTS

2.1 3-Phase Motor Disconnect Switches

.1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use NEMA 12 enclosures for indoor dry areas, NEMA 4X for wet, Category 2 areas or outdoor. Switches to be H.P. rated.

2.2 120 V, 1-Phase Disconnect Switches

.1 Manual starter without overload relay or as specified.

2.3 208 V, 1-Phase Motor Disconnect Switches

.1 Manual starter without overload relay or as specified.

3. EXECUTION

3.1 Installation

.1 Provide all wiring to all force flow and unit heaters and their thermostats. Unit heaters and baseboard heaters shall be provided by Division 23 and handed over to Division 26 for installation.

.2 Provide all wiring and connect equipment provided by Division 40-Instrimentation and Control and Division 43-Process.

.3 Do control wiring as indicated on the Drawings and the motor control schedules.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Connections to HVAC, Instrumentation and Control and Process Equipment

.1 Connections to HVAC, Instrumentation and Control and Process Equipment as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Intent

.1 Provide demonstration and instruction sessions to familiarize the Contract Administrator and City operation and maintenance (O&M) personnel with electrical systems and their operation and maintenance.

.2 Submit system sign off sheets for each system listed prior to Substantial Performance.

.3 Complete a motor survey sheet for each motor and submit prior to Substantial Performance. Include a control-wiring diagram for each motor neatly drawn in ladder form. Indicate all terminal and wire numbers. Identify all associated control components. Provide typed copies of these lists and diagrams in the O&M Manuals. Include motor overload selection charts for each type and application of overload relay.

.4 All sign-off and survey sheets shall be typewritten.

1.2 Manufacturer's Site Services

.1 Arrange and pay for appropriately qualified Manufacturers' Representatives to provide or assist in providing electrical equipment and system demonstration and instruction as specified herein.

1.3 Coordination

.1 The Contract Administrator will chair demonstration and instruction sessions.

.2 Establish agenda for demonstration and instruction sessions in conjunction with the Contract Administrator. Coordinate scheduling of sessions with the Contract Administrator.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Systems Demonstration

.1 Demonstrate operation of the following systems:

.1 600V Electrical System

.2 208/120 V Electrical System

.3 Mechanical Equipment Connections and Controls.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Electrical Equipment and System Demonstration and Instruction

.1 Electrical Equipment and System Demonstration and Instruction as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical,

Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

MOTOR SURVEY SHEET

Motor Name & Number _____

Manufacturer _____

H.P. _____ Max. Ambient _____ °C

R.P.M. _____ Service Factor _____

Volts _____ / _____ / _____ Insulation Class _____

AMPS _____ / _____ / _____ EEMAC Design _____

PHASE _____ Time Rating _____

Frame _____ Type _____

Serial #

Model # _____

Starter _____ Type _____

OPERATING CONDITIONS

Full Load Operating Amps _____ A _____ B _____ C

Full Load Operating Voltage _____ A-B _____ B-C _____ C-A
at Motor

Overload Relay Installed _____ Adjustable Setting _____ %

M.C.P. AMPS _____ Adjustable Setting _____

Acceleration Time (If over 5 seconds) _____

Reduced Voltage Starter Tap Setting _____

Reduced Voltage Starter Transition Time Setting _____

Special Controls and Remarks (Thermistor and Relay Type, Capacitors and where connected, etc.

_____

_____

SYSTEM COMPLETION AND COMMISSIONING

SYSTEM: _____

The above system is installed as per the drawings and specifications, is complete and has been commissioned.

Electrical Contractor

Signed by: _____Dated: _____

General Contractor

Signed by: _____Dated: _____

Deficiencies Attached

This system has been reviewed by:

Contract Administrator

Signed by: _____Dated _____

The Contract Administrator's personnel have been instructed in the operation and maintenance of the above system:

Contract Administrator

Signed by: _____Dated _____

The above does not constitute a waiver of any of the requirements of the Contract Documents.

	ELECTRICAL CONTRACTOR	GENERAL CONTRACTOR
	_____	_____
Address:	_____	_____
	_____	_____
	_____	_____
Phone:	_____	_____

END OF SECTION

1. GENERAL

1.1 Coordination

.1 Coordinate starting of electrical equipment and systems with testing, adjusting, and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.

.2 HVAC equipment and systems specified in Division 23.

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such Work has been completed prior to starting of electrical equipment and systems.

2. PRODUCT (NOT USED)

3. EXECUTION

3.1 Energizing Electrical System

.1 Prior to energizing the new electrical system:

.1 Verify supply authority voltage and phase rotation.

.2 Close and open all devices to ensure proper mechanical operation.

3.2 Starting Motors

.1 Prior to starting motors:

.1 Confirm motor nameplate data with motor starter heater overloads.

3.3 Energizing Equipment

.1 Prior to energizing equipment provided under other Sections and equipment provided by the Contract Administrator, confirm equipment nameplate with characteristics of power supply.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Starting of Electrical Equipment and System

.1 Starting of Electrical Equipment and System as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Intent

.1 Except where otherwise specified, arrange and pay for testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the Contract Administrator who shall also sign the test documentation.

.5 Submit procedures proposed in writing for approval two (2) weeks prior to test.

1.2 Manufacturer's Production Test Records

.1 If requested, submit copies of production test records for production tests required by NEMA and CSA standards for manufactured electrical equipment.

1.3 Site Testing Reports

.1 Log and tabulate test results on appropriate test report forms.

.2 Submit forms to Contract Administrator for approval prior to use.

.3 Submit completed test report forms as specified, immediately after tests are performed.

1.4 Reference Documents

.1 Perform tests in accordance with:

.1 The Contract.

.2 Requirements of Authorities Having Jurisdiction.

.3 Manufacturer's published instructions.

.4 Applicable CSA, IEEE, NEMA and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Contract Administrator before proceeding with test and obtain clarification.

1.5 Manufacturer's Site Services

.1 Arrange and pay for the Site Services of appropriately qualified Manufacturer's Representatives where Site testing, adjusting, or balancing of electrical equipment or systems' performed by Manufacturer's Representatives is:

.1 Specified

.2 At the request of the Contract Administrator, or

.3 Otherwise required to ensure that electrical equipment and systems are operational in full compliance with the Contract.

1.6 Sequencing and Scheduling

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

2. PRODUCTS

2.1 Test Equipment

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

3. EXECUTION

3.1 Testing of Wiring and Wiring Devices

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 V megger. Resistance values shall be as recommended by cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

3.2 Ground Resistance Testing

.1 Measure ground resistance with earth test meter to verify compliance with CSA C22.2 No. 0.4-04 (R2013)-Bonding of Electrical Equipment and Canadian Electrical Code.

3.3 Load Balance Testing

.1 Perform load tests when as many loads as possible, prior to Acceptance of the Work, are operable.

.2 Turn on all possible loads.

.3 Test load balance on all feeders at distribution centres, motor control centre and panelboards.

.4 If load balance exceeds 15%, reconnect circuits to balance loads.

3.4 Power Factor Testing

.1 Record power factor readings at fifteen (15) minute intervals for full twenty-four (24) hour period during normal operation of the facility.

.2 Take reading at following locations on distribution system:

.1 Main Service.

.2 Motor Control Centre.

3.5 Voltage Testing and Adjusting

.1 Test voltage at all panelboards.

.2 Test voltage at motor control centre.

.3 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by the Contract Administrator.

3.6 Calibration and Verification

.1 The calibration and verification shall be carried out in the field after installation and connection of equipment, but prior to energization, in the presence of the Contract Administrator.

.2 Submittals

.1 Submit details of all test procedures and instruments, together with technician's names, to the Contract Administrator, prior to proceeding.

.2 Submit written verification report after installation is completed to reflect as-built conditions.

.3 Calibration and Verification

.1 Carry out the tests required of calibration and verification firm as specified in the other related sections.

.2 Ensure all bus and cable connections are tightened to Manufacturer's specifications.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Testing, Adjusting and Balancing of Electrical Equipment and Systems

.1 Testing, Adjusting and Balancing of Electrical Equipment and Systems as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical, Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.18.3-12, Conduit, Tubing, and Cable Fittings, and Update No. 1 (2014).

.2 CSA C22.2 No.18.4-15, Hardware for the Support of Conduit, Tubing, and Cable.

.3 CSA C22.2 No.18.5-13, Positioning Devices.

.4 CSA C22.2 No.65-13, Wire Connectors, and Update No. 1 (2013)..

2. PRODUCTS

2.1 Materials

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

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

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CSA-C22.2 No.18.3, 18.4 and 18.5.

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 C22.2 No.65.

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

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Wire and Box Connectors 0-1000 V

.1 Wire and Box Connectors 0-1000 V as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References, Codes, and Standards

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 0.3-09 (R2014), Test Methods for Electrical Wires and Cables, and Update No. 1 (2010).

.2 CSA-C22.2 No. 131-14, Type TECK 90 Cable, and Update No. 1 (2016).

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00.

2. PRODUCTS

2.1 Building Wires

.1 Conductors: stranded for #10 AWG and larger, minimum power conductor size #12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene (XLPE) material rated RW90.

2.2 1 kV Teck90 Cable

.1 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: copper, minimum size #12 AWG or as indicated.

.2 Armour: interlocking aluminum.

.3 Fastenings:

.1 One-hole malleable iron 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 (2) or more cables at 1,500 mm centers.

.3 Six (6) mm diameter threaded rods to support suspended channels.

.4 Connectors:

.1 Watertight, approved for TECK cable.

2.3 Control Cables

.1 Single conductor wire to be 98% conductivity copper type TEW or TBS insulation rated at 600 V, solid or stranded conductor as required, size as noted on Drawings and specified herein, minimum #14 AWG with 90°C

.2 Cable for power and control shall be based on Teck 90 armoured cable, with stranded copper conductors, 90°C insulation, rated at 600 VAC, integral copper ground wire, PVC inner jacket, aluminum interlocking armour, and PVC outer jacket having heat, flame, and moisture retardant properties. Flame retardancy of outer jacket to be rated in accordance with CSA C22.2, No. 0.3. Conductor size shall be minimum #14 AWG or as noted on the Drawings.

.3 Analog instrumentation cable shall use single or multiple pair, seven (7) strand copper conductor, individually twisted and shielded, individual tinned copper drain wire, complete electrical isolation between shields, overall multi-conductor cable shield with drain wire, XLPE inner jacket, interlocking aluminum armour, and FT4 flame retardant rated outer PVC jacket. Cable shall be provided with a black, white, colour code and number code for each pair. Cable and conductor insulation to be rated for 105°C (dry) and 600 V. Conductor size shall be minimum #18 AWG or as noted on the Drawings.

2.4 300 V Instrument Cable – Armoured

.1 Conductors: 16 AWG, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.

.2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.

.3 Twisted pairs/triads cabled with staggered lays.

.4 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).

.7 Fastenings:

.1 One hole 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 300 mm centers.

.8 Connectors:

.1 Watertight, explosion proof approved for armoured cable.

3. EXECUTION

3.1 General

.1 Install and rate power cables in accordance with the Canadian Electrical Code requirements.

.2 Minimum power conductor including luminaire drops to be #12 AWG.

.3 Minimum conductor size #14 AWG for all discrete control cables.

.4 Minimum conductor size #18 AWG for twisted pair analog signal cables.

3.2 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 25.

.2 In cabletroughs in accordance with Section 26 05 37.

.3 In wire ways and auxiliary gutters.

3.3 Installation of Teck Cable 0 - 1000 V

.1 Install cables.

.2 Group cables wherever possible on channels.

.3 Lay cable in cabletroughs in accordance with Section 26 05 37.

.4 Terminate cables in accordance with Section 26 05 20.

3.4 Installation of Control Cables

.1 Install control cables in conduit or cable troughs.

.2 Ground control cable shield at one end only. Shields to be continuous over entire run.

3.5 Workmanship

.1 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.

.2 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Manitoba Electrical Code. Submit data sheet with values measured.

.3 Do not install any power conductor smaller than #12 AWG, except where specifically indicated otherwise, i.e., for fire alarm system station circuits, P.A. wiring, etc.

.4 Provide conductors as shown on Drawings and cable schedule. Minimum conductor sizes are indicated. Voltage drop from lighting panels to farthest outlet must not exceed 2% at full load in any case. Advise Contract Administrator if problem is foreseen.

.5 Exercise care in stripping insulation from wire. Do not nick conductors.

3.6 Identification, Coding and Balancing

.1 For branch circuit wiring, follow identification system shown on the Drawings and as specified in Section 26 05 00.

.2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on As-Constructed Drawings.

.3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.

.4 Conductors sized No. 10 and smaller are required to be factory coloured or numbered, not taped on Site.

.5 For direct current wiring use red for positive and black for negative.

3.7 Testing

.1 All power and control wiring shall be tested for insulation resistance value with a megger. Resistance values shall be as recommended by the cable manufacturer.

.2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Contract Administrator.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Wires and Cables 0 – 1000 V

.1 Wires and Cables 0 – 1000 V as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical, Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 18.1-13 Metallic Outlet Boxes.

.2 CSA C22.2 No. 18.2-06 (R2011) Non-metallic Outlet Boxes.

.3 CSA C22.2 No. 18.3-12 Conduit, Tubing, and Cable Fittings.

.4 CSA C22.2 No. 18.4-15 Hardware for the Support of Conduit, Tubing, and Cable.

.5 CSA C22.2 No. 18.5-13 Positioning Devices.

.6 CSA C22.2 No. 45.1-07 (R2012) Electrical Rigid Metal Conduit – Steel.

.7 CSA C22.2 No. 45.2-08 (R2013) Electrical Rigid Metal Conduit — Aluminum, Red Brass, and Stainless Steel.

.8 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.9 CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.

.10 CSA C22.2 No. 227.3-15, Mechanical Protection Tubing (MPT) and fittings.

2. PRODUCTS

2.1 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45.2, aluminum threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45.1, with zinc coating and corrosion resistant epoxy finish inside and outside.

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

2.2 Conduit Fastenings

.1 One hole stainless steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole stainless 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 m on centre.

.4 Threaded stainless steel rods, 9 mm diameter, to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: to CSA C22.2 No. 18.3, No. 18.4, and No. 18.5, 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 Fish Cord

.1 Polypropylene.

3. EXECUTION

3.1 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 and in unfinished areas.

.3 Use rigid aluminum threaded conduit in Ordinary and Category 1 locations.

.4 Use epoxy coated conduit underground, in concrete, and in Category 2 locations.

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

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

.7 Install conduit sealing fittings in hazardous areas.

.1 Fill with compound.

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

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

.10 Install fish cord in empty conduits.

.11 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

3.2 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 or surface mounted aluminum channels.

.5 Do not pass conduits through structural members except as indicated. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 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.

3.4 Conduits in Cast-In-Place Concrete

.1 Use epoxy coated rigid steel conduits.

.2 Locate to suit reinforcing steel.

.1 Install in centre one third of slab.

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

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

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

.1 Use cold mastic between sleeve and conduit.

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

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

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

3.5 Conduits in Cast-In-Place Slabs on Grade

.1 Use epoxy coated rigid steel conduits.

.2 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.

.1 Provide 50 mm of sand over concrete envelope below floor slab.

3.6 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Conduits, Conduit Fastenings and Conduit Fittings

.1 Conduits, Conduit Fastenings and Conduit Fittings as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Description

.1 Supply and install a complete grounding system to include new equipment provided in this Contract. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Manitoba Electrical Code, Local Building Code, and the local Electrical Inspection Branch.

.2 The system is to consist of cables, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.

1.2 References

.1 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE 837 (2014), Qualifying Permanent Connections Used in Substation Grounding

.2 Canadian Standards Association (CSA)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, and Update No. 1 (2015)

2. PRODUCTS

2.1 Equipment

.1 Ground bus:

.1 Material: Tin plated copper

.2 Size: As per drawings

.2 Rod electrodes: copper clad steel, 19 mm dia by 3 m long.

.3 Cables 2/0 and smaller to be connected to ground bars via Type QA-2B. Connections for cables larger than 3/0 shall be brazed.

.4 All ground wires to be stranded copper TWH complete with a green jacket unless otherwise shown.

.5 Uninsulated ground wires shall be bare stranded copper, soft annealed. Size as indicated.

.6 Motor Control Centre (MCC): provide a copper ground bar complete with lugs suitable to terminate all ground cables. Ground bus shall be 12 mm thick, 100 mm high and 1000 mm long. Bus shall be complete with pre-drilled holes suitable for lug mounting as required. Refer to Drawings for details.

.7 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 Bonding jumpers, straps

.5 Pressure wire connectors

3. EXECUTION

3.1 General

.1 Install complete permanent, continuous grounding system, including conductors, accessories. All connectors shall be installed in accordance with Manufacturers' requirements. All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground wire.

.2 All transformers, switchgear, MCCs, panelboards and splitters fed from the main distribution centre shall be grounded by grounding conductors sized as shown. The ground wire shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus. Ground wire to be green TWH. Use mechanical connectors for grounding connections to equipment provided with lugs.

.3 All sub panels such as lighting panels, local distribution panels, etc., shall be grounded with a green ground wire run back to the panel from which it is fed. The ground conductor shall be sized according to the Manitoba Electrical Code.

.4 All main distribution centres, MCCs, switchgear, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground wire required.

.5 All bolted connections must be accessible.

.6 All motors shall be grounded by means of an adequately sized green ground wire contained within the feeder conduit.

.7 Include a separate green ground wire in all power conduits including branch circuit wiring sized to Manitoba Electrical Code.

.8 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per Manitoba Electrical Code.

.9 Use compression connectors for all grounding splices and terminations unless otherwise shown on the Drawings.

.10 Install rigid conduit sleeves where ground wires pass through concrete slabs.

.11 Conduit installed buried in earth or installed in or under grade floor slabs shall have separate ground wire installed.

.12 Ground all utility services to the electrical system ground.

.13 Protect exposed grounding conductors from mechanical injury.

.14 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.15 Soldered joints shall not be permitted.

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

.17 Install electrical room ground bus to wall as indicated, utilizing insulated off sets.

3.2 System and Circuit Grounding

.1 Install system and circuit grounding connections to neutral of secondary 600 V system, secondary 208 V system.

3.3 Equipment Grounding

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, switchgear, duct systems, frames of motors, MCCs, starters, control panels distribution panels.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Grounding

.1 Grounding as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply and install all hangers, supports and inserts for the installation shown on the Drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures shall employ 41 mm square strut channel together with the Manufacturer's connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.3 Shall be rated for use in hazardous locations and category environments as necessary.

.2 Finishes:

.1 Hot dipped galvanized.

.2 Nuts, bolts, machine screws: cadmium plated.

.3 Square strut channel:

.1 Section 41 mm square strut channel or as required for load and span, with mounting screws, or approved. 41 mm square strut channel is a minimum standard for supporting conduits 50 mm and larger.

2.2 Concrete and Masonry Anchors

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four (4).

2.3 Non-Metallic Anchors

.1 Material: plastic anchors for sheet metal screws

2.4 Cable Supports and Clamps

.1 General: as per conduit supports, except that for single conductor cables, suitable non-ferrous, or approved stainless steel or aluminum clamps shall be used.

3. EXECUTION

3.1 General

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Contract Administrator is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 m span and 8 mm over a 2 m span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.6 Provide rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel Work.

.6 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.

.2 Support two (2) or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.7 Use plastic anchors for light loads only. Use metal anchors for all other loads.

.8 Shot driven pins may only be used with written approval of the Contract Administrator.

.9 Use round or pan head screws for fastening straps, boxes, etc.

.10 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four (4) 6 mm fasteners.

.11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.13 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.14 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Fastenings and Supports

.1 Fastenings and Supports as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 6-1993 (R2011), Industrial Control and Systems: Enclosures.

1.2 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data for cabinets in accordance with Section 26 05 00.

.2 Provide Manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide Drawings stamped and signed by Professional Engineer registered or licensed in the Province of Manitoba.

2. PRODUCTS

2.1 Junction Boxes, Cabinets, and Pull Boxes

.1 NEMA Type of enclosure refer to Section 26 05 00 - Common Work Results For Electrical.

.2 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes

.3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

2.2 Cabinets

.1 Materials:

.1 Locks: to match panelboards.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Install a back mounting plate for DIN rail mounted terminal blocks. Plate to be painted white enamel.

.3 Install metal divider in cabinets with more than one voltage.

.4 Surface or flush with trim and hinged door, latch and lock and two (2) keys, size as indicated or to suit. Keyed to match panelboard keys 19 mm.

3. EXECUTION

3.1 Installation

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the Drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.6 Terminate cables and conductors as required.

.7 Make all necessary cable entry holes in junction boxes supplied by Contractor or others, regardless of material.

.2 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items.

.2 Install terminal block where indicated.

.3 Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Splitters, Junction Boxes, Pull Boxes and Cabinets

.1 Splitters, Junction Boxes, Pull Boxes and Cabinets as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete system of boxes for the installation of wiring and equipment.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

.2 PRODUCTS

1.3 Outlet and Conduit Boxes General

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

.2 102 mm square or larger outlet boxes as required for special devices.

.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.

1.4 Outlet Boxes for Metal Conduit

.1 Materials

.1 Surface mounting exposed: cast ferrous for threaded conduit, with attached lugs, two coats corrosion resistant finish.

.2 Components

.1 Ceiling outlets, surface mounting:

.1 Cast outlet boxes suitable for rigid conduit.

.2 Crouse-Hinds VXF/VFT series.

.2 Wall outlets, surface, exposed mounting or used for outdoor outlets: one or more gang, Crouse-Hinds FS series or FD series, Condulet.

.3 Covers: unless wiring devices and plates are mounted, provide blank, round canopy covers to match boxes.

1.5 Conduit Boxes

.1 Cast FS or FD Feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

1.6 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 32 mm and pull boxes for larger conduits.

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

2. EXECUTION

2.1 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. Remove upon completion of Work.

.3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.4 Install all outlets flush and surface mounted as required for the installation.

.5 Surface mount above suspended ceilings, or in unfinished areas.

.6 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.7 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.8 Use plaster rings to correct depth. Use 30 mm on concrete block.

.9 Do not use sectional boxes.

.10 Provide boxes sized as required by the Canadian Electrical Code.

.11 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.12 Outlets installed in partition walls to be offset by a minimum of one stud space.

.13 Primary bushings in termination box for cable connection.

.14 Secondary bushings in termination box for bus duct connection.

.15 Control junction box.

3. METHOD OF MEASUREMENT AND PAYMENT

3.1 Method of Measurement and Payment

.1 Wiring Devices

.1 Outlet Boxes, Conduit Boxes and Fittings as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical, Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide a complete system of cable trays required to fully support all cable and conduit throughout the facility. System shall provide separate trays or barriers for 600 VAC systems, 120 VAC systems, and 24 VDC systems. System shall be complete with all supports and hangers and necessary for the installation.

.2 Coordinate the location of the support channels so as not to interfere with other services.

.3 Not all cable tray required is indicated on the Drawings. Provide additional tray as required to fully support all cable and conduit throughout the facility.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 126.1-09 (R2014) - Metal Cable Tray Systems.

.2 CSA C22.2 No. 126.2-02 (R2012) - Nonmetallic Cable Tray Systems

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings and Product data in accordance with Section 26 05 00.

.2 Provide detailed layout plans indicating cable tray locations, sizes, barriers and supports.

.3 Prior to construction, submit design Drawings and calculations indicating all tray loading and seismic support designs have been reviewed by and bear the stamp of a Professional Engineer registered in the Province of Manitoba.

2. PRODUCTS

2.1 Cabletray

.1 All tray mounted indoor shall be galvanized steel ladder type, Class C1 to CSA C22.2 No. 126.1 with 300 mm rung spacing, 150 mm side rails.

.2 Use aluminum tray in intermediate level of pumping station. Class C1 to CSA C22.2 No. 126.1 with 300 mm rung spacing, 150 mm side rails.

.3 Use aluminum tray in outdoor areas and intermediate level of pumping station. Class D to CSA C22.2 No. 126.1 with 300 mm rung spacing, 150 mm side rails.

.4 Width as required to prevent cable de-rating. The Contractor is responsible for increasing cable sizes due to de-rating factors from cable spacing.

.5 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints, reducers and other fittings where required. Field fabricate only those fittings not available from Manufacturer.

.6 Provide stainless steel rod hanger clamps, rod hangers, wall mounting support brackets and all necessary accessories for complete installation.

.7 Barriers where different voltage systems or electrical systems are in the same tray, or as indicated.

.8 Unless otherwise approved by the Contract Administrator, provide cabletrays of the same manufacturer throughout the Work

2.2 Supports

.1 Provide stainless steel rod hangers, rod hanger clamps and accessories as required.

.2 Wall mounted support brackets: Provide aluminum channel strut supports mounted vertically in concrete wall complete with mounting brackets sized to suit cabletray width and loading.

3. EXECUTION

3.1 Installation

.1 Suspend cabletrays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and not more than 3000 mm on centers. Fasten hangers to channels securely mounted to the structure.

.2 Do not drill through wood ceiling trusses. Provide wood blocking on top of ceiling truss to anchor rod hangers and channels.

.3 Install trays and raceways generally as indicated on Drawings. Coordinate this Work with the other trades to ensure adequate horizontal and vertical clearances.

.4 Provide minimum vertical clearance above the trays as indicated on the Drawings.

.5 Provide minimum 600 mm horizontal clearance on one side of cabletray throughout.

.6 All trays are shown diagrammatically on the Drawings. Determine the exact location in the field. Install tray runs to prevent interference with process or service piping and ducting and to maintain clearance for tray access. Coordinate the exact location of tray supports and runs with the work of other Divisions.

.7 Do not install tray routes and tray supports until the location of same has been reviewed by the Contract Administrator.

.8 Install tray systems in such a manner as to conserve head-room and minimize the use of free space through which they pass. Maintain a minimum 2,100 mm clear head-room wherever possible.

.9 Run trays parallel to building lines unless otherwise shown on the Drawings. Where two or more trays run the same route, make parallel and ensure offsets and bends are uniform.

.10 When the ends on square strut channel type shelf brackets are below 2100 mm AFF in a walking area, cut flush with tray. Permanently cap the end of square strut channels, etc. with plastic caps. Suitably protect sharp corners and edges of tray to prevent personal hazard.

.11 Where hanger rods are used, use stainless steel and not be smaller than 12 mm in diameter.

.12 Extend a stranded #2/0 tin plated bare, or green insulated, copper ground conductor the length of each tray route, and solidly connect sections of tray runs to the ground bus of the

electrical room. Connect ground conductor to the tray every 15 m with approved grounding clamps suitable for connecting aluminum tray with copper conductor.

.13 Generally run cables of different voltage classes in separate trays. Where a common tray is shown on Drawings, separate the cables for different voltage classes from each other by metal barriers as supplied by the tray Manufacturer.

.14 Check all trays for surface smoothness prior to installation and remove all burrs, ridges, etc. on tray surfaces facing cables.

.15 Size cabletrays as indicated on Drawings. If any discrepancies are found or changes in tray size are required, advise the Contract Administrator before installing the tray.

3.2 Cables in Cabletray

.1 Install cables individually.

.2 Lay cables into cabletray. Use rollers when necessary to pull cables.

.3 Secure cables in tray at 5 m centers, with nylon ties.

.4 Identify cables with nameplates in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.5 Mark power and communication runs in accordance with colour coding outlined in Section 26 05 00 - Common Work Results - For Electrical.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Cable Trays for Electrical Systems

.1 Cable Trays for Electrical Systems as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Description

.1 Supply and install wireways and auxiliary gutters and fittings as a means for flexible wiring system.

.2 All wireways and auxiliary gutters to be 2-piece with removable cover to provide access to wiring.

.3 Wireways, auxiliary gutters and fittings are based on CSA C22.2, No. 26.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 26-13, Construction and Test of Wireways, Auxiliary Gutters, and Associated Fittings.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 26 05 00 - Electrical General Requirements.

2. PRODUCTS

2.1 Wireways

.1 Wireways, auxiliary gutters and fittings: to CSA C22.2, No. 26.

.1 Two-piece sheet steel with removable bolted cover to give uninterrupted access to wiring.

.2 Finish: gray enamel.

.3 Use aluminum in classified area.

.2 Elbows, tees, couplings, and hanger fittings manufactured as accessories to wireway supplied.

3. EXECUTION

3.1 Installation

.1 Install wireways and auxiliary gutters.

.2 Keep number of elbows, offsets, and connections to minimum.

.3 Install supports, elbows, tees, connectors, and fittings.

.4 Install barriers to separate different voltages or to separate different systems.

.5 Install gutter to full length of equipment.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Wireways and Auxiliary Gutters

.1 Wireways and Auxiliary Gutters as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CSA CSA-Z809-08, Sustainable Forest Management, and Update No. 1 (2010).

.2 Forest Stewardship Council (FSC)

.1 FSC-STD-01-001 V5-2 (2015), FSC Principle and Criteria for Forest Stewardship.

.3 Sustainable Forestry Initiative (SFI)

1. SFI 2015-2019 Standards and Rules.

2. PRODUCTS

2.1 Cable Protection

.1 Install as per Drawing C2-BE-007.

3. EXECUTION

3.1 Direct Burial of Cables

.1 After sand bed specified is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Maintain 75 mm minimum separation between cables of different circuits. Maintain 300 mm horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position. At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables. Maintain 300 mm minimum lateral and vertical separation for fire alarm and control, cables when crossing other cables, with fire alarm and control cables in upper position. Install treated planks on lower cables 0.6 m in each direction at crossings. All weather wood is not acceptable.

3.2 Cable Installation in Ducts

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 CSA-approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables properly terminated, seal ends of cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.3 Markers

.1 Mark cable every 30 m along cable or duct runs and changes in direction or as indicated on the Drawings.

.2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00.

.2 Check phase rotation and identify each phase conductor of each feeder.

.3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.4 Pre-acceptance test.

.1 After installing power cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.3 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.

.4 Remove and replace entire length of cable if cable fails to meet any of test criteria.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Installation of Cables in Trenches and in Ducts

.1 Installation of Cables in Trenches and in Ducts as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide a coordination/protective study, short circuit study and arc flash study of all equipment specified herein for the new pumping station building and submit for review.

.2 Coordination, Short Circuit and arc flash study to comply with minimum CEC requirements and provide all warning labelling.

.3 Include the following:

.1 600 V air circuit breaker over current, overload, and ground fault devises.

.2 600 V distribution panels and 120/208 V panelboards and switchgear connecting feeder cables and bus duct.

.3 Lock rotor current, acceleration time and damage curve for motors 75 kW and larger.

.4 Any additional data necessary for successful completion of the coordination and short circuit study.

.5 Study shall be inclusive for new distribution equipment.

.4 Data shall clearly state the operating time in cycles of each breaker and indicate whether the time current curves for relays are inclusive of breaker tripping times or otherwise.

.5 Prepare a summation chart showing all ratings and settings with easy reference to the appropriate curve.

.6 Symmetrical and asymmetrical fault current calculations shall be submitted to verify the correct choice of the protective elements of the system.

.7 Prepare a systems single line diagram on which the resultant short circuit values, device numbers and equipment ratings are shown.

.8 Include a list of recommended settings for each relay.

.9 Set all protective devices to recommended settings.

1.2 Qualifications

.1 This study shall bear the stamp of a Professional Engineer registered in the Province of Manitoba.

.2 Study shall be completed before MCC Shop Drawing submission.

1.3 Submittals

.1 Submittals as per Section 26 05 00.

.2 Submit the complete study for review prior to carrying out calibration and verification.

.3 Submit typed results of coordination and short circuit study in maintenance manuals.

2. PRODUCTS

2.1 Tripping Devices

.1 Relay style, CT ratios and fuse sizes have been selected on a preliminary basis for design purposes. Final selection shall be based on the results of this study and shall be included at no extra cost.

3. EXECUTION

3.1 Data

.1 Provide the MCC supplier with all relevant data for equipment not provided by that supplier.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Coordination, Short Circuit and Arc Flash Study

.1 Coordination, Short Circuit and Arc Flash Study as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CAN3-C17-M84 (R2015) - Alternating - Current Electricity Metering.

.2 Institute of Electrical and Electronics Engineers (IEEE)

.1 C37.90.1-2002 IEEE Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

.2 Indicate meter, instrument, outline dimensions, panel drilling dimensions and include cutout template.

2. PRODUCTS

2.1 Digital Metering Instrument

.1 Microprocessor-based data collection and storage meter to monitor power conditions on transformer secondaries as shown on the plans.

.2 Meter to display true RMS value of:

.1	Amps	3-phase current
.2	Volts	Line-to-line or line-to-neutral 3-phase voltage
.3	kW	kilowatts
.4	kVA	kilovoltamperes
.5	Pf	power factor
.6	F	frequency
.7	kWd	kilowatt demand
.8	Ad	amperes demand
.9	kWh	kilowatt hours

.10 Total kWH as an accumulating total, providing bi-directional (import/export) indication.

.11 Total kVARH as an accumulating total, providing bi-directional (import/export) indication.

.12 kW Demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.

.13 Amps Demand.

.14 kVA Demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.

.15 Total harmonic current and voltage.

.16 Individual harmonic true rms current and voltage to the 63rd harmonic.

.3 Each power meter to have:

.1 True RMS measurement.

.2 Direct connection to 600 V, 3 phase, 4 wire system.

.3 Fourth current input for measurement of ground or neutral current.

.4 Eight (8) digital inputs for status/counter inputs, self excited dry contact sensing, to remotely monitor breaker status, ground fault relay status, or any other dry contact input.

.5 Storage in non-volatile memory for the following:

.1 A time-stamped alarm and event log of up to 800 events which records event date, time (to 0.001 sec), event type, and value for all over/under limit conditions, all status input activity, and all relay operations.

.2 A time-stamped minimum/maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log to be read from the front panel display or via the communications port.

.3 All setup data.

.6 Waveform capture capability allowing any of the eight voltage and current input channels to be digitally sampled at 256 samples/60 Hz cycle. Waveform capture to be initiated using commands made via the communications port or event triggered. Waveform capture data is to be made accessible via the communications port.

.7 Liquid crystal display, 320 x 240 pixels resolution, backlight.

.8 Serial communications ports:

.1 One (1) RS-232C/RS-485, and one (1) RS-485.

.2 Protocols: ION, Modbus RTU.

.3 Baud rate: RS-232, 300 bps to 115,200 bps.

.4 Baud rate: RS-485, 300 bps to 57,600 bps.

.9 Ethernet port:

.1 Protocols: ION, Modbus TCP.

.2 10BaseT.

.3 Simultaneous communications using ION and Modbus TCP protocols.

.10 Field programmability as follows:

.1 Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate, TCP/IP address and the relay operation are programmable from the front panel.

.2 All parameters in 10.1 above, plus additional alarm/event parameters may be programmed via the communications port using a portable terminal or a computer.

.3 Ensure programming is password protected.

.11 Compliance with the following standards:

.1 ULC Listed.

.2 CSA Certified.

.3 Voltage, current, status, relay and power inputs pass the IEEE C37.90.1 tests.

.4 Certified to comply with FCC Part 15 Subpart J for Class A computing devices.

.12 300 amps for one (1) second surge protection on all four (4) current inputs.

.13 The following accuracy, resolution, range, and power supply ratings specifications:

Parameter	Accuracy	Resolution	Range
Volts (V1, V2, V3)	0.1%	0.1%	0 - 1,000,000[1]
Amps (I1, I2, I3)	0.1%	0.1%	0 - 30,000
Neutral Current (I4)	0.4%	0.1%	0 - 9,999
kW	class 0.2	0.1%	0 - 1,000,000[2]
kVAR	class 0.2	0.1%	0 - 1,000,000[2]
kVA	class 0.2	0.1%	0 - 1,000,000[2]
Power Factor	0.2%	1.0%	1.0 to ±0.6
Frequency	0.005 Hz	0.1 Hz[3]	40 to 450 Hz
kW Demand	class 0.2	0.1%	0 - 1,000,000
Amps Demand	class 0.2	0.1%	0 - 30,000
kWH (-F, -R)	class 0.2	1 kWH	0 - 1,000,000,000
kVARH (-F, -R)	class 0.2	1 kVARH	0 - 1,000,000,000

.1 Reads in kV for voltages over 9,999.

.2 Reads in MVA, MW, MVAR for readings over 9,999 K.

.3 1 Hz resolution at 400 Hz range.

.4 Power Supply

.1 85 to 250 VAC or 110 to 300 VDC.

.2 Burden: 15 VA typical, 35 VA maximum.

.3 Record and store the following information in meter memory. Recall and reset stored data via meter controls and meter indicator.

.1	Volts	max/min at 1 second interval
.2	Amps	max/min at 1 second interval
.3	F	max/min at 1 second interval
.4	kW	max/min at 1 second interval
.5	Pf	max/min (or kVA max/min) at 1 second interval
.6	kWd	at field programmable intervals of 1 minute to 30 minutes; set at 1 minute
.7	Ad	per kWd

.5 10-Base-T communications port for future addition of remote data acquisition.

.6 Field programmable for set-up and system variables.

.7 Test terminal blocks as required.

.8 CSA Certified.

2.2 Current Transformers

.1 Provide shorting switches or test blocks for all meter CT inputs.

2.3 Equipment Identification

.1 Provide equipment identification.

3. EXECUTION

3.1 Metering Installation

.1 Install meters in panels as indicated.

.2 Make connections in accordance with diagrams.

3.2 Field Quality Control

.1 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.2 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Metering and Switchboard Instruments

.2 Metering and Switchboard Instruments as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Work

.1 Provide enclosed dry type transformers 600 V primary to 120/208 V.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C9-02 (R2016), Dry-Type Transformers.

.2 CSA C22.2 No. 47-13, Air-cooled transformers (dry type).

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

1.3 Submittals

.1 Product Data – 3-phase, 4 Wire Secondary.

.1 Submit product data in accordance with Section 26 05 00.

2. PRODUCTS

2.1 Transformers

.1 General: dry type, air-cooled, self-ventilated, code gauge steel, complete with ventilation openings, removable access panels, mounting brackets, and solderless primary and secondary cable connectors. Enclosures to have zinc chromate prime coat and enamel finish coat per Section 26 05 00. Transformers to be single- or 3-phase as noted on the Drawings.

.2 Design

.1 Type: ANN

.2 3-phase, kVA as indicated on the Drawings, 600 V input, 120/208 V output, 60 Hz.

.3 Voltage primary taps: 2.5% full capacity above and below normal.

.4 Insulation: Class H

.5 Basic Impulse Level (BIL): 20 kV B.I.L.

.6 Hipot: 4 kV

.7 Average Sound Level: to meet the local municipal and building codes and meet at minimum the following criteria:

.1 45 dB maximum up to 45 kVA

.2 50 dB maximum up to 150 kVA

.3 55 dB maximum up to 300 kVA

.4 60 dB maximum above 500 kVA

.8 Impedance at 170°C: 6.0% maximum up to 112.5 kVA; 5.5% maximum above 112.5 kVA..

.9 Finish: In accordance with Section 26 05 00.

.10 Three Phase Windings: arrange with three primary windings connected in delta and three secondary windings connected in wye.

.11 Max. Winding Temperature: 150°C rise with temperature continuous full load.

.12 Max. Lead Connection: 55°C rise with temperature continuous full load.

.13 Copper winding.

.14 All connections are front accessible only and taps.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

2.3 Acceptable Manufacturers:

.1 Transformer shall match and be from the same manufacturer as the Motor Control Centre.

3. EXECUTION

3.1 Installation

.1 Built-In Motor Control Centre.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Dry Type Transformers up to 600 V - Primary

.1 Dry Type Transformers up to 600 V - Primary as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association (CSA)

.1 C22.2 NO. 29-15 - Panelboards and enclosed panelboards

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 26 05 00.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2. PRODUCTS

2.1 Panelboards

.1 Panelboards: Product of one Manufacturer.

.1 Manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 Enclosure:

.1 Built-In Motor Control Centre

.3 Panelboards: bus and breakers rated for 250 V to be 10kA, 600 V to be 25 kA (symmetrical interrupting capacity) or as indicated. Series rated breakers not acceptable.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Two (2) keys for each panelboard and key panelboards alike

.7 Tin plated Copper bus with neutral of same ampere rating as mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked grey enamel.

.11 Transient voltage surge suppressor surge protection – bus connected.

2.2 Breakers

.1 Breakers: refer to Section 26 28 16.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to City of Winnipeg.

2.3 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each panelboard Size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards Size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, include holder, clear protective cover and removable directory.

2.4 Acceptable Manufacturers

.1 Panelboard shall match and be from same manufacturer as the Motor Control Centre.

3. EXECUTION

3.1 Installation

.1 Built-In Motor Control Centre

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Panelboards – Breaker Type

.1 Panelboards – Breaker Type as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 26 05 00.

.2 Indicate:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams.

1.3 Operation and Maintenance Data

.1 Provide operation and maintenance (O&M) data for motor control centre (MCC) for incorporation into manual specified in Section 26 05 00.

.2 Include data for each type and style of starter.

1.4 Maintenance Materials

.1 Provide Spare Parts as recommended by the Manufacturer.

1.5 Source Quality Control

.1 Provide Manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Manufacturer to provide proof of quality control program in accordance with ISO 9001.

2. PRODUCTS

2.1 Supply Characteristics

.1 600 V, 60 Hz, delta connected, 3-phase, 4 wire, grounded.

2.2 General Description

.1 Compartmentalized vertical sections with common power busbars.

.2 Metal enclosed, free standing, enclosed dead front.

.3 Indoor NEMA 2 gasketted enclosure with drip hood, front mounting.

.4 Width of Motor Control Center not exceeds 4725 mm.

.5 Use of compact type molded case breakers is preferred.

2.3 Acceptable Manufacturers

.1 Eaton Freedom Series 2100.

.2 Square D Model 6 (Schneider Electric)

.3 Siemens MNS

2.4 Vertical Section Construction

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each unit to have complete top and bottom steel plate for isolation between units.

.3 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of MCC, isolated from busbars by steel barriers.

.4 Vertical wireways complete with doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.5 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

.6 Provision for outgoing cables to exit via top.

.7 Removable lifting means.

.8 Provision for future extension of both ends of MCC including busbars without need for further drilling, cutting or preparation in field.

.9 Divide assembly for shipment to Site, complete with hardware and instructions for re-assembly.

2.5 Sills

.1 Continuous 75 mm x 25 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.6 Busbars

.1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment self-cooled, extending entire width and height of MCC, supported on insulators and rated:

.1 Main horizontal busbars: 800 A

.2 Branch vertical busbars: 300 A

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 42 kA rms symmetrical minimum or as indicated.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.7 Ground Bus

.1 Copper ground bus extending entire width of MCC.

.2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

2.8 Motor Starters and Devices

.1 Equip the MCC with the combination starters as specified in Section 26 29 10 and as shown on the Drawings.

.2 An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access, unless the disconnect is in the “OFF” position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or reinsertion of the unit while in the “ON” position. Padlocking facilities shall be provided to positively lock the disconnect in the “OFF” position with up to three (3) padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

2.9 Main Motor Control Centre

.1 Phase unbalance and phase loss protection

2.10 Starter Unit Compartments

.1 Units NEMA size 5 and smaller, circuit breaker units 225 A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for one (1) and four (4) padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Motor restart prevention for motors 75 kW (100 HP) or greater.

.7 Pushbuttons and indicating lights mounted on door front.

.8 Hour meter for motor run time mounted on door front.

.9 Devices and components by one (1) manufacturer to facilitate maintenance.

.10 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

.11 Class II Type B Control wiring.

2.11 Motor Protection Requirements

Application	Rating	Protection
600V motors, general service	< 75 kW (100 hp)	Electronic Overload
	>= 75 kW (100 hp) < 187 kW (250 hp)	Overload Overcurrent Locked Rotor Ground Fault (zero-sequence CT) Winding Temperature (Thermistor or RTD)
600V motors, critical service	< 50 hp	Electronic Overload
	>= 37 kW (50 hp) < 75 kW (100 hp)	Electronic Overload Ground Fault (zero-sequence CT)
	>= 75 kW (100 hp) < 187 kW (250 hp)	Overload Overcurrent Locked Rotor Ground Fault (zero-sequence CT) Winding Temperature (RTD)

2.12 Wiring Identification

.1 Provide wiring identification in accordance with Section 26 05 00.

2.13 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

2.14 Finishes

.1 Apply finishes in accordance with Section 26 05 00.

.2 Paint MCC exterior light grey.

3. EXECUTION

3.1 Installation

.1 Set and secure MCC in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload heater elements are installed.

.4 Some re-arrangement of compartments is permitted from that indicated to suit Manufacturer's standards, provided that re-arrangement gives approximately the spaces shown on the Drawings.

.5 Coordinate concrete pad with bevelled edges as shown on the Drawings, sized to suit MCC, install and level channel sills and mount MCC.

.6 Provide control centres with vertical sections, each 2286 mm high, 508 m deep and 508 mm wide, assembled into a group having a common power bus and forming an enclosure to which additional sections may be readily added.

.7 Design for all power and control connections to be made from the front. All bus and feeder bolted connections shall be accessible from the front.

.8 Sections with horizontal wiring spaces top and bottom and with 102 mm full height vertical wiring spaces with cable tile supports. Insulate wireways from horizontal and vertical bus.

.9 Incorporate starters, circuit breakers, panels, etc. as detailed.

.10 Provide all spaces complete with bussing hardware and other accessories required so that additional combination starter units can be readily installed. Provide barriers to isolate the space from all buswork.

.11 For each section of structure, provide a 3-phase horizontal bus rated as shown, and a 3-phase vertical bus rated 300 A. Tin plate vertical and horizontal bus at each joint. Provide a continuous copper ground bus in bottom of each section. where indicated on MCC schedule, provide fully rated neutral. Bus shall be copper with labyrinth design insulation - isolation for vertical bus.

.12 Contain each complete control device within an individual metal enclosure complete isolated from all other equipment. Provide plug-in type units.

.13 Provide tin-plated copper busbar stabs reinforced with strong spring steel to ensure high contact pressure.

.14 Equip door of each individual unit with a removable plate replaceable with similar plate complete with pushbuttons, pilot lights or selector switches as required. Use pilot lights of push-to-test type and push button of heavy-duty oil tight construction.

.15 Provide appropriate flanges and bus connections for incoming line and feeders.

.16 All joints and connections to be tin plated, cadmium plate all bolts, nuts and lock washers to resist corrosion.

.17 Provide pull apart terminal block plug in each starter for all external control connections, such that each starter unit may be easily removed. All terminals shall be identified.

.18 Provide barriers to isolate all buswork to prevent accidental contact when starter units are removed or spaced are provided. Barriers shall also provide phase-to-phase isolation of the vertical bus.

.19 Complete control wiring diagrams for each starter with conductor identification clearly shown shall be affixed to the interior cover of the starter section or provide a book of wiring diagrams for all starters in each MCC.

.20 MCCs shall be fitted with individual 600V/120 V control transformers of sufficient V.A. capacity to handle the control requirements of each MCC cell plus 10% capacity for external control devices.

.21 Primary and secondary high rupturing capacity (HRC) fusing shall be installed on the control transformer.

.22 All terminals shall be number coded or otherwise suitably identified to indicate which section or module of the MCC they are associated with and their function.

3.2 Starter Verification

.1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:

.1 Check of control circuits.

.2 Verify that overload relay installed in correctly sized for motor used.

.3 Record overload relay size and motor nameplate amperage.

.4 Visual inspection of fuses and contactors.

.5 Ensure all connections are tight.

.2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running.

.3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

3.3 Overload Relays

.1 Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time motors, provide special overload relays to suit the start-up condition.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of MCC during an eight hour period.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Motor Control Centre

.1 Motor Control Centre as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical, Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association (CSA)

.1 C22.2 NO. 42-10 (R2015) - General use receptacles, attachment plugs, and similar wiring devices

.2 C22.2 NO. 42.1-13 - Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D)

.3 C22.2 NO. 55-15 - Special use switches

.4 C22.2 NO. 111-10 (R2015) - General-use snap switches (Bi-national standard, with UL 20)

2. PRODUCTS

2.1 Manufacturer

.1 Wiring devices to be of one (1) manufacture throughout project.

.2 Acceptable Manufacturers:

.1 Arrow-Hart (Cooper/Eaton)

.2 Crouse-Hinds (Eaton)

.3 Hubbell Inc.

2.2 Devices

.1 The catalogue numbers shown below are for the particular Manufacturer's series and all necessary suffixes shall be added for the requirements as stated. All devices shall be specification grade minimum.

.2 Devices to be brown with stainless steel coverplates in all but mechanical areas unless noted otherwise. Use galvanized steel coverplates in mechanical areas and for surface mounted devices. Category 2 and outdoor areas shall use NEMA 4X boxes and coverplates.

2.3 Switches

.1 120-277 V, 20 A, single and double pole, three-way and four-way.

.2 For wet locations use the following switches: 20 A, 120 V single pole brown, side wired press-switch.

.3 For Category 2 area:

.1 Switches shall be marked and CSA approved for use in Category 2 area (NEMA 4X).

.4 Manually - operated general purpose AC switches shall have the following features:

.1 Terminal holes approved for AWG # 10 wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and/or side wiring.

2.4 Receptacles

.1 Duplex 15 A, 120 V, 3 wire, brown, U-ground, with the following features:

.1 Brown urea molded housing.

.2 Suitable for # 10 AWG for back and side wiring.

.3 Eight (8) back wired entrances, four (4) side wiring screws.

.4 Break-off links for use as split receptacles.

.5 Triple wipe contacts and riveted grounding contacts.

.2 Duplex 15 A, 120 V, 3 wire, brown, U-ground ground fault receptacle.

.3 Single 15 A, 120 V, 3 wire housekeeping receptacle with stainless steel plate engraved with Housekeeping.

.4 Receptacles located in the wet areas and on the exterior of the building to be weatherproof construction.

.5 Receptacles located in the Category 2 areas to be NEMA 4X construction.

.6 Provide coverplates for all wiring devices.

.7 Use sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.

.8 Use stainless steel 1 mm thick coverplates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.9 Weatherproof double lift spring-loaded cast aluminum coverplates, complete with gaskets for single receptacles or switches.

.10 Weatherproof spring-loaded cast aluminum coverplates complete with gaskets for single receptacles or switches.

.11 Use gasketted DS cast covers on FS and FD type boxes.

3. EXECUTION

3.1 Installation

.1 Install single throw switches with handle in the "UP" position when switch closed.

.2 Install switches vertically in gang type outlet box when more than one switch is required in one location.

.3 Mount switches on the latch side of the doorway as close as possible to door frame unless otherwise indicated on Drawings.

.4 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.5 Protect cover plate finish with paper or plastic film until all painting and other Work is finished, and then remove paper.

.6 Install suitable common coverplates where wiring devices are grouped. Do not distort plates by tightening screws excessively.

.7 Do not use coverplates meant for flush outlet boxes on surface mounted boxes.

.8 Wherever possible, mount equipment in a straight line at a uniform mounting height, coordinated with other equipment and materials.

.9 Mounting dimensions are to the centre of the devices. Final instructions on mounting heights shall be given by Contract Administrator at the Site. The above shall be used as a guide, but shall be subject to final verification prior to installation.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Wiring Devices

.1 Wiring Devices as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 C22.2 NO. 5-16 - Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE-2016)

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00.

.2 Include time-current characteristic curves for breakers with minimum symmetrical (rms) interrupting capacity as shown at system voltage.

2. PRODUCTS

2.1 Breakers General

.1 Bolt-On Moulded Case Circuit Breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-Trip Breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from three (3) to eight (8) times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

.5 Add Electronic trip unit with adjustable settings to meet co-ordination study requirements where applicable or as shown on the Drawings.

2.2 Thermal Magnetic Breakers

.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 Magnetic Breakers

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

2.4 Moulded Case Switch

.1 Moulded case switch shall be complete with a high instantaneous magnetic fixed trip, factory set to trip at high fault currents.

2.5 Enclosure for Individually Mounted Breakers or Moulded Case Switch

.1 Enclosure shall be CSA code gauge galvanized steel, hinged door, front mounted external operating handle, lockable in “off” position, NEMA 1 unless shown otherwise. Use NEMA 12, for industrial application and Category 1 area, use NEMA 4X for Category 2 or outdoor areas, for wet environment or as shown “WP” on Drawings. Increase enclosure size above standard for large cables.

.2 Where distribution system has grounded neutral conductor, provide neutral bar, with ampere rating equal to breaker/switch rating in enclosure.

3. EXECUTION

3.1 Installation

.1 Install circuit breakers as indicated on Drawings and specified herein.

.2 Install circuit breakers in panelboards to satisfy branch circuit requirements under the Scope of Work of this Contract.

.3 Identification: Provide lamacoid plate on each breaker showing voltage, source of supply and load being fed - 120/208 V, 3-phase, 4W or 3W as appropriate.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Moulded Case Circuit Breakers

.1 Moulded Case Circuit Breakers as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide disconnect switches for 347/600 V and 120/208 V distribution as indicated on the Drawings.

1.2 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

2. PRODUCTS

2.1 Disconnect Switches

.1 Ratings: 600 V for 347/600 V distribution, 240 V for 120/208 V distribution. Unless otherwise shown, 3 pole for 3-phase, 3 wire distribution, 3 pole, and solid neutral for 3-phase 4 wire distribution. Ampere ratings as shown on the Drawings or to suit load requirements. For motors, use disconnects switches with HP ratings at least equal to motor HP.

.2 Enclosures: Refer to 26 05 00 Common Work Results - For Electrical

.3 Finish: one (1) primer coat and one (1) finish coat on all metal surfaces, colours as per Section 26 05 00.

.4 Switch mechanisms: quick-make and quick-break action with self-wiping contacts, solderless pressure lug connectors. For switches 100 A and over, provide non-tracking arc shrouds. All switch poles to operate together from a common operating bar. Provide for padlocking disconnect switches in OFF position. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.

.5 Neutral Bars: where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.

.6 Fuse Holders: provide fuse holders (relocatable and suitable without adapters) on load side of switches, ampere rating equal to switch ratings, suitable for fuses specified.

.7 Approved Manufacturers:

.1 Schneider Electric.

.2 Eaton.

.3 Siemens.

2.2 Fuses

.1 All fuses to be 100,000 a (minimum) interrupting capacity of the current limited type. In addition, fuses feeding motors to be of the time delay type. Provide one (1) full set of spare fuses, three (3) for each different ampere rating used, stored in suitable enclosure.

3. EXECUTION

3.1 Disconnect Switches

.1 Mounting: provide supports independent of conduits. Wall-mount where possible, otherwise provided Unistrut frame support. Where switches are grouped mount in uniform arrangement.

.2 Wiring: connect line and load cable to all switches.

.3 Fuse Rating: install so that rating is visible.

.4 Identification: provide lamacoid plate in accordance with Section 26 05 00 and the City of Winnipeg Identification Standard.

.5 Nameplate: Size 3

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Disconnect Switches Fused and Non-Fused Up to 600 V – Primary

.1 Disconnect Switches Fused and Non-Fused Up to 600 V – Primary as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

.3 NEMA ICS 1-2000 (R2015), Industrial Control and Systems: General Requirements.

.2 Canadian Standards Association (CSA)

.1 C22.2 NO. 14-13 - Industrial control equipment

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 26 05 00.

2. PRODUCTS

2.1 Enclosure:

.1 Refer to

2.2 AC Control Relays

.1 Convertible contact type: contacts field convertible from normally open (NO) to normally closed (NC), electrically held, solid state timer. Coil rating: as required. Contact rating: as required.

.2 Sealed contact type: electrically held with required poles and front mounted contact block to provide additional poles. Coil rating: as required. Contact rating: as required.

.3 Fixed contact plug-in type: general purpose with required poles. Coil rating: as required. Contact rating: as required.

2.3 Relay Accessories

.1 Standard contact cartridges: NO - convertible to NC in field.

2.4 Solid State Timing Relays

.1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

.2 Operation: on-delay or off-delay.

.3 Potentiometer: self-contained to provide time interval adjustment.

.4 Supply voltage: 120 VAC, 60 Hz.

.5 Temperature range: -20°C to 60°C.

.6 Output contact rating: maximum voltage 300 VAC or DC. Current:

.7 Timing ranges: minimum 0.1 s, maximum 60 s.

2.5 Instantaneous Trip Current Relays

.1 Contacts: NO, NC automatic reset with adjustable tripping point.

.2 Control: 3 wire, with provision for shorting contacts during accelerating period of motor.

2.6 Pushbuttons

.1 Illuminated, heavy duty oil tight. Operator flush type, as indicated. Green, with 1-NO and 1-NC contacts rated at as required, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labelled "emergency stop".

2.7 Selector Switches

.1 Maintained, 2 or 3 position labelled as indicated heavy-duty oil tight, operator’s wing lever, contact arrangement as indicated, rated as required.

2.8 Indicating Lights

.1 Heavy-duty oil tight, transformer light emitting diode (LED) type, push-to-test, lens colour: as indicated, supply voltage: as required, lamp voltage: as required, labels as indicated.

2.9 Control and Relay Panels

.1 Enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.10 Control Circuit Transformers

.1 Single phase, dry type.

.2 Primary: 600 V, 60 Hz AC.

.3 Secondary: 120 VAC.

.4 Rating: 150 VA minimum.

.5 Secondary fuse as required.

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

3. EXECUTION

3.1 Installation

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

3.2 Field Quality Control

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

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

.3 Check out complete system for operational sequencing.

.4 Submit to Contract Administrator one (1) copy of test results.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Control Devices

.1 Control Devices as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 2:2000 (R2005), Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts

.3 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures

1.2 Starter Requirements

.1 In general, there are two categories of starting equipment for 3-phase motors.

.1 Integral Mounted Starters: some items of mechanical equipment such as boilers, have the starter mounted as part of the equipment. For this equipment, supply disconnects and wire to the terminals of the equipment.

.2 Starters in Motor Control Centres (MCCs): for motors fed from MCC, wire from the equipment to the MCC.

.2 Provide manual starters for all single phase motors unless otherwise indicated.

.3 Provide interlocking between starters where required.

.4 All starter accessories such as pilot lights, Hand-Off-Auto, Start-Stop, etc. whether integrally or remote mounted shall be heavy-duty oil tight, unless otherwise specified.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings in accordance with Section 26 05 00.

.2 Indicate:

.1 Mounting method and dimensions

.2 Starter size and type

.3 Layout of identified internal and front panel components

.4 Enclosure types

.5 Wiring diagram for each type of starter

.6 Interconnection diagrams

1.4 Operation and Maintenance Data

.1 Provide operation and maintenance (O&M) data for motor starters for incorporation into manual specified in Section 26 05 00 and Section 01 78 00 – Closeout Submittals.

.2 Include O&M data for each type and style of starter.

1.5 Maintenance Materials

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

.1 Three (3) contacts, stationary

.2 Three (3) contacts, movable

.3 One (1) contact, auxiliary

.4 One (1) control transformer

.5 One (1) operating coil

.6 Two (2) fuses

.7 10% indicating lamp bulbs used

2. PRODUCTS

2.1 Materials

.1 Starters to NEMA ICS 2.

2.2 Enclosure

.1 Refer to 26 05 00 Common Work Results For Electrical

.2 For all motors 22.4 kW and above, the starters shall contain thermistor control relay and accessories.

2.3 Manual Motor Starters

.1 Manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break

.2 Overload heaters, manual reset, trip indicating handle

.3 Rated volts and poles to suit application

.2 Accessories:

.1 Toggle switch or push-button: heavy duty oil-tight labelled as indicated.

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

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.4 Full Voltage Non Reversing (FVNR) Magnetic Starters

.1 Magnetic and combination magnetic starters of size, type, rating, and enclosure type as indicated 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.

.5 Hand-Off-Auto switches mounted on starter door.

.6 Time delay ON timing relay for staggered starting of motors.

.2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:

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

.2 Independent locking of enclosure door.

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

.3 Accessories:

.1 Pushbuttons or Selector switches: heavy-duty oil tight labelled as indicated.

.2 Indicating lights: heavy duty oil tight type and red pilot light to indicate energized motor circuit and where called for, green pilot light to indicate de-energized motor circuit. Pilot lights to be push-to-test transformer type.

.3 In addition to standard, 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.5 Control Transformer

.1 A control transformer of sufficient VA capacity, dry type, with primary voltage as indicated and 120 V secondary, complete with primary and secondary fuses (HRC Form J), installed in with starter as indicated.

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

2.6 Finishes

.1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.7 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

.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 indicated.

3. EXECUTION

3.1 Starter Verification

.1 Field check motor starters supplied prior to commissioning equipment.

.1 Check of control circuits.

.2 Verify that overload relay installed is correctly sized for motor used.

.3 Record overload relay size and motor nameplate amperage.

.4 Visual inspection of fuses and contactors.

.5 Ensure all connections are tight.

.2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running

.3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

3.2 Overload Relays

.1 For starters provided, select overload relays in accordance with relay and motor Manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time loads, provide special overload relays to suite the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.

.2 Operate switches, 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 indicated.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Motor Starters to 600 V

.1 Motor Starters to 600 V as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Work

.1 Factory integrated with branch circuit protection, power circuit components, control components, and door mounted operator devices into an enclosure, herein referred to a Combination Soft Starters and Controllers.

1.2 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings in accordance with Section 26 05 00.

.2 A submittal package shall be furnished to the Contract Administrator for approval prior to factory assembly of the Soft Starter. The submittal package shall consist of the following:

.1 Elementary diagrams showing factory power and control wiring along with field wiring connections for line and load power connections and control wiring connections.

.2 Voltage, horsepower, current rating, and product features will be furnished from standard catalog sheets.

1.4 Installation, Operation and Maintenance Data

.1 Manufacturer shall provide a copy of installation, operation and maintenance procedures to owner.

.2 Instruction manual shall include programming manuals, wiring diagrams, operating, and maintenance instructions.

1.5 Quality Assurance

.1 Low voltage Soft Starter shall be CSA Certified or ULC Listed.

.2 All Soft Starters shall be 100% factory tested to ensure proper performance.

1.6 Delivery, Storage, and Handling

.1 Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.

.2 Contractor shall inspect and report concealed damage to carrier within 48 hours.

.3 Contractor shall store in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation.

.4 Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish.

.5 Equipment shall be located in well - ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Indoor locations shall be protected to prevent moisture from entering enclosure.

.6 Storage temperatures shall be between -25°C to 65°C.

2. PRODUCT

2.1 Standard of Acceptance

.1 Schneider Electric-Altistart 48

2.2 Approved Manufacturers

.1 Schneider Electric

.2 Eaton

.3 Siemens

2.3 Electrical Ratings

.1 Provide equipment rated as indicated on drawings or as specified below.

.2 Input voltage ratings shall be 600 VAC +10% and –15%.

.3 Input frequency shall be from 45Hz to 65Hz with Auto Tracking Frequency range.

.4 The Soft Starter panel will have a fault withstand rating of 25k AIC for breaker disconnect style devices.

.5 The Soft Starter panel output current ratings shall be capable of continuous operation at a minimum of 100% rated motor full-load current in accordance with CEC Table 44.

.6 The Soft Starter panel shall be designed to operate in an ambient temperature range from 0°C to 40°C and provide minimum 6 (six) starters per hour.

2.4 Description

.1 Refer to Drawings for actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; interrupting and withstand ratings of devices, buses, and components; and other required details.

.2 The soft starter shall be capable of operating a NEMA design B squirrel cage induction motor with a full load current equal to or less than the continuous output current rating of the soft starter.

.3 The soft starter shall be microprocessor controlled and shall consist of a power section, logic board, and field wiring interface terminal board for ease of access to control and power wiring as well as maintenance requirements. The soft starter shall consist of the following general components:

.1 Three sets of back-to-back phased controlled power semiconductors rated 1600 PIV to 600V.

.2 Integral thermal sensor to trip and disengage the soft starter on heat sink over temperature.

.3 Programmable keypad and alphanumerical LCD display that indicates present mode of operation. The LCD keypad shall display programming and diagnostic data in full text.

.4 LED indicators to show the following: On, Start, Run, Soft Stop, Stop, Save/Slow Speed, Dual Set/Reverse, & Fault.

.5 Modbus RTU communications port.

.4 The soft starter input power section shall be designed to operate at either 600 VAC three phase input voltages.

.5 The soft starter output power section shall be designed for three phase NEMA design B.

.6 Soft Starter panels will include control power that is 120 VAC via a control power transformer.

.7 The Soft Starter panel shall include a Mag-Break motor circuit protector with a through-the-door handle interlocked to the enclosure door to provide a local and lockable means of removing all input power from the Soft Starter panel.

.8 Branch circuit protection fuses shall be provided to protect the Soft Starter and bypass contactor. Fuses shall be sized to provide proper branch circuit protection and be coordinated with other power circuit components.

.9 The Soft Starter panel shall be a built-in MCC type.

.10 The Soft Starter panel will include door mounted operator devices and a through the door NEMA 1 door mounted keypad to facilitate programming, control functions and diagnostics.

.11 An AC1 rated Bypass Contactor will be included and controlled by the Soft Starter to allow cooler and more efficient operation during run conditions. The Bypass Contactor shall be of the same manufacturer as the Soft Starter and be an engineered package with no field wiring or installation required. The Bypass Contactor shall function as an “up to speed” (UTS) Bypass for the Soft Starter and as an “Across the Line” (ATL) starter in the event if Soft Starter failure or maintenance.

2.5 Protective and Diagnostic Features

In the event of a fault, the soft starter will have tripped. Faults must be reset to restart operation once their cause has been rectified. The soft starter shall offer the following Faults list:

.1 External Fault (by a digital input)

.2 Frequency out of Range

.3 Heat Sink Over Temperature

.4 Long Start Time

.5 Overcurrent / Jam

.6 Overload

.7 Overvoltage

.8 Phase Loss

.9 Phase Sequence

.10 Shorted SCR

.11 Slow Speed Time

.12 Thermistor Trip

.13 Too Many Starts

.14 Undercurrent

.15 Undervoltage

.16 Wrong Motor Connection

.17 Wrong Parameters

.18 Wrong Wiring Connection

2.6 Features and Adjustments

.1 The Soft Starter panel will be factory programmed to operate all specified optional devices.

.2 The Soft Starter will include user selectable Start user selectable and Stop curves to match starting characteristics to load.

.3 The Soft Starter will include an 80% Kickstart voltage with adjustable Kickstart time.

.4 The Soft Starter will include user programmable Starting Voltage.

.5 The Soft Starter will include user programmable Starting Current.

.6 The Soft Starter will include user programmable Current Limit.

.7 The Soft Starter will include user programmable Acceleration and Deceleration times.

.8 The Soft Starter will include user programmable Auto Reset for Phase Loss and Undervoltage Fault.

.9 The Soft Starter will include Dual Setting functionality to allow setting a second set of basic motor parameters.

.10 For diagnostic assistance, the Soft Starter shall record and store in its memory run status and fault type of the past 10 faults and provided detailed information on soft starter operating conditions at the time of fault.

.11 Three user programmable inputs with the following functions:

.1 Energy Savings Mode, Slow Speed or Reset.

.2 Dual Adjust, Reversing or Reset.

.3 External Fault

.12 The Soft Starter shall have one (1) dedicated thermistor input that is programmable for PTC or NTC type thermistors.

.13 The Soft Starter shall provide an adjustable 4-20ma analog output signal that is proportional the motor current.

.14 Multiple configurations and all parameters can be save to a computer file via a PC communication kit.

2.7 Operator Controls

.1 The Soft Starter control power and digital inputs will be 120 VAC.

.2 All Soft Starters will include pull a-part terminals for its control connections.

.3 The Soft Starter panel shall have a control terminal strip for field I/O wiring.

.4 The Soft Starter will include four (4) customer safety interlocks.

.5 The Soft Starter will include an Auto Run Input.

.6 The Soft Starter will include fault relay outputs.

.7 The Soft Starter will include auxiliary run relay outputs.

.8 The Soft Starter will include three (3) programmable logic inputs.

.9 The Soft Starter will include one (1) scalable analog output.

.10 All Soft Starter panel door mounted operators will be industrial rated devices.

.1 Operator controls and indicating devices shall include: Soft Starter Keypad, Fault Light Hand-Off-Auto Switch, Run Light, Off Light and Fault Lights, Soft Starter Bypass.

2.8 Keypad Interface and Status LEDs

.1 The Soft Starter shall be supplied with a backlit alphanumeric Liquid Crystal Display (LCD) Multi-Function Keypad. The Keypad shall be capable of programming and monitoring the Soft starter.

.2 The Soft Starter shall display operating data, fault information, and programming parameters in English.

.3 The keypad shall display the last 10 faults and provides detailed information on soft starter operating conditions at the time of fault occurrence.

2.9 Network Communications

.1 The Soft Starter shall include Modbus RTU communication protocol.

3. INSTALLATION AND EXECUTION

3.1 Examination

.1 The Contractor shall perform the following procedures:

.1 Examine installation area to assure there is enough clearance to install panel.

.2 Check mounting surfaces for uniformity and level surface.

.3 Inspect for any physical damage

.4 Verify that equipment is ready to install.

.5 Verify field measurements are as instructed by Manufacturer.

.6 Verify that required utilities and control interfaces are available, in proper location and ready for use.

.7 Beginning of installation means installer accepts conditions.

3.2 Location and Installation

.1 The Contractor shall perform the installation.

.1 The Contractor shall install Soft Starter in accordance with referenced standards.

.2 Install per Manufacturer's instructions outlined in installation, operation and maintenance documentation.

.3 Install required safety labels.

3.3 Start-Up and Training

.1 Manufacturer shall have factory trained personnel at field locations convenient to the Site, available for trouble-shooting and/or start-up assistance.

.2 Soft Starter operational and maintenance training and/or start-up service shall be provided.

.1 Product installation must be complete prior to start-up services being provided.

.3 Personnel performing start-up must check / adjust Soft Starter settings circuit breakers, switches, doors, operating handle for proper mechanical and/or electrical operation.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.

.2 Operate switches, 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 indicated

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Combination Soft Starters and Controllers

.1 Combination Soft Starters and Controllers as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Section Includes

.1 Natural gas engine driven generator set 300kW rating, 600V, 3 phase.

1.2 References

.1 American National Standards Institute (ANSI)/National Electrical Manufacturers' Association (NEMA)

.1 ANSI/NEMA MG1-2016, Motors and Generators.

.2 Canadian Standards Association (CSA)

.1 CSA C282-15 - Emergency Electrical Power Supply for Buildings.

.2 CSA B149.1-15- Natural Gas and Propane Installation Code Interactive Standard.

.3 International Organization for Standardization (ISO)

.1 ISO 15550:2002 Internal Combustion Engines - Determination and Method for the Measurement of Engine Power - General Requirements.

.2 ISO 3046-1:2002, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations Of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional Requirements for Engines for General Use.

1.3 System Description

.1 The generating system shall be designed to be installed within the space limitations as indicated on the drawings. This includes generator, heat exchangers and exhaust system.

.2 Generating system consists of:

.1 Natural gas engine.

.2 Alternator.

.3 Alternator control panel.

.4 Automatic transfer equipment, including closed transition re-transfer and manual by-pass switch.

.5 Battery charger and battery.

.6 Automatic engine room ventilation system.

.7 Fuel supply system.

.8 Exhaust system (silencer, flexible pipe connector and thimble).

.9 Steel mounting base with vibration isolation springs.

.3 System designed to operate as emergency standby power source and shall be meet CSA C282.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 26 05 00.

.2 Include:

.1 Engine: make and model, with performance curves.

.2 Alternator: make and model.

.3 Voltage regulator: make, model and type.

.4 Automatic transfer switch: make, model and type.

.5 Manual bypass switch: make and model.

.6 Battery: make, type and capacity.

.7 Battery charger: make, type and model.

.8 Alternator control panel: make and type of meters and controls.

.9 Governor type and model.

.10 Automatic engine room ventilation system.

.11 Cooling air requirements in m^3/s.

.12 British standard or DIN rating of engine.

.13 Flow diagrams for:

.1 Fuel.

.2 Cooling air.

.14 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.

.15 Continuous full load output of set at 0.8PF lagging.

.16 Description of set operation including:

.1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.

.2 Manual starting.

.3 Automatic shut down and alarm on:

.1 Overcranking.

.2 Overspeed.

.3 High engine temp.

.4 Low lube oil pressure.

.5 Short circuit.

.6 Alternator overvoltage.

.7 Lube oil high temperature.

.8 Over temperature on alternator.

.4 Manual remote emergency stop.

1.5 Closeout Submittals

.1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:

.1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.

.2 Technical data:

.1 Illustrated parts lists with parts catalogue numbers.

.2 Schematic diagram of electrical controls.

.3 Flow diagrams for:

.1 Fuel system.

.2 Lubricating oil.

.3 Cooling system.

.4 Certified copy of factory test results.

.5 Maintenance and overhaul instructions and schedules.

.6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.6 Warranty

.1 For Work of this Section, 12 month warranty period prescribed is extended to 60 months or 1500 operating hours, whichever occurs first.

1.7 Extra Materials

.1 Provide maintenance materials in accordance with E8 - Closeout Submittals.

.2 Include:

.1 2 fuel filter replacement elements.

.2 2 lube oil filter replacement elements.

.3 2 air cleaner filter elements.

.4 2 sets of fuses for control panel.

.5 Special tools for unit servicing.

1.8 Source Quality Control

.1 Factory test generator set including engine, alternator, control panels, and accessories in presence of Contract Administrator.

.2 Notify Contract Administrator 5 days in advance of date of factory test.

.3 Test procedure:

.1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:

.1 Date.

.2 Generator set serial no.

.3 Engine, make, model, serial no.

.4 Alternator, make, model, serial no.

.5 Voltage regulator, make and model.

.6 Rating of generator set, kW, kV.A, V, A, r/min, Hz.

.2 Mark check sheet and record data on forms in duplicate as test proceeds.

.3 Contract Administrator 's signature on completed forms to indicate concurrence in results of test.

.4 Tests:

.1 With 100% rated load, operate set for 6 h, taking readings at 30 min intervals, and record following:

.1 Time of reading.

.2 Running time.

.3 Ambient temp in C.

.4 Lube oil pressure in kPa.

.5 Lube oil temp in C.

.6 Engine coolant discharge temp in C.

.7 Exhaust stack temp in C.

.8 Alternator voltage: phase 1, 2, 3.

.9 Alternator current: phase 1, 2, 3.

.10 Power in kW.

.11 Frequency in Hz.

.12 Power Factor.

.13 Battery charger current in A.

.14 Battery voltage.

.15 Alternator cooling air outlet temp.

.2 After completion of 6 h run, demonstrate following shut down devices and alarms:

.1 Overcranking.

.2 Overspeed.

.3 High engine temp.

.4 Low lube oil pressure.

.5 Short circuit.

.6 Alternator overvoltage.

.7 Low battery voltage, or no battery charge.

.8 Manual remote emergency stop.

.9 High alternator temperature.

.3 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:

.1 No load to full load to no load.

.2 No load to 70% load to no load.

.3 No load to 20% load to no load.

.4 20% load to 40% load to no load.

.5 40% load to 60% load to no load.

.6 60% load to 80% load to no load.

.5 Demonstrate:

.1 Automatic starting of set and automatic transfer of load on failure of normal power.

.2 Automatic shut down of engine on resumption of normal power.

.3 That battery charger reverts to high rate charge after cranking.

.6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

.7 All tests to be repeated on site in their entirety.

2. PRODUCTS

2.1 Approved Manufacturers

.1 Engine, alternator to be supplied by a single Manufacturer

.2 Approved Manufacturer:

.1 Cummins Inc.

.2 Kohler Co.

2.2 Natural Gas Engine

.1 Natural gas engine:.

.1 Engine: standard product of current manufacture, from company regularly engaged in production of such equipment.

.2 Turbo charged and after cooled, synchronous speed 1800 r/min.

.3 Capacity:

.1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load.

.1 Under following site conditions:

.1 Altitude:250 m.

.2 Ambient temperature: 40 degrees C.

.3 Relative humidity: 95 %.

.2 Minimum of 300 kW and must be suitable for starting two (2) 100 kW pumps with soft starters. The two (2) pumps will be started individually with a 30 second delay between load steps.

.4 Cooling System:

.1 Liquid cooled: Heavy duty industrial shell and tube heat exchangers.

.2 Sized to maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40 degrees C.

.3 Engine driven pumping with anti-freeze non-sludging above minus 46 degrees C.

.4 Design heat exchanger system based on the following criteria:

.1 16°C cold side approach temperature.

.2 17°C delta T cold side temperature rise maximum

.3 1,100 liters per minute cold side flow with a max pressure drop of 70 kPa.

.4 Ambient temperature of 40°C

.5 All heat exchangers and expansion tanks shall be skid mounted with generator unit and include all interconnecting piping.

.6 Supply and install temperature indicators on all inlets and outlets.

.7 Provide manual balancing valve to set flow rate. Pressure regulating valves not allowed.

.8 All valves to be failsafe (fail open).

.9 Single point connections for supply and discharge.

.10 Block heater: thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0 degrees C.

.1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.

.5 Fuel:

.1 Natural gas

.6 Fuel system:

.1 Natural Gas train to CSA B149.1 Natural Gas and Propane Installation Code.

.7 Inlet system: Air cleaner housing with cartridge type air filter(s).

.8 Governor:

.1 Electronic type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.

.9 Lubrication system:

.1 Pressure lubricated by engine driven pump.

.2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.

.3 Lube oil cooler.

.4 Engine sump drain valve.

.5 Oil level dip-stick.

.10 Starting system:

.1 Positive shift, gear engaging starter 24V dc.

.2 Cranking limiter to provide 3 cranking periods of 10s duration, each separated by 5 s rest.

.3 Lead acid, 24V storage battery with sufficient capacity to crank engine for 1min at 0 degrees C without using more than 25% of ampere hour capacity.

.4 Battery charger : constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: plus or minus 1% output for plus or minus 10% input variation. Automatic boost for 6h every 30 days. Equipped with dc voltmeter, dc ammeter and on-off switch. Minimum charger capacity: 10 A.

.5 Batteries to be housed in rack or cabinet complete with cover to guard against accidental contact.

.11 Vibration isolated engine instrument panel with:

.1 Lube oil pressure gauge.

.2 Lube oil temperature gauge.

.3 Lube oil level gauge.

.4 Coolant temperature gauge.

.5 Coolant level gauge.

.6 Running time meter: non-tamper type.

.12 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

.13 Drip tray.

2.3 Alternator

.1 Alternator: to ANSI/NEMA MG1.

.2 Rating: 3phase, 600 V, 3 wire, 300 kW (minimum), 60Hz, at 0.8PF.

.3 Output at 40 degrees C ambient:

.1 100% full load continuously.

.2 110% full load for 1h.

.3 150% full load for 1 min.

.4 Revolving field, brushless, single bearing.

.5 Drip proof.

.6 Amortisseur windings.

.7 Synchronous type.

.8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.

.9 Exciter: permanent magnet.

.10 NEMA MG-1 Class 180 insulation on windings.

.11 Thermistors or platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.

.12 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:

.1 Stability: 1% maximum voltage variation at any constant load from no load to full load.

.2 Regulation: 2% maximum voltage deviation between no-load steady state and full-load steady state.

.3 Transient: 15% maximum voltage dip on one-step application of 0.8PF full load.

.4 Transient: 10% maximum voltage rise on one-step removal of 0.8PF full load.

.5 Transient: 5 s maximum voltage recovery time with application or removal of 0.8PF full load.

.13 Alternator: capable of sustaining 300% rated current for period not less than 10s permitting selective tripping of down line protective devices when short circuit occurs.

2.4 Control Panel

.1 Totally enclosed, wall mounted.

.2 Instruments:

.1 Digital 100% solid state circuitry indicating type 2% accuracy, rectangular face, flush panel mounting:

.1 Voltmeter: ac, scale 0 to 1000 V, 3 Phase (L-L & L-N).

.2 Ammeter: ac, scale 0 to 1000 A, (3 Phase & total).

.3 Wattmeter scale 0 to 1000 kW, 3 Phase & total.

.4 Frequency meter: scale 55 to 65Hz.

.5 kVA, Total.

.6 kVAR, Total.

.7 kW.h, Total.

.8 kVAR.h, Total.

.9 PF, average total & per phase.

.10 DC voltage.

.11 Coolant temperature.

.12 Oil pressure.

.13 RPM.

.14 Hours run.

.15 System diagnostic

.2 All functions to be selected by keypad.

.3 Instrument Transformers

.1 Potential-dry type for indoor use:

.1 Ratio: 600 to 120.

.2 Rating: 600 V, 60Hz, BIL 10 kV.

.2 Current-dry type for indoor use:

.1 Ratio: as required.

.2 Rating: 600 V, 60Hz, BIL 10 kV.

.3 Positive action automatic short-circuiting device in secondary terminals.

.3 Controls:

.1 Engine start button.

.2 Selector switch: Off-Auto-Manual - Test (at full load or test at no load).

.3 Engine emergency stop button and provision for remote emergency stop button.

.1 Alternator output breaker:

.1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40 degrees C ambient, dual thermal-magnetic trip.

.2 Voltage control rheostat: mounted on inside of control panel.

.3 Operating lights, panel mounted:

.1 "Normal power" pilot light.

.2 "Emergency power" pilot light.

.3 Green pilot lights for breaker on and red pilot lights for breaker off.

.4 Solid state indicator lights for alarm, according to CSA C282, with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:

.1 Low engine temperature.

.2 Low battery voltage.

.3 Ventilation failure.

.4 Low coolant level.

.5 Automatic transfer switch in bypass mode.

.5 Solid state controller for automatic shutdown and alarms, according to CSA C282, with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:

.1 Engine overcrank.

.2 Engine overspeed.

.3 Engine high temperature.

.4 Engine low lube oil pressure.

.5 Short circuit.

.6 AC over voltage.

.7 Control switch not in auto.

.6 Lamp test button.

.7 Provision for remote monitoring.

2.5 Automatic Transfer Switch

.1 Automatic transfer switch to meet Section 26 36 23 – Automatic Load Transfer Equipment.

2.6 Steel Mounting Base

.1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.

.2 Assembly fitted with vibration isolators.

.1 Spring type isolators with adjustable side snubbers and adjustable for levelling.

.3 Sound insulation pads for installation between isolators and concrete base.

2.7 Exhaust system

.1 Refer also to Mechanical drawings.

.2 Heavy duty critical grade horizontally mounted exhaust silencer with condensate drain, plug and flanged couplings. Minimum 20 dBA noise reduction at engine rated output.

.3 Insulated, ULC listed wall thimble complete with rain guard.

.4 Heavy duty flexible engine to exhaust system connector, bellows type with flanged couplings.

.5 Fittings and accessories as required.

.6 Mineral wool insulated exhaust system.

.7 The exhaust system shall be designed to accommodate the room dimensions and associated space limitations.

.8 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion, flanged ends.

2.8 Fuel System

.1 To CSA B149.1 Natural Gas and Propane Installation Code.

.2 Shut-off cock.

.3 Renewable cartridge filter.

.4 Dual valves.

2.9 Cooling Air System

.1 Engine ventilating system:

.1 Refer to Division 23.

2.10 Equipment Identification

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

.2 Control panel:

.1 Size 4 nameplates for controls including alternator breakers and program selector switch.

.2 Size 2 nameplates for meters, alarms, indicating lights and minor controls.

2.11 Fabrication

.1 Shop assemble generating unit including:

.1 Base.

.2 Engine and radiator.

.3 Alternator.

.4 Control panel.

.5 Battery and charger.

.6 Automatic transfer equipment.

2.12 Finishes

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

.2 Alternator control cubicle: paint inside, exterior to match engine and alternator.

.3 Exhaust and inlet air hoods international orange.

.4 Other ducts and racks grey.

.5 Supply 0.25L of grey touch-up enamel.

3. EXECUTION

3.1 Installation

.1 Locate generating unit and install as indicated.

.2 Install fuel supply system as indicated.

.3 Install ventilating air duct system as indicated.

.4 Pipe muffler drains to nearest floor drain.

.5 Complete wiring and interconnections as indicated.

.6 Start generating set and test to ensure correct performance of components.

3.2 Field Quality Control

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

.2 Notify Contract Administrator 10 working days in advance of test date.

.3 Supply and connect load bank for on-site testing.

.4 Demonstrate:

.1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.

.2 Unit start and shut down on "Manual" control

.3 Unit start and transfer on "Test" control.

.4 Unit start on "Engine start" control.

.5 Operation of manual bypass switch.

.6 Operation of automatic alarms and shut down devices.

.5 Run unit on load for minimum period of 6 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.

.6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Power Generation Natural Gas

.2 Power Generation Natural Gas as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-C61869-1:14 - Instrument transformers - Part 1: General requirements (Adopted IEC 61869-1:2007, edition 1.0:2007, with Canadian deviations)

.2 CAN/CSA-C61869-2:14 - Instrument transformers - Part 2: Additional requirements for current transformers (Adopted IEC 61869-2:2012, edition 1.0:2012, with Canadian deviations).

.3 CSA C22.2 NO. 5-16 - Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE-2016)

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.2 System Description

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.3 Submittals

.1 Include:

.1 Make, model and type.

.2 Load classification:

.1 Tungsten lamp load: as indicated in kW.

.2 Ballast lamp load: as indicated in kW.

.3 Motor load: as indicated in kW.

.4 Restricted use: resistance and general loads, 0.8 pf or higher as indicated in kW.

.3 Single line diagram showing controls and relays.

.4 Description of equipment operation including:

.1 Automatic starting and transfer to standby unit and back to normal power.

.2 Test control.

.3 Manual control.

.4 Automatic shutdown.

1.4 Closeout Submittals

.1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.2 Detailed instructions to permit effective operation, maintenance and repair.

.3 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

2. PRODUCTS

2.1 Materials

.1 Contactors: to ANSI/NEMA ICS2.

2.2 Contactor Type Transfer Equipment

.1 Two (2) 3 phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, motor operated, as indicated.

.2 Rated: 600 V, 60 Hz, 600 A, 4 wire, solid neutral as indicated on Electrical Drawings.

.3 Main contacts: silver surfaced, protected by arc disruption means.

.4 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors. Provide complete bypass – isolation type switch.

.5 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.6 Fault withstand rating: as required in 25 kA symmetrical for three (3) cycles.

.7 Lever to operate switch manually when switch is isolated.

.8 Solid neutral bar, rated: as indicated.

.9 Overlapping neutral contacts on contactor type transfer equipment.

.10 Solid state electronic in phase monitor as indicated.

2.3 Controls

.1 Selector switch - four position "Test", "Auto", "Manual", "Engine start".

.1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.

.2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.

.3 Manual position - Transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.

.4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120 V secondary to isolate control circuits from:

.1 Normal power supply.

.2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

.1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.

.2 Time delay: normal power to standby, adjustable solid state, zero (0) to sixty (60) seconds.

.3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, zero (0) to sixty (60) seconds delay.

.4 Time delay on retransfer from standby to normal power, adjustable zero (0) to sixty (60) seconds.

.5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, five (5) second intervals to one hundred eight (180) seconds.

.6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, five (5) second intervals to one hundred eight (180) seconds.

.7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.4 Solid state electronic in-phase monitor as indicated.

.5 Switchable neutral pole on circuit breaker type equipment.

2.4 Accessories

.1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.

.2 Plant exerciser: one hundred sixty eight (168) hour timer to start standby unit once each week for selected interval but does not transfer load from normal supply. Timer adjustable zero (0) to one hundred sixty eight (168) hour in fifteen (15) minute intervals.

.3 Auxiliary relay to provide 1 N.O. and 1 N.C. contacts for remote alarms for ATS in generator supply and selector switch in “AUTO”.

.4 Instruments:

.1 Analogue or Digital true rms, indicating type 2% accuracy, flush panel mounting:

.1 Voltmeter: ac, scale 0 to 600 V as indicated.

.2 Ammeter: ac, scale 0 to 600 A as indicated.

.3 Frequency meter: scale 55 to 65 Hz.

.5 Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C".

.6 Potential transformers - dry type for indoor use:

.1 Ratio: 600 to 120.

.2 Rating: 600 V, 60 Hz, BIL 5 kV.

.3 Accuracy rating: 2%.

.7 Ammeter selector switch: rotary, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".

.8 Current transformers - dry type for indoor use:

.1 Ratio: 600A: 5A

.2 Rating: 600 V, 60Hz, BIL 5 kV.

.3 Accuracy rating: 2%.

.4 Positive action automatic short- circuiting device in secondary terminals.

.9 Manual bypass: complete with unit to isolate switch for maintenance purposes.

2.5 Equipment Identification

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

.2 Control panel:

.1 For selector switch and manual switch: size 5 nameplates.

.2 For meters, indicating lights, minor controls: size 3 nameplates.

.3 Nameplates to include: voltage, amperage and # of phases.

2.6 Approved Manufacturers

.1 Shall be provided by generator manufacturer in individual enclosure.

2.7 Source Quality Control

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.

.2 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

.4 In-phase monitor operation.

.3 Provide copy of test reports and include with Operations Manual as per Section 01 78 00 – Closeout Submittals.

3. EXECUTION

3.1 Installation

.1 Locate, install and connect transfer equipment.

.2 Check relays, solid state monitors and adjust as required.

.3 Install and connect battery and remote alarms.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 01 91 13 – General Commissioning Requirements.

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

.7 Repeat, at one (1) hour intervals, three (3) times, complete test with selector switch in each position, for each test.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Automatic Transfer Switch

.1 Automatic Transfer Switch as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical, Instrumentation and Control Systems” including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Description:

.1 Provide Surge Protection Devices (SPDs) components in Motor Control Centre as indicated on the Drawings.

.2 The components shall provide protection for electrical and electronic devices against the damaging effects of surges, transients and electrical line noise.

1.2 References:

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

.1 ANSI/IEEE C62.41.1-2002- IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits.

.2 ANSI/IEEE C62.45-2002- Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

.2 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.3 Canadian Standards Association (CSA)

.1 C22.2 NO. 8-13 - Electromagnetic interference (EMI) filters]

.4 Defense Logistics Agency - DLA Land and Maritime

.1 MIL-STD-220C, Method of Insertion Loss Measurement

.5 Underwriters Laboratories Inc. (UL):

.1 UL 1449: Standard for Safety, Surge Protective Devices.

.2 UL 1283: Standard for Safety, Electromagnetic Interference Filters.

1.3 Submittals:

.1 Submit the following in accordance with Section 26 05 00:

.1 Shop Drawings, Manufacturer's product data, and component ratings in accordance with this Section and the requirements of Section 26 05 00.

.2 SPD type, model number, system voltage, phases, modes of protection, Maximum Continuous Operating Voltage (MCOV) Voltage Protection Rating (VPR), Short Circuit Current Rating (SCCR), and Nominal Discharge Current (In).

.3 Provide outline Drawings and internal wiring diagrams.

.4 List all required installation criteria including circuit breaker trip rating to meet UL 1449.

.5 Identify all cable sizes, distance limits and accessory devices when SPD units are to be provided in separate enclosures, where applicable.

.6 For informational/purposes only, submit installation instructions and separate from all other submittals.

.2 UL 1449 listing and summary of factory test data.

1.4 Quality Assurance:

.1 SPD units and all components shall be designed manufactured and tested in accordance with the latest applicable UL 1449.

1.5 Warranty and Service:

.1 Provide in accordance with Section 26 05 00

.2 The Surge Protection Device (SPD) manufacturer is to warranty the components against defective materials and workmanship for a period of five years following delivery from the Manufacturer.

2. PRODUCTS

2.1 Manufacturers:

.1 Surge Protection Device components.

.1 Eaton.

.2 Schneider Electric.

.3 Siemens.

2.2 Provisions:

.1 Environmental Requirements:

.1 Operating Temperature: minus 40°C to 60°C.

.2 Relative Humidity: 5 to 95%.

.3 Operating Altitude: 0 to 12,000 Feet (0 to 3,660 meters).

.4 Audible Noise: Less than 35 dBA at 3 feet (1 m).

.2 Electrical Requirements:

.1 The maximum continuous operating voltage of all suppression components utilized is not to be less than 115% of the nominal operating voltage at the installed location.

.2 The SPD components are to be rated as follows:

600V MCC	240 kA per phase 120 kA per mode

.3 The mode of operation is to protect against surges and transients as follows:

System Configuration	Protection Mode
Single Phase, Two Wire (L,N) + Ground	L to G,L to N, and N to G
Single Phase, Two Wire (L,L) + Ground	L to L, and L to G
Split Phase, Three Wire + Ground	L to L, L to G,L to N, and N to G
Three Phase, Three Wire (Delta) + Ground	L to L, and L to G
Three Phase, Four Wire (Wye) + Ground	L to L, L to G,L to N, and N to G

2.3 Operation:

.1 The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor. The system shall not use silicone avalanche diodes, air gaps or other methods of suppression.

.2 Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHZ.

.3 SPD shall provide surge current diversion between each phase conductor and the neutral conductor, between each phase conductor and ground and between the neutral conductor and ground. For delta systems, the SPD shall have components directly connected between each phase conductor and between each phase conductor and ground.

.4 The SPD shall provide a low impedance path for surge current using oversized conductors with equal impedance paths to each suppression element. Plug-in style connections or printed circuit boards for use in the path of surge current shall not be used.

.5 Operating Parameters:

.1 The maximum response time shall not exceed 1 nanosecond.

.2 Provide with a noise filtering system capable of managing noise levels produced by electro-magnetic interference and radio frequency interference. The noise filtering system shall reject a minimum of 50 db at 100 kHz as measured by the 50 Ohm Insertion Loss Method (MIL-STD-220C).

.3 The parallel system components shall operate over a minimum frequency range of 47 Hertz to 63 Hertz.

.4 The SPD components shall limit total harmonic distortion produced to less than one percent.

.5 SPD component ratings to be per UL 1449.

.6 Each unit shall be factory tested at the maximum continuous operating voltage and short circuit tested, prior to delivery.

.6 Product Components:

.1 Protection and Filtering Elements:

.1 The SPD components shall consist of replaceable protection modules designed to suppress and divert transient voltages and surge currents. Each protection module

shall contain one or more individually fused metal oxide varisters capable of withstanding over 1000 surges of Category C (ANSI/IEEE C62.41.1) current rated at 10,000 amperes.

.2 Each protection module shall contain filtering elements capable of providing noise attenuation.

.3 The SPD components shall substantially limit transient waveform rise-time characteristics. The components are to be configured as parallel connected, current carrying elements designed to enhance the surge suppression and diversion performance of the protection modules.

.2 Provide individual fusing to allow the SPD to be isolated during fault conditions.

.3 Provide red and green solid-state status lights which indicate operational status of each unit and visual diagnostic monitoring of each component and module. Provide audible alarm to activate on fault condition, with a silence switch and push-to-test alarm switch.

.4 Provide surge counter with battery backup to retain memory upon loss of AC power.

.5 Provide remote status monitoring with form C dry contacts monitoring all phases.

2.4 Shop Testing:

.1 Perform factory performance testing on each unit.

.2 Tests shall be in accordance with the following standards:

.1 ANSI/IEEE C62.41.1 Cat. A, B, & C.

.2 ANSI/IEEE C62.45.

.3 UL 1449.

.3 Submit certified documentation of all factory tests performed.

.4 Perform above tests in addition to standard factory tests.

2.5 Spare Parts:

.1 Provide in accordance with Section 01 78 00 – Closeout Submittals and as specified.

.2 Provide one (1) spare protection module of each type for on-site spare parts purposes.

3. EXECUTION

3.1 Inspection:

.1 Visually inspect delivered unit(s) and accessories for conformance with Drawings and Specifications. Replace all components found to exhibit defects.

3.2 Installation:

.1 Install unit in compliance with the Manufacturer's printed instructions. All electrical installation work shall be in accordance with UL Listing Requirements and applicable Canadian Electrical Code.

.2 Verify UL 1449 label is provided on each unit.

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Surge Protection Devices

.1 Surge Protection Devices as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical, Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

END OF SECTION

1. GENERAL

1.1 Scope of Work

.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

1.2 Section Includes

.1 Commissioning of all building electrical systems and component including:

.1 Testing and adjustment.

.2 Demonstrations and Instruction.

.3 Instructions of all procedures for City personnel.

.4 Updating as-built data.

.5 Co-ordination of Operation and Maintenance material.

1.3 Commissioning

.1 Further to Section 01 91 13 – General Commissioning Requirements, the purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.

.2 The commissioning activities shall be co-ordinated by the Contractor.

.3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

.4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the commissioning exercise.

.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification.

1.4 Submittals

.1 A commissioning document shall be prepared by the Contractor prior to conducting these activities for use by the Commissioning Team.

.2 The electrical Subcontractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the Contractor.

.3 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the Contract Administrator and Commissioning Team prior to the start of the commissioning activities.

1.5 Preparation

.1 Provide test instruments required for all activities as defined in the commissioning documents.

.2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.

.3 Confirm all scheduled activities have identified personnel available.

.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

1.6 System Description

.1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.

.2 The City will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

.4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.5 Conduct presentation on the City's premises. The City will provide space.

1.7 Final Report

.1 This trade shall assemble all testing data and commissioning reports and submit them to the Contract Administrator.

.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

4. METHOD OF MEASUREMENT AND PAYMENT

4.1 Method of Measurement and Payment

.1 Commissioning of Electrical Systems

.1 Commissioning of Electrical Systems as described in this Specification will be paid for at the Contract Lump Sum Price for "Electrical, Instrumentation and Control Systems" including all items incidental to the Work included in this Specification.

END OF SECTION