FIELD CONTROL DEVICES

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the PLC Control System: transmitters, sensors, controls, meters, switches, transducers, and low voltage current transformers.

.2 Related Sections:

.1 The City of Winnipeg Standard Construction Specification CW1110 – General Instructions

.2 Section 26 05 01 - Common Work Results - Electrical.

.3 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

.1 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

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

.1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).

.1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).

.1 CSA-C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with The City of Winnipeg Standard Construction Specification CW1110 – General Instructions.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 EXISTING CONDITIONS

.1 Repair surfaces damaged during execution of Work.

.2 Turn over to Contract Administrator existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof and heat resistant assembly.

.3 Operating conditions: 0 - 32 °C with 10 – 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4X enclosures.

.8 Range: including temperature, humidity, pressure, as indicated in Control Narratives.

.9 All devices shall be CSA certified.

2.2 TEMPERATURE SENSORS

.1 General: to be resistance type to following requirements:

.1 RTD's: 100 or 1000 ohm at 0 °C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm °C.

.2 Sensing element: hermetically sealed.

.3 Stem and tip construction: type 304 stainless steel.

.4 Time constant response: less than 3 seconds to temperature change of 10 °C.

.5 Room temperature sensors to be wall mounting, in slotted type covers having brushed stainless steel finish, with guard.

.6 Separate mounting base for ease of installation.

.7 Stability 0.02 °C drift per year.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 °C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 °C per volt change.

.3 Output signal: 4 - 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale / 50 °C.

.10 Long term output drift: not to exceed 0.25 % of full scale / 6 months.

.2 Instrument calibrated range:

.1 P600-TE1/P600-TT1: 0 to 50 °C

.2 P650-TE1/P650-TT1: 0 to 50 °C

.3 S600-TE1/S600-TT1: 0 to 50 °C

.4 S650-TE1/S650-TT1: 0 to 50 °C

.5 U600-TE1/U600-TT1: 0 to 50 °C

.6 U605-TE4/U605-TT4: 0 to 50 °C

.7 U610-TE1/U610-TT1: 0 to 50 °C

.8 H600-TE1/H600-TT1: 0 to 50 °C

.9 H700-TE1/H700-TT1: 0 to 50 °C

.10 H725-TE1/H725-TT1: 0 to 50 °C

.11 H765-TE1/H765-TT1: 0 to 50 °C

2.4 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.02 % of full scale output over entire range.

.5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 °C.

.6 Over-pressure input protection to at least twice rated input pressure.

.7 Output short circuit and open circuit protection.

.8 316SS diaphragm seal with silicon oil.

.9 Accuracy: plus or minus 0.02% of Full Scale.

.2 Instrument calibrated range:

.1 S638-PT: -250 to 250 Pa

.2 S639-PT: -250 to 250 Pa

.3 S735-PT: -1000 to 250 Pa

.4 S745-PT: -1000 to 250 Pa

2.5 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically and reset automatically

.2 Adjustable setpoint, 0 to 50 °C, with a differential.

.3 Accuracy: plus or minus 1 °C.

.4 Snap action rating: 24V DC as required. Switch to be DPST for hardwire.

.5 Type as follows:

.1 Room: for wall mounting on standard electrical box with protective guard as indicated.

.2 Instrument initial setpoint:

.1 P600-TSL1: 4 °C

.2 P650-TSL1: 4 °C

.3 P600-TSL: 12 °C

.4 S600-TSL1: 4 °C

.5 S650-TSL1: 4 °C

2.6 GAS DETECTION

.1 Requirements:

.1 Supply voltage: 16 to 30 V DC

.2 Output signal: 4-20 mA into 500 ohm maximum load.

.3 Calibrated gas: Carbon monoxide (CO)

.4 Enclosure rating: NEMA 4X & NEMA 7

.5 Local display: 2 line, 20 character LCD.

.6 Ambient conditions:

.1 Temperature: -40 to 65 °C

.2 Humidity: 0 to 100 %

.2 Instrument calibrated range:

.1 U605GT-AE1/U605GT-AT1: 0 to 100 ppm

.2 U605GT-AE2/U605GT-AT2: 0 to 100 ppm

.3 U605GT-AE3/U605GT-AT3: 0 to 100 ppm

.3 Acceptable Product: Drager Polytron 2 XP Tox; no exceptions

2.7 CURRENT SENSING RELAYS

.1 Requirements:

.1 Suitable to detect belt loss or motor failure.

.2 Trip point adjustment, output status LED.

.3 Split core for easy mounting.

.4 Induced sensor power.

.5 Relay contacts: capable of handling 0.5 amps at 120 Vac / 24 Vdc. Output to be NO solid state.

.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.

.7 Adjustable latch level.

2.8 WIRING

.1 In accordance with Section 26 27 26 - Wiring Devices.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:

.1 Field wiring to digital device: #14 AWG minimum.

.2 Analog input and output: shielded #18 AWG minimum stranded twisted pair.

Part 3 Execution

3.1 INSTALLATION

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

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

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

.1 Enclosure shall have a NEMA 4X rating if located on the plant floor.

.2 Enclosure shall have a NEMA 12 rating if located in a climate controlled electrical or mechanical room.

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

.5 Electrical:

.1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Contract Administrator before beginning Work.

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

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

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

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

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

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

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

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4X enclosures.

.4 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

.2 Wire multiple sensors in series for low temperature protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use software averaging algorithm to derive overall average for control purposes.

3.3 PANELS

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

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

.3 Identify wiring and conduit clearly.

3.4 PRESSURE SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

3.5 IDENTIFICATION

.1 Identify field devices with a size 8 nameplate in accordance with Section 26 05 01 – Common Work Results - For Electrical.

3.6 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance.

.2 Demonstrate to Contract Administrator and City Personnel operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This specification shall define the electrical and mechanical components that make-up the PLC control panels.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

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

.2 CSA C22.2 No.158, Terminal Blocks.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with The City of Winnipeg Construction Specifications Section CW1110 – General Instructions.

.2 Include:

.1 Outline sketch showing ratings, dimensions and weights

.2 User manual that shall include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step-by-step operating procedures and general maintenance guidelines.

1.5 WARRANTY

.1 The panel manufacturer shall warrant the PLC against defects in materials and workmanship for two (2) years.

1.6 QUALITY ASSURANCE

.1 All PLC panel equipment and components shall bear a CSA approval.

1.7 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Manual to include:

.1 Technical data:

.1 Approved shop drawings;

.2 Characteristic curves for automatic circuit breakers and protective devices;

.3 Project data;

.4 Technical description of components;

.5 Parts lists with names and addresses of suppliers.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 FABRICATION

.1 All materials and components making up the PLC panel shall be new, of current manufacture and shall not have been in prior service except during factory testing.

.2 Wiring

.1 Wiring practices, materials and coding shall be in accordance with the requirements of the Canadian Electical Code.

.2 All wiring shall be copper.

.1 All discrete control circuits shall have a minimum #14 wire gauge.

.2 All analog control circuits shall have a minimum #18 wire gauge.

.3 The PLC panel enclosure shall be a two-door free standing floor mount enclosure.

.1 Enclosure shall have a NEMA 4X rating if located in the plant floor.

.2 Enclosure shall have a NEMA 12 rating if located in a climate controlled electrical or mechanical room.

2.2 PLC COMPONENTS

.1 Design is based on Schneider Electric's Modicon M340 series PLC platform. Refer to electrical drawings for models and quantities of each type of module.

.2 Telefast wiring modules provided for discrete modules to provide individual channel isolation at desired voltages.

.3 Alternates PLC designs may be submitted for approval.

.1 All modifications to the electrical drawings as a result of a deviation from the Modicon M340 series PLC platform will be at the expense of the contractor.

.2 Any alternate platform must be able to communicate via the Modbus\TCP protocol over an Ethernet network.

2.3 HMI COMPONENTS

.1 The HMI touch screen panel shall support the following features:

.1 10.4” touchscreen that supports SVGA resolutions (800 x 600 pixels).

.2 Communications: Modbus\TCP protocol.

.3 Operating temperature range: 0 °C to 50 °C

.4 Enclosure: IP65, NEMA 4X

.2 Acceptable Product: Schneider Electric XBTGT5430 or approved equal in accordance with B6.

2.4 ETHERNET SWITCH

.1 Ethernet switch shall be a managed with the following features:

.1 Support Modbus\TCP Industrial Ethernet protocol

.2 Support Turbo Ring, Turbo Chain, and RSTP/STP (IEEE 802.1w/D) for network redundancy.

.3 Contain a minimum of four (4) 10/100/1000BaseT(X) ports plus five (5) combo 10/100/1000BaseSFP slot Gigabit ports.

.4 Contain 2 relay outputs alarm contacts rated 1 A at 24 Vdc.

.5 Switch shall be DIN-Rail mountable.

.6 Switch shall be designed for industrial networks usage.

.7 Approved Product: Moxa EDS-G509 Series switch or approved equal in accordance with B6.

2.5 24 VDC POWER SUPPLY

.1 Input voltage: 120 Vac at 60 Hz.

.2 Output voltage: 24 Vdc

.3 Each PLC panel contains two 24 Vdc power supplies connected together with diodes for a redundant 24 Vdc power supply.

.4 Capacity: 100 W minimum, sized to panel load plus 50% spare capacity for each 24 Vdc power supply.

.5 Output Characteristics:

.1 Voltage adjustment range: ±10 %

.2 Ripple: 2 % (peak-peak) maximum

.3 Temperature influence: 0.05 % / °C maximum with rated load and output voltage at an ambient temperature between 0 °C to 50 °C

.6 Overload protection: 105 % minimum of rated load current, with automatic reset.

.7 Ambient temperature operating range: 100 % load output, 0 °C to 50 °C.

.8 Ambient humidity operating range: 25 % to 85 % minimum

.9 Dielectric strength: 3000 Vac for 1 minute between all inputs and outputs.

.10 Undervoltage detection indicator.

.11 General alarm contact (Form C) rated 1 A at 24 Vdc.

2.6 TERMINAL BLOCKS

.1 Terminal blocks shall comply with CSA C22.2 No. 158 – Terminal Blocks.

.2 Control voltage and discrete I/O, feed though type

- .1 CSA rated 600 V, 36 A
- .2 Conductor sizes: #26 through #10 AWG
- .3 TS 35 DIN Rail mounting
- .4 Moulding material: Thermoplastic
- .5 Acceptable Product: Weidmuller SAK 4 or approved equal in accordance with B6.

.3 Control voltage and discrete I/O, 2-Tier feed through type

- .1 CSA rated 300 V, 10 A
- .2 Conductor sizes: #26 through #12 AWG
- .3 TS 35 DIN Rail mouting
- .4 Moulding material: Thermoplastic
- .5 Acceptable Product: Weidmuller WDK 2.5 or approved equal in accordance with B6.

.4 Terminal, disconnect, fused

- .1 CSA rated 300 V, 10 A
- .2 Conductor sizes: #26 through #12 AWG
- .3 TS 35 DIN Rail mouting
- .4 5 x 20 mm fuse holder type, level type, hinged
- .5 Disconnect to include blown fuse indicator.
- .6 Moulding material: Thermoplastic
- .7 Acceptable Product: Weidmuller ASK 1EN or approved equal in accordance with B6.

.5 Terminal 2-tier, disconnect, fused and feed through type

- .1 CSA rated 300 V, 10 A
- .2 Conductor sizes: #22 through #12 AWG
- .3 TS 35 DIN Rail mouting
- .4 5 x 20 mm fuse holder type, level type, hinged
- .5 Disconnect to include blown fuse indicator.
- .6 Moulding material: Thermoplastic
- .7 Acceptable Product: Weidmuller KDKS1 LD EN or approved equal in accordance with B6.

.6 Terminal disconnect

- .1 CSA rated 300 V, 10 A

.2 Conductor sizes: #26 through #12 AWG

.3 TS 35 DIN Rail mounting

.4 Test points

.5 Moulding material: Thermoplastic

.6 Product: Weidmuller WTR 2.5 STB or approved equal in accordance with B6.

.7 Circuit breakers on terminal strips

.1 Use for power distribution as shown

.2 CSA approved, 250 Vac, 65 Vdc

.3 Thermal magnetic type

.4 Insulation resistance: 100 MΩ at 500 Vdc

.5 Current ratings: As indicated on drawings or as required

.6 TS 35 DIN Rail mounting

.7 Product: Weidmuller Series 4201 circuit breakers or approved equal in accordance with B6.

.8 Control fuses

.1 Where fast acting is specified

.1 Current rating as shown

.2 Product: BUSS GMA or approved equal in accordance with B6.

.2 Where time delay is specified

.1 Current rating as shown

.2 Product: BUSS GMD or approved equal in accordance with B6.

.9 General

.1 Use partitions between voltages classes as required. Partition to conform with terminal type.

.2 Use end plates to complete strip assembly

.3 Apply end anchors to strip

.4 Use manufacturers markings tags to identify terminals

.5 Where more than one terminal strip is identified in a panel or enclosure, apply label carrier

.1 Acceptable Product: Weidmuller SCH T5S or approved equal in accordance with B6.

2.7 PUSHBUTTONS

.1 Heavy industrial, operator recessed, flush, extended, mushroom type, as indicated. Colour as shown, with 1-NO and 1-NC EEMAC AC600 contacts, labels as indicated. Stop pushbuttons coloured red.

.2 30.5 mm NEMA type 4

.3 Acceptable Product: Allen Bradley 800T, Square D 9001 Series or approved equal in accordance with B6.

2.8 SELECTOR SWITCHES

.1 Maintained, spring return, 2, 3 position as indicated, labelled as indicated, heavy industrial oiltight, standard operators, contact arrangement as indicated, EEMAC AC 600 contacts.

.2 30.5 mm NEMA type 4

.3 Acceptable Product: Allen Bradley 800T, Square D 9001 Series or approved equal in accordance with B6.

2.9 INDICATING LIGHTS

.1 Heavy duty oil tight, full voltage, LED type, lens colour as indicated, supply voltage 120 Vac or 24 Vdc as required, labels as indicated.

2.10 LOOP SPLITTERS

.1 Input signal: 4-20 mA

.2 Output signal: 2 x 4-20 mA

.3 Input resistance: 50 Ω

.4 Maximum load resistance: 250 Ω

.5 Screw terminal block type

.6 Acceptable Product: Phoenix Contact MINI MCR-SL-UI-2I or approved equal in accordance with B6.

2.11 PLC AND HMI PROGRAMMING

.1 Provide all PLC programming services to program, test and commission the PLC panels to provide functionality as per the control narratives.

.2 Provide all programming required to facilitate data transfers between the PLC's and Bailey DCS.

.3 Provide all HMI programming for the PLC HMI's. Allow for review and approval of all HMI screens by the City staff.

2.12 PROGRAMMING SOFTWARE

.1 Turn over to the City of Winnipeg all licenses required to program both the PLC's and HMI's.

2.13 SPARE PARTS

.1 Provide the following spare parts to be turned over to the city

.1 One spare I/O module for each I/O module type used.

.2 One spare PLC processor

.3 One spare power supply

.4 One spare telefast block for each type used.

.5 Twelve spare relays for each type used within telefast blocks.

Part 3 Execution

3.1 ASSEMBLY

.1 PLC panel shall be shop assembled by a CSA approved panel shop.

.2 Test each I/O point up to the point of field termination to ensure all wiring within PLC panel is correct before shipping panels to site.

.3 Provide panel shop drawings

3.2 INSTALLATION

.1 Install PLC panels as indicated on drawings.

.2 Connect instrumentation loops as per loop drawings.

.3 Provide DVD's with final as-built programming of all PLC's and HMI.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 02 61 33 - Hazardous Materials.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

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

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

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

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

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

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

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 SUBMITTALS

.1 Submittals: in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Product Data: submit WHMIS MSDS in accordance with Section 02 61 33 - Hazardous Materials.

.3 Submit for review single line electrical diagrams and locate under plexiglass in electrical rooms.

.4 Shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions:

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

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

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

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

.5 Submit copies of 600 x 600 mm minimum size drawings and product data to inspection authorities.

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

.5 Quality Control: in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special 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 - LOAD BALANCE.

.5 Submit certificate of acceptance from inspection authority upon completion of Work to Contract Administrator.

.6 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

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

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.8 SYSTEM STARTUP

.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 engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

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

1.9 OPERATING INSTRUCTIONS

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

.2 Operating instructions to include following:

- .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- .3 Safety precautions.
- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

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

.4 Post instructions where directed.

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

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

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

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

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

.3 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 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities and Contract Administrator.

.2 Decal signs, 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 Identify electrical and controls equipment and instrumentation with nameplates and labels as follows:

.1 Nameplates: lamicoid 3 mm melamine, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Sizes as follows:

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

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

.3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.

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

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

.6 Identify equipment with Size 3 labels engraved as directed by Contract Administrator. Eg. "P600"

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

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

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

2.6 WIRING IDENTIFICATION

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

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

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

.5 Identify each wire at termination points with unique wire tag, generally as shown on the drawings. Markers shall consist of machine printed sleeves.

2.7 CONDUIT AND CABLE IDENTIFICATION

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

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

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

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

2.8 FINISHES

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

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

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

2.9 SCOPE OF WORK

.1 The scope of the electrical work includes all items identified on the drawings and the specifications. The following list of major work items has been provided to provide a high level overview.

.2 Supply and install new starter wrappers for the MCC's to accommodate the following motors:

.1 Secondary Clarifiers Supply Fan S670 (Size 1)
.2 Tunnels Exhaust Fan P625 (Size 1)
.3 Tunnels Exhaust Fan S695 (Size 1)
.4 Headworks Exhaust Fan H605A (Size 1)
.5 Headworks Exhaust Fan H605 (Size 1)
.6 Headworks Exhaust Fan H630 (Size 1)
.7 Headworks Exhaust Fan H655 (Size 1)
.8 Headworks Exhaust Fan H672 (Size 1)
.9 Headworks Exhaust Fan H730 (Size 3)
.10 Utilities Supply Fan U620 (Size 1)
.11 Utilities Exhaust Fan U625 (Size 1)
.12 Utilities Exhaust Fan U635 (Size 1)
.13 Utilities Exhaust Fan U675 (Size 1)

.3 Supply and install a new starter circuit within a NEMA 12 enclosure within the relevant electrical room for the following 120 Vac motors:

.1 Tunnels Exhaust Fan S612
.2 Tunnels Exhaust Fan S675
.3 Tunnels Exhaust Fan S680
.4 Tunnels Exhaust Fan S690
.5 Utilities Exhaust Fan U670

.4 Supply and install a new manual motor starter for the following 120 Vac motor loads:

.1 Utilities Exhaust Fan U720 (1/4 HP)
.2 Utilities Exhaust Fan U725 (1/4 HP)
.3 Utilities Exhaust Fan U726 (1/4 HP)

.5 Supply and install new feeder wrappers for the MCC's to accommodate the following motors:

.1 Primary Clarifier Exhaust Fan P605 (2 x 40 A Circuit Breakers)
.2 Primary Clarifier Exhaust Fan P655 (2 x 40 A Circuit Breakers)

.3 Secondary Clarifier Exhaust Fan S605 (2 x 30 A Circuit Breakers)

.4 Secondary Clarifier Exhaust Fan S655 (2 x 30 A Circuit Breakers)

.5 Odour Dispersion Stack Exhaust Fan S735 (1 x 200 A Circuit Breaker)

.6 Odour Dispersion Stack Exhaust Fan S745 (1 x 200 A Circuit Breaker)

.6 Provide a new Variable Frequency Drive (VFD) for the following motors:

.1 Primary Clarifier Exhaust Fan P605 (20 HP)

.2 Primary Clarifier Exhaust Fan P655 (20 HP)

.3 Secondary Clarifier Exhaust Fan S605 (15 HP)

.4 Secondary Clarifier Exhaust Fan S655 (15 HP)

.5 Odour Dispersion Stack Exhaust Fan S735 (100 HP)

.6 Odour Dispersion Stack Exhaust Fan S745 (100 HP)

.7 Supply and install all new power cabling for VFD loads from MCC through to the motor.

.8 Disconnect all cabling to the existing aeration basin exhaust fans S638 and S639 including disconnecting from MCC feeder wrapper. Leave feeder cable in place and label as spare at both ends. Turn over existing VFD's and motors to the City. Fans are fed from MCC-1SB and MCC-2SB which are located in the south west corner of the bioreators building.

.9 Wire new power cable feeders from the MCC or extend existing power feeder to the new location for the MUA units and exhaust fans as shown on the drawings. Provide local non fused disconnects for local servicing

.10 Provide power and control wiring to all field devices as identified on the electrical loop drawings.

.11 Provide new PLC panels as detailed on the electrical drawings for each of the following areas:

.1 Primary Clarifiers PLC panel

.2 Secondary Clarifiers PLC panel

.3 Headworks PLC panel

.4 Utilities PLC panel

.12 Provide all PLC programming, testing and commissioning services required to place the HVAC equipment into service.

.13 Provide al required temporary power and control wiring to facilitate the installation of new equipment while maintaining existing services as outlined on drawing 1-0103P-E0001-001.

.14 Relocate all existing electrical services as required to facilitate the installation / modification of mechanical, architectural and structural components.

.15 Install new / relocate existing lighting to accommodate the new equipment installation as outlined on the drawings. Not all existing electrical wiring and equipment which requires relocation is shown in detail. The Contractor shall review all Bid Opportunity drawings to determine global scope of relocation.

.16 Supply and install Ethernet networks including CAT6 and fiber optic cabling as outlined on the drawings. Provide a 1 inch conduit from the Secondary Clarifiers PLC panel to the Bailey control cabinet within the Secondary Clarifiers control room. Pull in four (4) CAT6E cables terminated within the PLC panel consistent with a redundant pair of ABB HPG-800 communication modules. Final terminations within the Bailey Control Cabinet shall be by the Contractor working under the direct supervision of City instrumentation department staff.

.17 Supply and install three new Carbon Monoxide gas detectors. Wire analyzers back to the existing Drager Gas Detection control panel within the Headworks electrical room.

Part 3 Execution

3.1 INSTALLATION

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

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

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

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

.1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

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

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

3.4 LOCATION OF OUTLETS

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

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

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

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

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

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Wall receptacles:

General: 300 mm.

Above top of continuous baseboard heater: 200 mm.

Above top of counters or counter splash backs: 175 mm.

In mechanical rooms: 1400 mm.

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

.4 Telephone and interphone outlets: 300 mm.

.5 Wall mounted telephone and interphone outlets: 1500 mm.

.6 Fire alarm stations: 1500 mm.

.7 Fire alarm bells: 2100 mm.

.8 Television outlets: 300 mm.

.9 Wall mounted speakers: 2100 mm.

.10 Clocks: 2100 mm.

.11 Door bell pushbuttons: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.7 FIELD QUALITY CONTROL

.1 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 PART 1 - SUBMITTALS: 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 in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.1 Power 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 and communications.

.6 Insulation resistance testing:

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

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

Check resistance to ground before energizing.

.3 Carry out tests in presence of 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 PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

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

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

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No.65-93(R1999), Wire Connectors.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

Part 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 as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 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.

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

END OF SECTION

WIRES AND CABLES

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 REFERENCES

.1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

1.3 PRODUCT DATA

.1 Submit product data in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 BUILDING WIRES

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

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 1000 V TECK90 POWER CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: copper, size as indicated. 12 AWG minimum where size is not indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.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 to prevent cable from drooping.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors: watertight, explosion-proof approved for TECK cable.

2.3 600 V TECK90 CONTROL CABLE

.1 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: 14 AWG copper, number coded.

.2 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.3 Inner jacket: polyvinyl chloride material.

.4 Armour: interlocking aluminum.

.5 Overall covering: thermoplastic polyvinyl chloride material.

.6 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 to prevent cable from drooping.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.7 Connectors: watertight, explosion-proof approved for TECK cable.

2.4 300 V INSTRUMENT CABLE - ARMOURED

.1 Conductors: 18 AWG minimum unless indicated otherwise, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.

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

.3 Twisted pairs/triads cables with staggered lays.

.4 Shielding:

.1 Individual twisted pair(s)/triad(s), 100% aluminum/mylar shield with ST drain wire.

.2 Individual drain wires one size smaller than conductor AWG.

.3 Overall drain wire the same AWG as conductors.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.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 to prevent cable from drooping.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors: Watertight, explosion-proof approved for TECK cable.

2.5 TYPE RW90 CONDUCTOR

.1 Cable: to CAN/CSA-C22.2 No. 38.

.2 Conductors: concentric stranded soft copper, size as indicated. 12 AWG minimum where size is not indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90 XLP, 600 V.

.4 Suitable for installation in temperatures down to -40 °C and a conductor operating temperature of 90 °C.

2.6 TYPE TEW CONDUCTOR

.1 Cable: to CAN/CSA-C22.2 No.127

.2 Conductors: 18 AWG, unless noted otherwise, for PLC/DCS cabinet internal wiring.

.3 Insulation: thermoplastic compound, 600V.

.4 Suitable for installation in temperatures down to -40 °C and a conductor operating temperature of 105 °C.

2.7 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 01 - Common Work Results – For Electrical

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

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

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Install cables.

.1 Group cables wherever possible on channels or in cabletroughs.

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

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

3.3 INSTALLATION OF ARMOURED INSTRUMENT CABLES

.1 Install cables.

.1 Group cables wherever possible on channels or in cabletroughs.

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

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

3.4 INSTALLATION OF CONTROL CABLES

.1 Install control cables in cable troughs where quantity warrants it.

.2 Ground control cable shield at one end only.

END OF SECTION

GROUNDING - SECONDARY

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

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

.1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required.

.2 Grounding conductors: stranded copper, tinned, soft annealed, size as indicated.

.3 Insulated grounding conductors: green, type RW90.

.4 Ground bus: copper, size 2/0 AWG, complete with insulated supports, fastenings, connectors.

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

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

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

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

.3 Protect exposed grounding conductors from mechanical injury.

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

.5 Soldered joints not permitted.

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

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

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

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

.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.

.11 Ground secondary service pedestals.

3.2 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600 V system and secondary 120 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, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.4 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.5 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.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.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 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 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

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

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

- .1 One-hole 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.

.7 Suspended support systems.

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

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

.8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.

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

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

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

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

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

END OF SECTION

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

.3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

Part 1 General

1.1 REFERENCES

.1 CSA C22.1-2006, Canadian Electrical Code, Part 1.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

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

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

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

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

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

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

2.5 FLOOR BOXES

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

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

2.7 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.

2.8 SERVICE FITTINGS

.1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.

.2 Pedestal type 'low tension' fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

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

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

.4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.

.2 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, aluminum threaded.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

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

.3 Channel type supports for two or more conduits at 1.5 m oc.

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

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

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

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

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

2.5 FISH CORD

.1 Polypropylene.

Part 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 in finished areas.

.3 Surface mount conduits except in mechanical and electrical service rooms and in unfinished areas.

.4 Use rigid aluminum threaded conduit except where specified otherwise.

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

.6 Install conduit sealing fittings in hazardous areas. Fill with compound.

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

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

.9 Mechanically bend steel conduit over 19 mm dia.

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

.11 Install fish cord in empty conduits.

.12 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

.13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.14 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 channels.

.5 Do not pass conduits through structural members except as indicated.

.6 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 Locate to suit reinforcing steel. Install in centre one third of slab.

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

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

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

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

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

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. 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.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA VE 1-2002, Metal Cable Tray Systems.

.2 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.2 SUBMITTALS

.1 Provide submittals in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cabletroughs used.

.5 Show actual cabletrough installation details and suspension system.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 CABLETROUGH

.1 Cabletroughs and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1.

.2 Ladder type, Class D1 to CAN/CSA C22.2 No. 126.1.

.3 Trays: extruded aluminum, minimum 300 mm wide with minimum depth of 75 mm.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: 300 mm minimum.

.5 Solid covers for complete cabletrough system including fittings.

.6 Barriers where different voltage systems are in same cabletrough.

.7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

.8 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 INSTALLATION

.1 Install complete cabletrough system in accordance with NEMA VE 2.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

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

.3 Secure cables in cabletrough at 6 m centres, with nylon ties.

.4 Identify cables every 30 m with size 2 nameplates in accordance with Section 26 05 01 – Common Work Results – For Electrical.

END OF SECTION

ELECTRICAL CABINETS AND ENCLOSURES

Part 1 General

1.1 RELATED SECTIONS

.1 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

Part 2 Products

2.1 MATERIALS

.1 NEMA 4X rated enclosure for all locations except within electrical rooms and control rooms.

.2 NEMA 12 rated enclosures for devices within electrical rooms or control rooms.

.3 Door: minimum 1 m wide, hinged, minimum 3 point latching, with padlocking means.

.4 Door interlocks

Part 3 Execution

3.1 INSTALLATION

.1 Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.

.2 Mount equipment in enclosure.

END OF SECTION

WIRING DEVICES

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.

.4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

Part 2 Products

2.1 SWITCHES

.1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111 as required.

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

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver cadmium oxide contacts.

.3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 Brown toggle.

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

.4 Switches of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 1200 Series or equivalent.

2.2 RECEPTACLES

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

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

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

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

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 5252 or equivalent.

2.3 COVER PLATES

.1 Stainless steel or pvc cover plates for wiring devices.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Weatherproof double lift spring-loaded stainless steel or pvc cover plates, complete with gaskets for duplex receptacles as indicated on the drawings.

.6 Weatherproof spring-loaded stainless steel or pvc cover plates complete with gaskets for single receptacles or switches as indicated on the drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

- .1 Install single throw switches with handle in "UP" position when switch closed.
- .2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Receptacles:

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

.2 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

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

.4 Mount lighting fixture receptacles local to fixtures.

.3 Cover plates:

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

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

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

END OF SECTION

FUSES – LOW VOLTAGE

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2No.248.12-94, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Submit fuse performance data characteristics for each fuse type and size. Performance data to include: average melting time-current characteristics.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.1 Place materials defined as hazardous or toxic waste in designated containers.

.2 Ensure emptied containers are sealed and stored safely for disposal away from children.

.3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

1.5 DELIVERY AND STORAGE

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in moisture free location.

1.6 MAINTENANCE MATERIALS

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

.2 Three spare fuses of each type and size installed above 600 A.

.3 Six spare fuses of each type and size installed up to and including 600 A.

Part 2 Products

2.1 FUSES GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

.1 Class L fuses (formerly HRC-L).

.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type L2, fast acting.

.2 Class J fuses (formerly HRCI- J).

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type J2, fast acting.

.3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its= peak let-through values not to exceed limits of UL 198E-1982, table 10.2.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

.4 Class -C fuses (formerly HRCII- C).

Part 3 Execution

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.1 Install Class R rejection clips for HRCI-R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters, fused circuit breakers, and accessory high-fault protectors.

1.2 RELATED SECTIONS

.1 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

.1 Submit product data in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick-make, quick-break over center switching mechanism that is mechanically trip-free, for manual and automatic operation with temperature compensation for 40 degrees C ambient. Automatic tripping of the breaker shall be clearly indicated by the handler position. Contacts shall be non-welding silver alloy, and arc extinguishing shall be accomplished by means of DE-ION arc chutes.

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

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

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated on the drawings.

.7 Circuit breakers identified as MCP will operate on the magnetic principle with a current sensing element in each pole.

.8 Circuit breakers 600 A through 2500 A frame shall be Cutler-Hammer type Westinghouse Series C with microprocessor-based RMS sensing trip units or approved equal in accordance with B6.

.1 Each moulded case circuit breaker microprocessor-based tripping system shall consist of three current transformers, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analysing the secondary current signals received from the circuit breaker current transformers and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.

.2 Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed. Rating plugs shall be interlocked such that a breaker cannot be closed and latched with the rating plug removed.

.3 The microprocessor-based trip unit shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.

.4 When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override. Internal ground fault protection adjustable pick-up ratings shall not exceed 1200 amperes.

.5 Breakers shall have built-in test points for testing the long time delay, instantaneous, and ground fault functions of the breaker by means of a 120 Volt operated test set. Provide one test set capable of testing all breakers 600 ampere frame and above.

.6 System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

.1 Adjustable long time pick-up and delay.

.2 Adjustable short time pick-up and delay.

.3 Adjustable instantaneous pick-up.

.7 Circuit Breakers shall be Cutler-Hammer type Westinghouse Series C circuit breakers, microprocessor-based RMS sensing trip units type Digitrip RMS 310 LSI or LSIG trip units or approved equal in accordance with B6.

.8 Accessories:

.1 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

.9 Enclosure:

.1 All enclosed circuit breakers shall have EEMAC 1 general purpose enclosures.

.2 All enclosed circuit breakers shall have metal nameplates, front cover mounted, that contain a permanent record of catalog number and maximum rating. Provide handle mechanisms that are padlockable in the "OFF" position.

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 Acceptable Product: Cutler-Hammer type Westinghouse Series C or approved equal in accordance with B6.

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.

Part 3 Execution

3.1 FACTORY TESTING

.1 Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of CSA standard.

3.2 INSTALLATION

.1 Install circuit breakers as indicated on drawings per the manufacturer's recommendations.

3.3 FIELD SETTINGS

.1 The contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the drawings.

END OF SECTION

DISCONNECT SWITCHES - FUSED AND NON-FUSED

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 Section 26 28 14 - Fuses - Low Voltage.

.3 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.

.2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.4 SUBMITTALS

.1 Submit product data in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

Part 2 Products

2.1 DISCONNECT SWITCHES

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

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

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

.4 Fuses: size as indicated on drawings, in accordance with Section 26 28 14 - Fuses - Low Voltage.

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

.6 Quick-make, quick-break action.

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

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

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

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

CONTROL DEVICES

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14-95(R2001), Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2001, Industrial Control and Systems: General Requirements.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Include schematic, wiring, interconnection diagrams.

1.5 QUALITY ASSURANCE

.1 Submit to Contract Administrator one copy of test results.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

Part 2 Products

2.1 AC CONTROL RELAYS

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

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 120 Vac. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

.3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 120 V. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

2.2 DC CONTROL RELAYS

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

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 24 Vdc. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

.3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 24 Vdc. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

2.3 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open - convertible to normally-closed 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 Supply voltage: 120 V, AC, 60 Hz.

.4 Temperature range: minus 20 degrees C to 60 degrees C.

.5 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1.

.6 Timing ranges: minimum 1.0 s, maximum 5, 30 or 60 s.

2.5 OPERATOR CONTROL STATIONS

.1 Enclosure:

.1 In general CSA Type 4X, surface mounting.

.2 In clarifier electrical room with positive pressure CSA Type 1, surface mounting.

2.6 PUSHBUTTONS

.1 Heavy duty Oil tight. Operator extend type. Black, with 1-NO and 1-NC contacts rated at 2 A minimum, AC, labels as indicated. Stop pushbuttons coloured red, labelled as indicated.

2.7 SELECTOR SWITCHES

.1 Maintained, 2 or 3 position as required labelled as indicated heavy duty oil tight, operators standard, contact arrangement as indicated, rated 120 V, 2 A, AC minimum or 24 Vdc, 2 A minimum as required.

2.8 INDICATING LIGHTS

.1 Heavy duty Oil tight, full voltage, LED type, lens colour: as indicated, supply voltage: 120 V, lamp voltage: 120 V, labels as indicated.

2.9 CONTROL AND RELAY PANELS

.1 CSA Type 1 sheet steel 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 V, AC.

.4 VA Rating: as required by loads plus 20%.

.5 Secondary fuse rating: as required by loads

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

Part 3 Execution

3.1 INSTALLATION

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

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

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

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

.4 Check out complete system for operational sequencing.

END OF SECTION

MOTOR STARTERS TO 600 V

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA)

.1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.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 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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

1.5 EXTRA MATERIALS

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

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

.1 3 contacts, stationary.
.2 3 contacts, movable.
.3 1 contacts, auxiliary.
.4 1 control transformer.
.5 1 operating coil.
.6 2 fuses.
.7 10% indicating lamp bulbs used.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 MATERIALS

.1 Starters: to NEMA ICS 2-2000

2.2 MANUAL MOTOR STARTERS

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

- .1 Switching mechanism, quick make and break.
- .2 Three overload heaters, manual reset, trip indicating handle.

.2 Accessories:

- .1 Pushbutton: heavy duty oil tight labelled as indicated.
- .2 Indicating light: heavy duty oil tight type and colour as indicated.
- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE 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.

.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 3 padlocks.
- .2 Independent locking of enclosure door.
- .3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

- .1 Pushbuttons and selector switches: heavy duty oil tight labelled as indicated.
- .2 Indicating lights: heavy duty oil tight type and color as indicated.
- .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

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

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

2.5 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

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

.3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical 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.

END OF SECTION

VARIABLE FREQUENCY DRIVES

Part 1 General

1.1 SCOPE

.1 This specification shall apply to the materials, design, fabrication, inspection, and testing of 600 V Variable Frequency Drives (VFD) used to control the speed and torque of NEMA design B induction motors.

.2 Detailed specifications on the VFD shall be indicated in this specification, drawings and attachments. In case of a conflict between the various specifications, the vendor shall contact the Contract Adminstrator for clarification. The VFD shall be manufactured by ABB or approved equal in accordance with B6.

.3 Ensure VFD can handle the motor loads of the equipment actually purchased by the Contractor.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

.1 The VFD shall be designed, manufactured and tested in accordance with the latest applicable standards of CSA, NEMA, ANSI and UL, including but not limited to:

.1 CSA C22.2 No. 14-M91—Industrial Control Equipment

.2 IEEE 519-1992 – Guide for Harmonic Content and Control

.3 NEMA ICS7—Industrial Control and Systems Adjustable Frequency Drives

.4 NEMA MG1—Motors and Generators

.5 NEMA ICS 7.1—Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Frequency Drives

.2 In all cases where more than one regulation, code, standard or specification applies to the same conditions, the most stringent one shall apply. Conflicts among any of the provisions of these listed codes, standards or specifications shall be referred to the Contract Administrator for resolution.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Drawings shall be in SI units. If imperial units are used as well, they shall be shown in parenthesis after the SI units. In case of conflict between the two, SI units shall be considered to be correct.

.3 Equipment tag number, purchase order number and project name shall be shown on all Supplier supplied drawings. Data shall be located close to the title block.

.4 All drawings and data shall be submitted in a form that is easily reproduced. All data and drawings shall be submitted in both paper and electronic form. Final drawings are all required to be as-built.

.5 Review or approval of Supplier's drawings, design calculations and other documentation does not relieve Supplier of any responsibility for correctness of such drawings, calculations or other documentation.

.6 The following information shall be submitted to the Contract Administrator for approval:

.1 Master drawing index
.2 Dimensioned front view elevation
.3 Dimensioned floor plan
.4 Dimensioned top view
.5 Unit control schematics and wiring diagrams
.6 Nameplate schedule
.7 Cable entry/exit locations
.8 Assembly ratings, including short circuit, voltage, and continuous current ratings
.9 Major component ratings
.10 Minimum clearances to other equipment.
.11 Frequency spectrum for harmonic currents at line side of filter (where provided) at 50% and 100% of rated load.
.12 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and toral harmonic current distortion (TDD). The VFD manufacturere shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE electrical system standard 519. All VFDs shall include a minimum of 3% equivalent impedance reactors. VFDs shall include some form of active mitigation.
.13 Manufacturers technical data sheets

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Operation and maintenance manuals shall include as a minimum for each type and style of starter: Instruction books and/or leaflets, recommended renewal parts list and a complete set of as-built drawings.

.3 The following information shall be submitted to Contract Administrator for record purposes:

.1 Final as-built drawings and information
.2 Certified production test reports

.3 Installation information

.4 Seismic certification and equipment anchorage details (where applicable)

Part 2 Products

2.1 GENERAL

.1 All VFDs shall be a solid state AC to AC inverter controlled device utilizing the latest isolated gate bipolar transistor (IGBT) technology. The VFD shall utilize Direct Torque Control (DTC) as the primary motor control, employing an inner loop torque control strategy that mathematically determines the optimal motor torque and flux every 25 microseconds. The VFD must also provide an optional motor control operational mode for scalar of V/Hz operation.

.2 The VFDs will be fed from a MCC and be protected by Breakers. Vendor shall indicate recommended breaker size.

.3 The benefits that the motor control DTC shall make available for the operation of a NEMA design B induction motor shall be:

.1 Steady state speed accuracy within 1/10th the slip without an encoder, for process repeatability.

.2 100% motor torque from zero speed available for acceleration with the VFD continuous current rating equal to or greater then the motor full load amp rating.

.3 At and below 90% speed, 100% torque is achievable even with 10% low line voltage.

.4 Ability to limit torque to protect the mechanical system with a common single torque setting above and below field weakening.

.5 Ability to provide torque in % of motor shaft torque (with in +/- 4% linearity) on the VFD control panel, analog output or via field bus of actual.

.6 Quiet motor operation for audibly friendly working environment in comparison to other low voltage PWM solutions utilizing a carrier frequency.

.7 Have available the ability to operate in open loop torque control, with an ability to switch between speed and torque control on the fly with the change of state to a digital input.

.8 Have an ability to share load or speed between two or more induction AC motors connected to the same system, when those motors are controlled by separate VFDs.

2.2 RATINGS

.1 The VFD shall be designed for heavy-duty applications and in accordance with applicable datasheets.

.2 The VFD shall be rated to operate from 3-phase power at 525 to 690 VAC (600 Vac, UL and CSA) +10/-10%. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.

.3 The VFD shall be rated to operate at the following environmental operating conditions: ambient temperature 0 to 40°C continuous. VFDs that can operate at 40° C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level without derating, less than 95% humidity, non-condensing.

.4 The VFD shall be rated to operate from input power from 48Hz to 63Hz.

.5 Output voltage and current ratings shall match the adjustable frequency operating requirements of standard NEMA design A or NEMA design B motors.

.6 The Heavy Duty overload current capacity shall be 150% of rated current for one (1) minute out of five (5) minutes.

.7 The VFD efficiency shall be 98% or better of the full rated capability of the VFD at full speed and load.

.8 The VFD shall be capable of starting when fed from temporary diesel generator (nominal size of 500 kVA).

.9 Drive rated for a minimum fault current of 65 kA Sym. I.C.

2.3 CONSTRUCTION

.1 All models shall provide a complete, ready-to-install solution.

.2 The latest, most efficient IGBT power technology shall be used. This technology shall be used for all power and voltage ranges offered by the manufacturer.

.3 The VFD shall offer microprocessor based control logic that is isolated from power circuitry.

.4 The VFD shall use the same main control board for all ratings.

.5 Control connections shall remain consistent for all power ratings.

.6 Wall mountable VFDs shall be available from 1.0 to 200HP and have the following features;

- .1 Wall mounted NEMA Type 12 enclosures for electrical / mechanical rooms
- .2 Wall mounted NEMA Type 4X enclosures for plant floor locations
- .3 Include a control panel mounted on the front of the VFD
- .4 Include coated circuit boards as standard
- .5 Include integrated internal AC line reactor or DC choke
- .6 Offer option internally mounted braking chopper for use in dynamic braking with 100% continuous duty operation.

.7 Desired optional features shall be furnished and mounted by the VFD manufacturer and shall also be available as field installable kits as an alternative. All optional features shall carry all of the necessary certifications as described above. Field installed kits shall not affect the VFD's certification.

.8 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical. Nameplates shall be permanently attached with screws.

.9 The enclosure shall have appropriate warning labels indicating "CAUTION MULTIPLE CONTROL POWER SOURCES"

.10 A panel mounted non-resetable elapsed-time meter to measure operating hours with a minimum 6 digits display.

2.4 OPERATOR INTERFACE

.1 The VFD shall be equipped with a front mounted operator control panel consisting of a four- (4) line by 20-character back-lit alphanumeric LCD display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.

.2 The control panel shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

.3 The display of the control panel shall have the following features:

.1 The LCD display shall have contrast adjustment provisions to optimize viewing at angle.

.2 All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

.3 During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:

.1 Speed/torque in percent (%), RPM or user-scaled units

.2 Output frequency, voltage, current and torque

.3 Power and kilowatt hours

.4 Heatsink temperature and DC bus voltage

.5 Status of discrete inputs and outputs

.6 Values of analog input and output signals

.7 Values of PID controller reference, feedback and error signals

.4 The control panel shall be used for local control, for setting all parameters, and for stepping through the displays and menus.

.5 A copy function to upload and store parameter settings from an VFD and download stored parameter settings to the same VFD or to another VFD shall exist.

.6 An intelligent start-up assistant shall be provided as standard. The Start-up routine will guide the user through all necessary adjustments to optimize operation.

.1 The Start-Up routine shall include "plug and produce" operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.

.2 The Start-Up routine shall prompt the user for Motor Nameplate Data including power, speed, voltage, frequency and current.

.3 An auto-tune function shall identify the optimal motor tuning parameters for typical applications.

.4 An auto-tune function shall also be available to tune the PID speed regulator loop. Manual adjustments shall also be allowed.

.5 A selection of at least six (6) pre-programmed application macro parameter sets shall be provided to minimize the number of parameter adjustments required during start-up. Macros offered shall include Factory Default, Hand/Auto, PID Control, and Torque Control. A selection of two (2) user defined macros shall are also be available.

.6 Selection shall be offered for both 2-wire and 3-wire Start/Stop control.

2.5 PROTECTIVE FEATURES

.1 For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the VFD's fault history.

.2 The VFD shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.

.3 Output short circuit and ground fault protection rated for 100,000 amps without relying on line fuses shall be provided per UL508C.

.4 Motor phase loss protection shall be provided.

.5 The VFD shall provide electronic motor overload protection qualified per UL508C.

.6 Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated voltage or undervoltage at 65% of min. rated voltage.

.7 The VFD shall protect itself against input phase loss.

.8 A power loss ride through feature shall allow the VFD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

.9 Stall protection shall be programmable to provide a warning or stop the VFD after the motor has operated above a programmed torque level for a programmed time limit.

.10 Underload protection shall be programmable to provide a warning or stop the VFD after the motor has operated below a selected underload curve for a programmed time limit.

.11 Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

.12 Input terminals shall be provided for connecting a motor thermistor (PTC type) to the VFD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

2.6 CONTROL INPUTS AND OUTPUTS

.1 Discrete Inputs

.1 Minimum of six (6) discrete inputs shall be provided.

.2 A minimum of six (6) of the inputs shall be independently programmable with function selections (run/stop using 2 wire or 3 wire control, hand-off-auto, etc.).

.3 Inputs shall be designed for use with either the VFD's internal 24 VDC supply or a customer supplied external 24 VDC supply.

.2 Discrete outputs

.1 Minimum of three (3) form C relay contact outputs shall be provided

.2 All outputs shall be independently programmable to activate with at least 30 function selections including;

.1 Operating conditions such as drive ready, drive running, reversed and at set speed

.2 General warning and fault conditions

.3 Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque and PID feedback.

.4 Relay contacts shall be rated to switch 2 Amps at 24 VDC or 115/230 VAC.

.3 Analog Inputs

.1 Minimum of two (2) analog inputs shall be provided:

.1 At least one (1) must support bi-polar voltage input

.2 Resolution of analog inputs must be at least 11bit total resolution

.2 Inputs shall be independently programmable to provide signals including speed / frequency reference, torque reference or set point, PID set point and PID feedback / actual.

.3 A differential input isolation amplifier shall be provided for each input.

.4 Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.

.5 If the input reference is lost, the VFD shall give the user the option of the following. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.

.1 Stopping and displaying a fault

.2 Running at a programmable preset speed

.3 Hold the VFD speed based on the last good reference received

.4 Cause a warning to be issued, as selected by the user.

.6 When inputs are used as speed references, reference signal processing shall include increase/decrease floating point control and control of speed and direction using a "joystick" reference signal. Two (2) analog inputs shall be programmable

to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

.4 Analog Outputs

.1 Minimum of two (2) 0 / 4-20 mA analog outputs shall be provided.

.2 Outputs shall be independently programmable to provide signals proportional to output function selections including output speed, frequency, voltage, current and power.

2.7 CONTROL FUNCTIONS AND ADJUSTMENTS

.1 Output frequency shall be adjustable between 0Hz and 300Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.

.2 Stop mode selections shall include coast to stop and ramp to stop.

.3 The VFD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.

.4 The VFD shall be capable of starting into a rotating motor with or without existing magnetic flux on the motor regardless of the motor direction. From the time the start signal is given to the VFD to the time the VFD has control of the motor shall not exceed two (2) seconds. Once the VFD has control of the motor it will than accelerate or decelerate the motor to the active reference speed without tripping or faulting or causing component damage to the VFD. The VFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

.5 The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

.6 Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.

.7 Speed control functions shall include:

.1 Adjustable min/max speed limits.

.2 Selection of up to 15 preset speed settings for external speed control.

.3 Three sets of critical speed lockout adjustments.

.4 A built-in PID controller to control a process variable such as pressure, flow or fluid level.

.8 Functions shall include flux optimization for optimizing energy efficiency and limit the audible noise produced by the motor by providing the optimum magnetic flux for any given speed / load operating point.

.9 The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay

output shall include programmable time delays that will allow for VFD acceleration from zero speed without signaling a false underload condition.

.10 Three (3) programmable critical frequency lockout ranges shall be provided to prevent the VFD from operating the load continuously at an unstable speed.

.11 The VFD shall offer software to select the VFDs action in the event of a loss of the primary speed reference.

.12 The VFD shall have fifteen (15) internal adaptive programming blocks capable of twenty (20) different functions. These blocks shall be connectable to VFD's actual signals and functions allowing the user to tailor the VFD to the specific application requirements without additional hardware. These blocks shall be programmable through the standard operator panel and through the use of programming software.

2.8 COMMUNICATIONS

.1 The VFD shall be capable of communicating with other VFDs or controllers via a serial communications link. A variety of communications interface modules for the typical overriding control systems shall be available.

.2 The VFD shall have a Modbus/TCP interface module for remote interrogation by a DCS or PLC controller. Vendor shall indicate all drive parameters that are accessible from this interface.

.3 Interface modules shall mount directly to the VFD control board or be connected via fiber optic cables to minimize interference and provide maximum throughput.

.4 I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:

.1 Run-Stop control
.2 Hand-Off-Auto Control
.3 Speed Adjustment
.4 PID (proportional/integral/derivative) control adjustments
.5 Current Limit
.6 Accel/Decel time adjustments

.5 The VFD shall have the capability of allowing the overriding controller to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.

.6 A connection shall also be provided for personal computer interface. Software shall be available for VFD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of VFD performance.

2.9 FACTORY TESTING

.1 The manufacturer's standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA and NEMA standards. Results from the test shall be provided with closeout submittals.

2.10 ACCEPTABLE PRODUCT

.1 ABB ACS800-U1 Series VFD c/w TCI HG7 Harmonic Filter for 15 and 20 HP Drives or approved equal in accordance with B6.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Manufacturer's installation instructions and recommendations.

.2 Hire factory trained representative for setup and commissioning of VFD. Provide written report to Contract Administrator.

.3 Hire factory trained representative to provide one day of training for City of Winnipeg personnel.

.4 Confirm power lugs and VFD can accommodate the pump motor cables leads.

.5 Setup VFD so that equipment is controlled as per controls narrative.

END OF SECTION

STATIC UNINTERRUPTIBLE POWER SUPPLY

Part 1 General

1.1 SUMMARY

.1 This specification shall define the electrical and mechanical characteristics and requirements for a continuous-duty, single-phase, solid-state uninterruptible power supply (UPS). The UPS shall provide high-quality AC power for sensitive electronic equipment loads.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C813.1-01, Performance Test Method for Uninterruptible Power Supplies.

.2 American National Standards Institute (ANSI)

.1 ANSI C62.41 - IEEE Standard 587, Guide on Surge Voltages in AC Power Circuits Rated up to 600V

.3 International Electrotechnical Commission (IEC)

.1 IEC 61000-4-2 – Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test.

1.4 SYSTEM DESCRIPTION

.1 The UPS shall be designed to operate as a true on-line double conversion system in the following modes:

.1 Normal: In normal operation incoming AC power shall be fed to the input power factor corrected (PFC) rectifier that converts the AC power to DC power for the inverter. In this mode, power shall also be derived from utility power for the battery charger. The inverter shall derive DC power from either the PFC rectifier or the battery and regenerate filtered and regulated AC sinewave power for the connected load. The battery shall be charged once the unit is connected to utility power, regardless of whether the UPS is ON or OFF. In the event of a utility outage or severe abnormality (sag or swell), the inverter shall support the connected load from battery power until the battery is discharged or the utility returns, whichever occurs first.

.2 Battery: Upon failure of utility / mains AC power, the critical AC load shall be supplied by the inverter, which obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility / mains AC source.

.3 Recharge: Upon restoration of utility / mains AC power, after a utility / mains AC power outage, the input converter shall automatically restart and assume supplying power to the inverter and the battery charger to recharge the battery.

.4 Automatic Restart: Upon restoration of utility / mains AC power, after a utility / mains AC power outage and complete battery discharge, the UPS shall automatically restart and assume supplying power to the critical load and the battery charger automatically recharges the battery. This feature shall be capable of being disabled by the user.

.5 Bypass: The integral bypass shall perform an automatic transfer of the critical AC load from the inverter to the bypass source, in the event of an overload, PFC failure, overtemperature, DC bus overvoltage or inverter failure conditions.

1.5 DESIGN REQUIREMENTS

.1 Voltage

.1 Input: 120 Vac nominal: 0-140 Vac, 60 Hz, single-phase, 2-wire plus ground.

.2 Output: 120 Vac nominal: 120 Vac ±3 %, 60, single-phase, 2-wire plus ground.

.2 Output Load Capacity: 1500 VA / 1300 Watts at 0.9 lagging power factor

.3 Internal Battery: Valve-regulated, non-spillable, flame—retardant lead acid cells

.4 Reserve Time: 4 minutes at full load with ambient temperature of 25 °C

.5 Battery Recharge: The UPS shall contain a battery recharge rate designed to prolong battery life. Recharge time for UPS internal batteries shall be 3 hours to 90 % capacity after a complete discharge into full load.

1.6 SYSTEM PERFORMANCE

.1 AC Inputs to UPS

.1 Voltage configuration: The UPS shall operate at the following values without drawing power from the batteries:

.1 At 90 % Load

.1 Transfer Voltage: 97 Vac

.2 Comeback Voltage: 104 Vac

.2 At 70 % Load

.1 Transfer Voltage: 78 Vac

.2 Comeback Voltage: 85 Vac

.3 At 30 % Load

.1 Transfer Voltage: 61 Vac

.2 Comeback Voltage: 68 Vac

.2 Frequency: UPS shall auto-sense input frequency when first powered up and shall operate within the following specifications. UPS shall be capable of cold start with default frequency of 60 Hz.

.3 Input Power Factor: Greater than 0.99 lagging at rated load.

.4 Input current reflected distortion: 5 % total harmonic distortion (THD)

.5 Input current: 12 A

.6 Inrush current (initial startup, no load): The UPS shall have a maximum inrush current of 6 times the full load peak input current.

.7 Input line transient immunity: UPS shall conform to an input line transient confirming to ANSI C62.41, Category A, Level 3 test.

.8 Surge protection: MOV ratings shall be 175 V, 80 Joules minimum connected L-N.

.2 AC Outputs, UPS Inverter

.1 Voltage configuration: 120 Vac, 60 Hz, single-phase, 2-wire plus ground.

.2 Voltage regulation: ±3 % steady state.

.3 Frequency regulation: ±5 % synchronized to utility / mains. ±0.1 Hz free running or on battery operation.

.4 Frequency slew rate: 1.0 Hz per second maximum

.5 Voltage distortion: <3 % total harmonic distortion (THD) typical into a 100 % linear load, <5 % THD typical into a 100% non-linear load with a crest factor ration of 3:1.

.6 Load power factor range: The rated load power factor will be 0.9 lag.

.7 Output power rating: 1500 VA / 1350 Watts at 0.9 lagging power factor.

.8 Output overload capability:

.1 105-125 % for 5 minutes

.2 125-150 % for 1 minute

.3 150-200 % for 2 seconds

.4 >200 % for 0.25 seconds

.9 Voltage transient response:

.1 ±7 % in line mode 0-100 % loading of the UPS.

.2 ±7 % in battery mode 0-100 % loading of the UPS.

.10 Transient recovery time: To nominal voltage within 90 ms.

.11 Efficiency: ≥ 89% AC to AC, minimum

1.7 ENVIRONMENTAL CONDITIONS

.1 Ambient temperature: The UPS shall be operational with the following maximum power factor degradation at full load:

.1 0 to 25 °C: 100 %

.2 26 to 30 °C: 100-93 %

.3 31 to 35 °C: 92-86 %

.4 36 to 40 °C: 85-79 %

.2 Relative humidity: 0-95 % non-condensing

.3 Audible noise:

.1 <45 dBA maximum at 1 m from front and side

.2 <46 dBA maximum at 1 meter from rear.

.4 Electrostatic discharge: The UPS shall be able to withstand an electrostatic discharge compliant to IEC 61000-4-2.

1.8 SHOP DRAWINGS

.1 Submit shop drawings in accordance with The City of Winnipeg Construction Specifications Section CW1110 – General Instructions.

.2 Include:

.1 Outline sketch showing ratings, dimensions and weights

.2 User manual that shall include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step-by-step operating procedures and general maintenance guidelines.

1.9 WARRANTY

.1 The UPS manufacturer shall warrant the UPS against defects in materials and workmanship for two (2) years. The no-hassle replacement warranty shall include shipping to and from the customer site.

1.10 QUALITY ASSURANCE

.1 The UPS manufacturer shall be ISO 9001:2008 certified.

.2 The UPS manufacturer shall fully and completely test the UPS to ensure compliance with the specification. These tests shall include operational discharge and recharge tests on the internal battery to ensure performance.

1.11 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Manual to include:

.1 Technical data:

.1 Approved shop drawings;

.2 Characteristic curves for automatic circuit breakers and protective devices;

.3 Project data;

.4 Technical description of components;

.5 Parts lists with names and addresses of suppliers.

1.12 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 FABRICATION

.1 All materials and components making up the UPS shall be new, of current manufacture and shall not have been in prior service except during factory testing. All relays shall be provided with dust covers.

.2 All wiring shall be copper.

.3 Enclosure

.1 The UPS unit shall be composed of the following components housed in a NEMA 1 enclosure and shall meet the requirements of IP20.

.1 Input PFC converter

.2 Battery charger

.3 Input filter

.4 Internal bypass circuit

.5 Batteries

.2 The UPS enclosure shall be cleaned, primed and painted.

.3 The internal battery unit shall be shipped separately and shall be installed during the UPS installation process.

.4 The UPS shall be forced air cooled by an internally mounted, continuous fan. Fan power shall be provided from the internal DC supply. Air intake shall be through the front of the unit and exhausted out the rear of the unit.

2.2 COMPONENTS

2.3 INPUT CONVERTER

.1 Incoming AC power shall be converted to a regulated DC output by the input converter supplying DC power to the inverter.

.2 The input converter shall provide input power factor correction (PFC) and input current distortion reduction.

.3 AC input current limit

.1 The input converter shall be provided with AC input current limiting whereby the maximum input current is limited to 125 % of the full load input current rating.

.4 Input Protection

.1 The UPS shall have built-in protection against undervoltage, overcurrent and overvoltage conditions including low-energy lighting surges introduced on the primary AC mains.

.2 The UPS shall be able to sustain input surges without damage per criteria listed in ANSI C62.41, Category A, Level 3

.3 The UPS shall have circuit breakers

.5 Battery Recharge

.1 The UPS shall contain a battery recharge rate designed to prolong battery life.

.2 The battery shall be constant current charged to restore capacity, then shall be constant voltage charged to maintain the battery in a fully charged state.

.3 Recharge time for the internal UPS batteries shall be three (3) hours maximum to 90 % capacity (full load discharge rate).

.4 The UP shall contain DC overvoltage protection so that if a DC voltage exceeds the pre-set limit, the UPS will shut down automatically and the critical load will be transferred to bypass.

2.4 INVERTER

.1 The UPS inverter shall be a pulse-width-modulated (PWM) design capable of providing the specified AC output.

.2 The inverter shall convert DC power from the input converter output or the battery into precise sinewave AC power for supporting the critical AC load.

.3 Overload

.1 The inverter shall be capable of supplying current and voltage for overloads exceeding 100 % and up to 200 % of full load current.

.2 A visual indicator and audible alarm shall indicate overload operation

.3 For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components.

.4 The inverter shall be self-protecting against any magnitude of connected output overload.

.5 The inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective devices.

.4 Inverter DC Protection

.1 The inverter shall be protected by the following DC shutdown levels:

.1 DC Overvoltage Shutdown

.2 DC Undervoltage Shutdown (End of Discharge)

.3 DC Undervoltage Warning (Low Battery Reserve)

.5 The inverter shall hold the output frequency to ±0.1 Hz of nominal when not synchronized to the utility / mains source.

.6 Output Protection: The UPS inverter shall employ electronic current limiting circuitry.

.7 To prevent battery damage from overdischarging, the UPS control logic shall automatically raise the shutdown voltage setpoint; depending on output load at the onset of battery operation.

2.5 DISPLAY AND CONTROLS

.1 The UPS shall be provided with a microprocessor-based unit status display and controls section designed for convenient and reliable user operation.

.2 The monitoring functions such as status and alarm indicators shall be displayed on an LED display.

.3 The UPS shall contain the following indicator lights:

.1 Fault Indicator – Shall illuminate red if the UPS has detected a fault and shall be off if there is no fault.

.2 AC Input Indicator – Shall illuminate green when the utility input power is normal; shall be off during utility failure; shall flash when a L-N reversal occurs in the AC input power supply or when there is a loss of proper grounding for the UPS.

.3 Battery Indicator – Shall illuminate amber when the battery is supplying power; shall be off when the battery is not supplying power.

.4 Inverter Indicator – Shall illuminate green when the inverter is supply power; shall be off when the inverter is not supplying power.

.5 Bypass Indicator – Shall illuminate amber when the bypass is supplying power; shall be off when the bypass is not supply power; shall flash when utility power is outside specification.

.4 Controls

.1 The UPS startup and shutdown operation shall be accomplished by the ON and OFF push buttons on the front panel of the UPS.

.2 The ON push button shall be a means to turn the UPS on and also manually test the battery and reset active visual and audible alarms.

.3 Pressing the OFF push button once shall allow manual transfer of the load from the inverter to bypass power.

.4 Pressing the OFF push button twice within four-second time period when the UPS is in bypass mode shall completely shut down the UPS and its connected load in normal and battery mode.

2.6 ON-LINE BATTERY TEST

.1 The UPS shall feature an automatic battery test with the factory default test interval set at every 2 weeks.

.2 The battery test shall ensure the capability of the battery to supply power to the inverter while loaded.

.3 If the battery test fails, the UPS shall display a warning message to indicate the internal batteries need replaced.

.4 The battery test feature shall be user accessible by the push button on the front of the unit and with communication software.

.5 The automatic battery test feature shall be capable of being disabled or configured to operate every 7, 14, 21 or 28 days through user configuration program.

2.7 BYPASS

.1 A bypass circuit shall be provided as an integral part of the UPS

.2 The bypass control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals and operating alarm conditions

.3 The control circuit shall provide a transfer of the load to the bypass source if available and if the inverter is capable of powering the load (i.e. if there is an overload condition, if the unit is in manual bypass mode or if the voltage or frequency is out of tolerance).

.4 The transfer control logic shall activate the bypass automatically, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:

.1 UPS overvoltage
.2 UPS overtemperature
.3 PFC failure
.4 Inverter failure
.5 DC bus overvoltage

.5 Once the overload condition is reduced the load shall be automatically transferred back to inverter power.

2.8 INTERNAL BATTERY

.1 Valve-regulated, non-spillable, flame-retardant lead acid cells shall be used as a stored-energy source for the UPS.

.2 The battery shall be housed internal to the UPS cabinet and sized to support the inverter at rated load and power factor, with ambient temperature of 25 °C for a minimum of 7 minutes reserve time.

.3 The expected life of the battery shall be 3-5 years or a minimum of 250 complete discharge cycles.

.4 The UPS units shall have the capability to allow the operator to replace the internal battery.

2.9 OUTPUT DISTRIBUTION

.1 Output distribution shall be integral to the UPS and located on the rear of the unit with six (6) NEMA 5-15R receptacles.

2.10 COMMUNICATIONS

.1 The UPS shall provide a contact closure for remote monitoring of alarm conditions in the UPS delivering signals for:

.1 On Battery
.2 On Bypass
.3 Low Battery
.4 Summary Alarm
.5 UPS Fault
.6 On UPS

.2 The alarm contact shall be rated for 24 Vdc at 1 A.

2.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.12 ACCEPTABLE PRODUCT

.1 Liebert GXT3 On-Line UPS 1500VA or approved equal in accordance with B6.

Part 3 Execution

3.1 INSTALLATION

.1 Connect AC mains to main input terminal.

.2 Connect UPS output to load.

.3 Start-up UPS and make preliminary tests to ensure satisfactory performance.

END OF SECTION

LIGHTING

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-97, Electric Lamp Ballasts-Line Frequency Flourescent Lamp Ballast.

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

.1 ANSI/IEEE C62.41-1991, Surge Voltages in Low-Voltage AC Power Circuits.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM F1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 United States of America, Federal Communications Commission (FCC)

.1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

.1 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Contract Administrator.

.3 Photometric data to include: VCP Table and spacing criterion.

.4 Ballast Data.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Disposal of flourescent lamps.

.5 Disposal of old PCB filled ballasts (if still existing) on renovation jobs.

Part 2 Products

2.1 LAMPS

.1 Fluorescent lamps.

Lamp Design	Bulb shape Wattage	Base	Type	Initial Lumens	Life h	Description	Colour °K
A	T8-32	md.bip	RS	3150	18000	Cool white	4100

2.2 BALLASTS

.1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic design A.

.1 Rating: 120 V, 60 Hz, for use with 2-32W, rapid start lamps.

.2 RFI/EMI suppression circuit to: FCC (CFR47) Part 18, sub-part C, Class A and Part 15, sub-part B, Class B.

.3 Totally encased and designed for 40 °C ambient temperature.

.4 Power factor: minimum 95 % with 95% of rated lamp lumens.

.5 Crest factor: 1.5 maximum current, 2.0 maximum voltage.

.6 Capacitor: thermally protected.

.7 Thermal protection: non-resettable on coil.

.8 Harmonics: 10 % maximum THD, including 49th for electronic discrete and hybrid ballasts, 25 % maximum THD including 49th for electromagnetic ballasts.

.9 Operating frequency of electronic ballast: 21 khz minimum.

.10 Total Circuit Power: 62 Watts.

.11 Ballast Factor: greater than 0.90.

.12 Sound rated: Class A.

.13 Mounting: integral with luminaire.

.14 Manitoba Hydro Power Smart Premium Ballast listing

2.3 FINISHES

.1 Reflector and other inside surfaces finished as follows:

.1 White, minimum reflection factor 85%.

.2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.

.3 Gloss not less than 80 units as measured with Gardner 60° gloss meter.

2.4 LIGHT CONTROL DEVICES

.1 Design A.

.1 Material: polycarbonate.

.2 Frame: hinged gasketted latched.

2.5 LUMINAIRES

.1 Fluorescent luminaire design: Type A- on drawings.

.1 No. of lamps: 2.

.2 Enclosed and gasketted industrial explosion proof fluorescent luminaire for use in hazardous locations.

.3 Mounting: surface.

.4 Nominal dimensions: 1219 mm long x 305 mm wide.

.5 Lamp design: A.

.6 Light control device design: A.

.7 Ballast design: A.

.8 Ballast chamber: built-in.

.9 Housing: Fiberglass reinforced polyester material.

.10 Internal Reflector: Highly reflective white polycarbonate material.

2.6 ACCEPTABLE PRODUCT

.1 NRL: VP4-211 or approved equal in accordance with B6.

.2 Appelton: FVR232120 or approved equal in accordance with B6.

Part 3 Execution

3.1 INSTALLATION

.1 Where indicated to replace ballast, remove and dispose of existing ballast, clean fixture, install new ballast and relamp fixture.

.2 Locate and install luminaires as indicated. Luminaries typically replace existing lighting in an area. Existing lighting to be removed and disposed of.

.3 Where existing luminaries are shown as relocated. Contractor shall maintain all hazardous seals as required for the fixture rating.

3.2 WIRING

.1 Connect luminaires to lighting circuits using wiring methods appropriate for hazardous locations.

3.3 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

STRUCTURED CABLING FOR COMMUNICATIONS SYSTEMS

Part 1 General

1.1 RELATED SECTIONS

.1 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
- .2 CSA-C22.2 No. 232-M1988(R2004), Optical Fiber Cables.

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)

- .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
- .2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
- .3 TIA/EIA-568-B.3-(2000), Optical Fiber Cabling Components Standard.
- .4 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
- .5 TIA TSB-140-2004, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
- .6 TIA-598-C-(2005), Optical Fiber Cable Color Coding.

1.3 DEFINITIONS

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.4 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

- .1 Horizontal cables link equipment to PLC Panels located in the same area.
- .2 PLC Panels are linked to each other by backbone cables.
- .3 DCS also linked to PLC Panels by backbone cables.

1.5 SUBMITTALS

.1 Provide submittals in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

.2 As-built Records and Drawings:

.1 Provide Microsoft Access database reflecting cable installation and cross-connections.

.2 Provide electronic drawings in AutoCAD 2010 format depicting all construction.

.3 Provide two (2) bound complete hard-copy sets of as-built records to the Contract Administrator.

.1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

1.6 QUALITY ASSURANCE

.1 Health and Safety Requirements: In accordance with Contractor's Safety Program and OSHA authorities having jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal: separate waste materials for reuse and recycling.

Part 2 Products

2.1 FOUR-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

.1 Armoured Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-B.2.

2.2 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

.1 Patch panel, Din rail mountable or wall mountable, 12 ports minimum:

.1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-B.2.

.2 Horizontal cable-management unit for every 12 ports.

2.3 UTP PATCH CORDS

.1 1 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-B.2.

2.4 OPTICAL-FIBER CABLE

.1 Armoured tray rarted, multi-mode 62.5/125 micron, 6 strands to: CSA-C22.2 No. 232 and TIA/EIA-568-B.3, flame test classification FT4, each end terminated with duplex LC connectors.

2.5 OPTICAL-FIBER PATCH PANEL

.1 Mounted on panel backboard, with lockable cover, capable of terminating 9 pairs (18 strands) of fiber, equipped with duplex LC compatible adapters.

2.6 OPTICAL-FIBER PATCH CORDS

.1 Cable, 2 strands, 1 metres long, each end equipped with duplex LC connectors. Multi-Mode 62.5/125 micron to: TIA/EIA-568-B.3.

Part 3 Execution

3.1 INSTALLATION OF OPTICAL-FIBER CABLE TRUNKS

.1 Install an optical-fiber backbones between the following locations:

.1 Utilities PLC Panel and Secondary Control Room Network Cabinet (Bailey DCS Interface)

.2 Utilities PLC Panel and Primary Clarifiers PLC Panel

.3 Utilities PLC Panel and Secondary Clarifiers PLC Panel

.4 Primary Clarifiers PLC Panel and Headworks PLC Panel.

.2 Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination hardware in PLC panel as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

.2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.3 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install horizontal cables as indicated in cabletroughs in accordance with Section 26 05 36 – Cable Trays for Electrical Systems.

.2 Support horizontal cables at intervals not exceeding 1.5 metres.

.3 Install horizontal cables from PLC Panel to individual field equipment.

.1 Provide supplementary support channels in accordance to Section 26 05 29 – Hangers and Supports for Electrical Systems to support cables at intervals not exceeding 1.5 metres.

.2 Identify and label as indicated to: TIA/EIA-606-A.

.4 Terminate horizontal cables in PLC Panel and at individual equipment location.

.1 Identify and label as indicated to: TIA/EIA-606-A.

.5 Coil spare cables and store in ceiling space in zone.

.6 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.4 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using patch cords as specified.

3.5 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as electronic record on DVD.

- .1 Perform tests for Permanent Link on installed cables, including spares:
  - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.2 Test Optical-fiber strands for attenuation to: TIA/EIA-568-B.1 and correct deficiencies: provide record of results as electronic record on DVD.

- .1 Test horizontal links need at only one wavelength (850 nm or 1300 nm) and in one direction.
  - .1 Attenuation to be less than 2.0 dB, unless consolidation point is used.
  - .2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.
- .2 Test backbone links in both directions. Backbone links:
  - .1 Test multi-mode fiber at both applicable wavelengths (850 nm and 1300 nm).
- .3 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.
  - .1 Multi-mode-fiber attenuation coefficients:
    - .1 3.5 db/km @ 850 nm; and
    - .2 1.5 db km @ 1300 nm
  - .2 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

.3 Perform additional Tier 2 tests using optical time domain reflectometer (OTDR) on backbone fiber pairs to: TSB-140.

- .1 Correct deficiencies.
- .2 Provide record of results as described in SUBMITTALS.

.4 Provide record of results as electronic record on DVD to: TIA/TSB-140.

END OF SECTION