1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

.2 Shop drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each shop drawing shall give the identifying number of the specific piece of equipment etc. for which it was prepared

.3 Each shop drawing or catalogue sheet shall be stamped and signed by the Contractor to indicate that it has checked the drawing for conformance with all requirements of Contract Documents including the Contract Drawings, that it has coordinated equipment included on the shop drawings with other equipment to which it is attached and/or connected thereto and that it has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades.

.4 Indicate:

.1 Dimensioned positions of mounting devices.

.2 Dimensioned positions of terminations.

.3 Identified internal and external component layout on assembly drawing.

.4 Insulating liquid capacity.

.5 Complete set of instruction manual.

.6 Submit operation and maintenance manuals.

.7 Include the following information in the Operation and Maintenance manuals:

.1 Names and address of local suppliers for the items included.

.2 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

.3 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.

.8 Review information provided in the maintenance instructions and manuals with the City's operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

.9 Provide maintenance data for liquid cooled transformers for incorporation into manual

.10 Include insulating liquid maintenance data.

.11 Manufacturer must provide complete factory tests, signed by a professional Engineer to the customer for approval before shipping.

.12 Ship transformers complete with first fill of liquid.

.13 Continuously check and expedite delivery of equipment and materials.

.14 As required, inspect equipment, etc. at the source of manufacture.

1.02 LOCAL ELECTRICAL UTILITY AND AUTHORITY REQUIREMENTS

.1 Confirm local electrical utility requirements, obtain required standards and include for applicable general requirements as follows:

.1 necessary submissions and notifications to local electrical utility to obtain required inspections, approvals and certifications;

.2 enclosure design considerations to include relevant factors such as controlled access, tamper-resistance, and for outdoor applications weather-proofing and corrosion resistance, in compliance with local electrical utility requirements;

.3 steel hinged doors with locking provisions in compliance with local electrical utility requirements;

.4 lightning surge arrestor protection and grounding and bonding in compliance with local electrical utility requirements;

.5 nameplates and warning signs as per local governing electrical utility and other local authority and code requirements;

.6 guard posts (bollards) to protect units as per local electrical utility requirements;

.7 leak containment requirements as per local governing electrical utility and other local authority and code requirements;

.8 compliance with local electrical utility requirements and local inspection authorities prior to energization of equipment.

2 PRODUCTS

2.01 PAD MOUNTED TRANSFORMER – REFER TO SCHEDULE FOR QUANTITY AND TYPE

.1 Type ONAN 12.47 kV, 3-phase, 4-wire, 60 cycle AC delta primary, 347/600 volt, 3-phase, 4-wire, 60 cycle AC wye low voltage secondary for Building Transformer, 277/480V 3-phase, 4-wire, 60 cycle AC wye low voltage secondary for Charger Transformer outdoor weatherproof pad mount transformer. Transformers to be CSA approved and/or ULC listed and labelled. transformer to be oil liquid immersed, designed, manufactured and complete with manufacturer's standard features and accessories in accordance with requirements herein specified and as per listed codes and standards. Transformers to comply with latest requirements of following codes and standards:

.1 CSA C227.4 UPD 2 Three-phase, pad-mounted distribution transformers with separable insulated high-voltage connectors;

.2 ANSI/IEEE C57.12.34, IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High-Voltage, 34.5 kV Nominal System Voltage and Below; Low-Voltage, 15 kV Nominal System Voltage and Below;

.3 ANSI/IEEE C57.12.22 Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled Three-Phase Distribution Transformers With High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 Grd Y/19 920 Volts and Below; Low Voltage, 480 Volts and Below;

.4 Natural Resources Canada, Canada Energy Efficiency Act, Energy Efficiency Regulations, SOR/2016 – 311 Amendment 14 and ON Reg.404-12 – effective as of Jan. 1, 2018;

.5 DOE 2016 – U.S. Department of Energy, Energy Conservation Program; Distribution Transformers Energy Conservation Standards DOE 10 CFR Part 431. Revised Apr. 2013 - effective Jan. 1, 2016;

.6 applicable local governing authority codes and standards.

.2 Capacities for transformer are shown on drawings, at 65C° (117F°) temperature rise above 40°C (104°F) ambient, without fans. Transformers to be capable of additional 33% capacity output when equipped with fans.

.3 Transformer to be outdoor sealed type, completely tamper proof with features as follows:

.1 enclosure design considerations to include relevant factors such as controlled access, tamper-resistance, weather-proofing and corrosion resistant;

.2 pad-lockable hinged doors and removable panels over high voltage and low voltage bushings, gauges, relief valves and ancillary devices;

.3 access to each compartment to be provided by hinged door with a minimum 5 pin type hinge with 3 pentahead bolts; no other exposed hardware or fastening devices;

.4 doors and panels to be constructed from heavy gauge hot-rolled, sheet steel;

.5 controls enclosure to be minimum NEMA 3R rated, finished in corrosion resistant weatherproof ANSI green enamel;

.6 suitable for mounting onto concrete pad as detailed.

.7 complete with primary and secondary cable compartments.

.8 high voltage bushing wells for dead front operation

.9 spade type low voltage terminals

.10 copper windings for high voltage and low voltage windings

.11 Bay-o-net expulsion fuses

.12 Separate accessible low voltage compartment for connection of overhead cable bus or bus duct.

.4 Sound level for transformer to be in accordance with CSA Standard CAN3 C88.

.5 Basic impulse level (BIL) for transformer to be 95 kV BIL at 12.47 kV.

.6 Impedance for transformers to be within range from 6.0% to 6.5%, +/- CSA tolerances. Each supplied transformer to have same matching impedances.

.7 Efficiency of transformers to be greater than 98%.

.8 Tank:

.1 Transformer tank to be sealed, constructed of high quality steel plate with electrically welded seams, tank wall stiffening reinforcing members and a structural steel I-beam base.

.2 Tank to include a welded-on or bolted-on tank coverplate with an inspection and maintenance handhole and bolt-on cover, lifting lugs, jacking facilities and stainless steel grounding pads.

.3 Components to include a bottom oil drain and sampling valve, a hermetically sealed liquid level gauge with low level alarm contacts, a high winding temperature alarm and alert contacts for connection to a remote alarm, a hermetically sealed dial type liquid temperature thermometer and a pressure vacuum gauge.

.4 Tank to also be complete with an integral tank high pressure relief device with hood for deflecting away from controls and a padlockable tamperproof cover.

.5 Tank to be cleaned, primed and finished with oil resistant paint on inside, and outside with primer and overcoat oil-based equipment enamel.

.9 Cooling Tubes:

.1 Cooling tubes on each side of transformer to consist of external flattened profiled pressed plate seam welded and welded to header pipes.

.2 Cooling tubes to be suitable for operation with fans which are to be controlled by oil temperature thermostat.

.10 Liquid Fill:

.1 Mineral insulating oil in conformance with latest edition of CAN/CSA No. C50, readily obtainable, compatible with transformer insulation and meeting CSA C50 requirements as to viscosity, breakdown voltage, and chemical purity. Fluid features include:

.1 easy to re-process/dispose;

.2 biodegradable and low toxic;

.3 minimum open cup flash point of $\geq$145°C (293°F) and a fire point of $\geq$165°C (329°F).

.2 Provide required liquid fill.

.11 Core & Coil Assembly:

.1 Core to be constructed from grain oriented electrical grade silicone steel and be designed using a maximum 1.7 Tesla, designed for low in-rush current less than 6 times rated current and for low excitation current of less than 1% at rated voltage.

.2 Core and coil assembly to be rigidly braced, shock and vibration resistant. Windings to be insulated copper. Coil to be insulated with insulation suitable for a 65C° (117F°) temperature rise. Coil to consist of thermally upgraded paper insulated copper coil windings, wound with adequate bracing and blocking to minimize effects of short circuit. Insulation is provided on outer layers of primary windings along with proper mechanical bracing between winding sections. Coil windings to be constructed of 99.9% high conductivity copper.

.3 Utilize pressboard with stand voltage, dielectric constant, aging characteristics, low shrinkage, and bending properties suitable for specific applications for high-low barriers and yoke and tank shields.

.4 Allocate duct strips with high compressive strength, low power factor at high temperatures and excellent transformer liquid impregnation, evenly throughout windings to allow for uniform heat dissipation.

.5 Primary voltage taps to consist of four (4) 2-1/2% full capacity off load taps, two (2) FCAN and two (2) FCBN, operated by a non-load tap changer with operating lever located outside tank. Lever to include position indicator and padlocking provisions. Terminal boards to be provided with core and coil assembly for primary and secondary leads and taps.

.12 Connection Facilities:

.1 Separate transformer primary and secondary connection facilities to be provided to suit design requirements of manufacturers of individual connected equipment.

.2 Include CSA approved primary connectors for TECK primary cables.

.3 Include spade type connections for secondary connections.

.4 High voltage bushings: to EEMAC L9-3

.5 Provide sidewall mounted throat with C2 class primary bushings within a tamperproof air terminal chamber extended to grade level.

.6 Provide sidewall mounted throat secondary bushings with a tamperproof air terminal chamber extended to grade level.

.7 XO to be brought out to a separate bushing and grounded externally.

.8 Bay-o-net fuses in load break dry well to be sized as per transformer rating

.13 Additional Requirements:

.1 Windings, core, frames, and other parts of transformers to be designed, constructed and braced to prevent change in shape or displacement, or movement in handling, and to withstand surges, short circuits or any other electrical conditions which may develop.

.2 Core and windings to be vibration isolated from frames with neoprene pads or equivalent means.

.3 Sudden pressure gas relay to operate on rate of change of internal pressure and with contacts to trip secondary breakers as required and as confirmed with Contract Administrator.

.4 Spring isolation type anti-vibration mountings between I-beam base and concrete floor pad, to isolate not less than 90% of disturbing vibrations.

.5 Structural I-beam steel base assembly.

.6 Ohio Brass station/intermediate/distribution class polymer metal oxide varistor (MOV) lightning arrestors to suit application; lightning arrestors to be rated for system voltage rating; maximum continuous operating voltage (MCOV) to be as per manufacturer's recommendations.

.7 Internal current limiting fuses.

.8 Each transformer to be complete with heavy gauge (minimum No. 16 USS gauge) galvanized steel drain pan sized to contain complete liquid fill of transformer, reinforced with galvanized steel angles, continuous welded joints, galvanized steel pipe drain connection with 50 mm (2") hose end drain valve and pan bottom sloped to drain connection. Exterior of pans to be heavy coated with suitable primer. Interior of pans to be heavy coated with bituminous paint.

.9 Metal nameplate permanently affixed on each transformer clearly showing information as per CAN/CSA C88 requirements.

.10 Warning signs to local governing authority and code requirements.

.14 Testing, Start-up, Verification and Training:

.1 Perform standard factory testing and submit copy of detailed reports to Contract Administrator for review.

.2 Assist installing Contractor in installation of equipment and to inspect installation, test equipment, perform start-up and verify equipment. Coordinate work with Contractor.

.3 Perform testing at times reviewed with Contract Administrator.

.4 Provide instructions on system operating and maintenance.

.15 Acceptable manufacturers:

.1 Northern Transformers.

.2 Asea Brown Boveri.

.3 Schneider Electric.

.4 Siemens Electric.

.5 Pioneer Transformers.

.6 Eaton/ Cooper Power Systems.

.7 PTI Transformers

3 EXECUTION

3.01 INSTALLATION OF PAD MOUNTED TRANSFORMERS

.1 Not applicable.

END OF SECTION

1 PART 1 GENERAL

1.01 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.02 CODES AND STANDARDS

.1 General:

.1 Primary Standards:

.1 CSA C22.1-24, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations

.2 City of Winnipeg, Electrical Bylaw No. 104

.2 High Voltage Switch:

.1 Primary Standards:

.1 IEEE C37.30 High Voltage Air Switches, Insulators and Bus Supports

.2 IEEE C37.32 Preferred Rating, Manufacturing Specifications and Application Guide for High Voltage Air Switches, Bus Supports and Switch Accessories.

.3 IEEE C37.34 Standard Test Code for High Voltage Air Switches.

.3 High Voltage Fuse:

.1 Primary Standards:

.1 IEEE C37.41 IEEE Standard Design Tests for High Voltage (>1000V) Fuses and Accessories.

.2 IEEE C37.42 IEEE Standard Specifications for High Voltage (>1000V) Fuses and Accessories.

.3 IEEE C37.48 IEEE Guide for the Application, Operation, and Coordination of High Voltage (>1000V) Current Limiting Fuses.

1.03 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Basic Electrical Materials and Methods. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Submit the following documents:

.1 As part of the tender package submission, provide:

.1 Preliminary drawings of high voltage disconnect switch and fuse assembly showing:

.1 Dimensioned layout and elevations indicating operating clearances.

.2 Dimensions and weights including total weight and shipping weights,

.2 Preliminary schedule for the design, approval, manufacture, test and delivery to Site.

.3 Proposed delivery plan including:

.1 Method of transport,

.2 Condition monitoring requirements (impact recorder, pressurization monitor),

.3 Listing of items to be shipped loose.

.4 Approval Documents and Drawing

.1 Approval Documents and Drawings

.1 Provide the following approval drawings to be submitted shall include, but not be limited to the following:

.1 Dimensioned layout and elevations indicating operating clearances.

.2 Operating handle installation details.

.3 Disconnecting mechanism, switching type, mounting design.

.4 Interlocking schemes and connection details.

.5 Nameplate data,

.6 Ratings including voltage, continuous current, momentary current and impulse.

.7 Confirmed dimensions and weights,

.8 Connection, wiring and terminal block diagrams.

.9 Instructions for field installation, assembly and disassembly.

.10 Instructions for operating and maintenance of the equipment and accessories.

.11 Instructions for installing key interlocks.

.12 Instructions for equipment start-up and operation, calibration procedures, operational adjustments and troubleshooting.

.13 Instructions and schedule for routine and preventative equipment maintenance, to assure meeting specified equipment service life time.

.14 Detailed bill of materials including names of manufacturers and catalogue number of all components including replacement parts.

.15 FAT procedures for all equipment.

.16 Complete technical information and supplier data sheets for major items to be supplied.

.2 Drawings for approval shall be submitted within eight (8) weeks after award of Contract in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 A detailed manufacturing schedule shall be submitted within four (4) weeks after award of Contract. The Schedule shall detail each activity with start and finish dates, duration, etc. for each step of the design, manufacturing, factory and witness testing, delivery, site assembly, testing, and commissioning of the switch.

.3 Test Plans:

.1 Provide a complete factory inspection and test plan for review and approval within twelve (12) weeks after award of Contract.

.2 Provide notification in advance of all tests and inspections. Provide fourteen (14) days notice advance notice for tests and inspections during manufacturing, and twenty-one (21) days for final witness testing.

.3 Test data and reports shall be submitted within seven (7) days after completion of tests.

.4 Submit final test reports for acceptance prior to the units being shipped.

.5 “As-Manufactured” drawings shall be submitted a minimum of fourteen (14) days prior to the scheduled shipping date. Final “As-Manufactured” package shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Requirements.

.5 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.04 MAINTENANCE

.1 Provide a recommended tools and spare parts list as required by Section 01 33 00, Submittal Procedures.

1.05 OPERATING CONDITIONS

.1 Provide all necessary safeguards and protection for optimal performance of the equipment.

.1	Location:	Outdoors
.2	Temperature:	-40°C to 40°C
.3	Relative Humidity:	20% to 100%
.4	Elevation:	239 m ASL
.5	Duty:	24 hours/day, 365 days/year.

2 PART 2 PRODUCTS

2.01 HIGH VOLTAGE DISCONNECT SWITCH CHARACTERISTICS

.1 Ratings

.1 High voltage disconnect switch shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	66 kV
.2	Rated Maximum Voltage:	72.5 kV
.3	Current Rating:	1200 A
.4	Nominal Frequency:	60 Hz
.5	Basic Insulation Level:	350 kV
.6	Short Circuit Withstand:	Min. 50 kA (for 3 seconds)

.2 The equipment will be installed outdoors in a switchyard. The disconnect shall be a three-pole vertical break, three insulators, gang operated, single throw switch complete with quick-break arcing horn, a manual gear operating handle and auxiliary contacts (4 N.O. / 4 N.C.).

.3 Mounting hardware shall be provided as required for mounting the disconnect.

.4 The disconnect switch terminal pads shall be provided with 4-hole NEMA aluminum terminal pads.

.5 The manual gear operated handle shall be complete with appropriate couplings, shafts, pipes, lag screws, bolts, etc. required to install the disconnect in accordance with drawings. The manual gear operated handle shall include provision for installing key interlock.

.6 The disconnect switch shall include an adjustable blade stop for the disconnect switch blade and adjustable stops for the control mechanism.

.7 All required hardware shall be hot dip galvanized as per ASTM A123.

.8 All non-energized metallic components of the disconnect shall be grounded.

.9 Ground lugs sized for connection to a 4/0 AWG stranded bare copper grounding conductor shall be provided to ground all non-energized metallic components of the disconnect switch.

.10 Approved Equipment Manufacturer:

.1 Southern States, S & C, Mind Core, Cleaveland-Price or approved equal.

2.02 HIGH VOLTAGE FUSE CHARACTERISTICS

.1 Expulsion Fuse Ratings

.1 High voltage power fuse shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	69 kV
.2	Rated Maximum Voltage:	72.5 kV
.3	Current Rating:	300E
.4	Nominal Frequency:	60 Hz
.5	Basic Insulation Level:	350 kV
.6	Interrupting Rating (Sym.):	17.5 kA

.2 The equipment will be installed outdoors in a switchyard. The power fuse shall be three phase, vertical mounting with 180° opening and 150E fuse unit (standard speed). Provide three (3) spare 150E fuse unit. Each phase shall be individually mounted on the wood pole.

.3 The power fuse terminal pads shall be provided with 4-hole NEMA aluminum terminal pads.

.4 All required hardware shall be hot dip galvanized as per ASTM A123.

.5 All non-energized metallic components of the disconnect shall be grounded.

.6 Ground lugs sized for connection to a 4/0 AWG stranded bare copper grounding conductor shall be provided to ground all non-energized metallic components of the power fuse.

.7 Approved Equipment Manufacturer:

.1 S & C Electric SMD-2B or approved equal.

.2 Current-Limiting Fuse Ratings

.1 High voltage current-limiting fuse shall be designed to operate satisfactorily for the following minimum basic electrical parameters:

.1	Nominal Voltage:	38 kV
.2	Rated Maximum Voltage:	69 kV
.3	Current Rating:	100 kA
.4	Nominal Frequency:	60 Hz
.5	Basic Insulation Level:	350 kV
.6	Rated Max. Interrupting:	20 kA

.2 The equipment will be installed outdoors in a switchyard. The current-limiting fuse shall be mounted on base plate and polymer insulator standoff as part of the fuse assembly. Each phase shall be individually mounted on the wood pole.

.3 The current-limiting fuse terminal pads shall be provided with wedge aluminum connector bolted to the terminal pads.

.4 All required hardware shall be hot dip galvanized as per ASTM A123.

.5 All non-energized metallic components of the disconnect shall be grounded.

.6 Ground lugs sized for connection to a 4/0 AWG stranded bare copper grounding conductor shall be provided to ground all non-energized metallic components of the power fuse.

.7 Approved Equipment Manufacturer:

.1 ABB Trans-Guard EXT or approved equal.

2.03 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Basic Electrical Materials and Methods, and as indicated on the Datasheet.

.2 Provide metallic (stainless steel) Nameplate (Rating Plate) on the outside of the base plate.

.3 Nameplates and equipment tags shall be in accordance with the requirements of Section 26 05 00.

.4 Nameplates shall be attached by means of rivets, drive pins, or self-tapping screws. Note that the use of “sheet metal” or other screws having sharp points is NOT acceptable.

.5 Submit a detailed list of all proposed nameplates and equipment tags for review prior to fabrication.

2.04 SOURCE QUALITY CONTROL

.1 Submit to the Contract Administrator standard factory test certificates for each material in accordance with Specification Section 26 08 05, General Electrical Requirements - Electrical.

.2 All inspection and testing shall be carried out at the Vendor's works and shall be available for witnessing and approval by the City's representative. Vendor shall maintain an inspection and test plan and quality assurance manual for review and acceptance. The plans shall specify each characteristic to be verified: the requirements, the amount of inspection or testing, and the organizational element responsible for performing the inspections. Preference shall be given to Vendors that have a quality system certified to ISO 9001.

.3 Factory Acceptance Tests (FAT) shall be conducted in the presence of the Contractor. FAT shall be scheduled at least four (4) weeks prior to shipping and with a minimum of three (3) weeks' notice

.4 Manufacturing tests for disconnect switch shall be conducted in accordance with the provisions of IEEE C37.34 and shall include, as a minimum, the following tests

.1 Power-frequency withstand voltage tests.

.2 Switch performance tests.

.3 Mechanical operations test.

.5 Insulators shall be designed in accordance with ANSI C29.1 requirements.

.6 Provide certified test reports for each unit as part of the operations and maintenance manual.

.7 Provide type test reports as required.

2.05 PREPARATION FOR SHIPMENT

.1 Nameplates and Identification Tags

.1 Each major piece of equipment shall have a IEEE compliant standard nameplate securely affixed in a conspicuous place, showing the following information.

.1 Manufacturer's name and address.

.2 Purchaser's equipment number.

.3 Model number.

.4 Serial number.

.5 Mass of Equipment.

.2 Other information the manufacturer and the City may consider necessary to complete identification of the equipment.

.2 Assembly, Packaging and Shipping Instructions

.1 All components shall be completely assembled and match marked, as required, at the Vendor's assembly area prior to shipment.

.2 Preparation for Shipment

.1 Surfaces requiring protection shall be coated with suitable rust preventive material. After coating, spare parts shall be wrapped in heavy moisture-proof paper.

.2 All flanges shall be coated with a suitable rust preventive material and covered with a full-size steel cover, ¼ in. (6 mm) minimum thickness, with rubber gasket and bolted in place by a minimum of four full size bolts. All drilled and tapped holes shall be plugged with steel bar stock plugs. All other exposed pipe ends shall be capped. Plastic plugs are not allowed.

.3 Miscellaneous parts shall be tagged or marked with the item numbers for which they are intended. All such parts shall be suitably boxed and shipped with the unit.

.4 One complete set of printed Installation, Operation and Maintenance instructions shall be packaged with the crates and shipped to the jobsite.

3 PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 FIELD QUALITY CONTROL

.1 Pre-Commissioning Tests

.1 Demonstrate, in the presence of the City and/or the Engineer, all mechanical and electrical equipment are working properly.

.2 Submit commissioning plan to the Engineer for review fourteen (14 days) before the planned commissioning date.

.3 Vendor shall assist the Contractor when performing initial testing to establish the integrity of the system with respect to:

.1 Performance of safety and protection devices.

.2 Clearances.

.3 System operation.

.4 Submit relevant equipment repair procedures to the Engineer if repairable defects are identified during testing. Do not repair or use defective parts without prior approval from the Engineer.

.2 Commissioning Tests

.1 Vendor shall assist the Contractor in conducting commissioning tests only after the satisfactory completion of the pre-commissioning tests, and prior to the turnover of the equipment to the City.

.3 Start-Up and Training

.1 Provide suitable field service technician to verify all cable and wiring terminations made by others and advise the City of any errors. Start-up equipment and conduct all required tests.

.2 Vendor to provide training and demonstration to the City covering all aspects of equipment operation, maintenance, troubleshooting and controls.

.3 The Vendor shall assist the Contractor during commissioning of the disconnect switch and fuse assembly under his responsibility in the Scope.

.4 Onsite service technician shall be present for the following stages of construction:

.1 Field quality control.

.2 Equipment startup.

.3 All levels of commissioning.

END OF SECTION

1 PART 1 GENERAL

1.01 RELATED SECTIONS

.1 Specific reference is made to the following sections:

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

1.02 CODES AND STANDARDS

.1 General:

.1 Primary Standards:

.1 CSA C22.1-24, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations

.2 City of Winnipeg, Electrical Bylaw No. 104

.3 CAN/CSA C22.3 NO. 1-20, Overhead Systems

.4 C22.2 NO. 41-22, Grounding and bonding equipment (Tri-national standard, with NMX-J-590-ANCE and UL 467)

.5 CSA-W59, Welded Steel Construction

.2 Reference Standards:

.1 IEEE 80-2013, IEEE Guide for Safety in AC Substation Grounding

.2 Transformers:

.1 Primary Standards:

.1 CAN/CSA-C88:16 (R2021), Power Transformers and Reactors

.2 IEEE Std C57.12.00-2010, IEEE Standard General Requirements for Liquid-immersed Distribution, Power and Regulation transformers

.2 Reference Standards:

.1 IEEE Std C57.12.70-2011, IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers

.2 IEEE Std C57.12.80-2010, IEEE Standard Terminology for Power and Distribution Transformers

.3 IEEE, C59.19.100, Guide for the Application of Power Apparatus Bushings

.4 IEEE C57.19.00, General Requirements and Test Procedure for Power Apparatus Bushings

.5 IEEE C57.19.01, Performance Characteristics and Dimensions for Outdoor Apparatus Bushings

.6 IEEE C59.19.100, Guide for the Application of Power Apparatus Bushing

.7 IEEE C57.91, Guide for Loading Mineral Oil Immersed Transformers

.8 IEEE C57.98, Guide for Transformer Impulse Tests

.9 IEEE C57.149-2012, IEEE Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers

.3 Insulating Oil/Fluid:

.1 Primary Standards:

.1 ASTM D6871-17, Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

.2 Reference Standards:

.1 IEEE Std C57.147-2008, IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers

.4 Neutral Grounding Devices/Resistors (NGR):

.1 Primary Standards:

.1 CSA C22.2 NO. 295-15, Neutral grounding devices

.2 Reference Standards:

.1 ANSI/IEEE Std 32-1972 (R1997), IEEE Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Device.

.2 IEEE Std. C57.32-2015 - IEEE Approved Draft Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.

1.03 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Basic Electrical Materials and Methods. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 Product Data:

.1 Provide Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Submit the following documents:

.1 Completed and signed Electrical Data Sheet, 66 kV - 12.47 kV Liquid Filled High Voltage Transformer.

.2 As part of the tender package submission, provide:

.1 Preliminary drawings of transformer showing:

.1 Description and location of major accessories,

.2 Dimensions and weights including total weight and shipping weights,

.3 Quantity of insulating fluid in liters.

.2 Information for major items to be supplied with transformer (including those listed on data sheet.

.3 Preliminary schedule for the design, approval, manufacture, test and delivery to Site.

.4 Proposed delivery plan including:

.1 Method of transport,

.2 Condition monitoring requirements (impact recorder, pressurization monitor),

.3 Transportation of insulating fluid,

.4 Listing of items to be shipped loose.

.4 Approval Documents and Drawing

.1 Approval Documents and Drawings

.1 Provide the following approval drawings to be submitted shall include, but not be limited to the following:

.1 Nameplate data,

.2 Confirmed dimensions and weights,

.3 Transformer centre of gravity,

.4 Transformer outline and shipping drawings and shipping weights,

.5 Layouts, schematics, and connection diagrams for the protection and control cabinet,

.6 Schematic and connection diagrams for the transformer auxiliary equipment,

.7 Complete technical information and supplier data sheets for major items to be supplied with the transformer (including those listed on transformer the datasheet)

.2 Drawings for approval shall be submitted within eight (8) weeks after award of Contract in the quantities and formats required by Section 01 33 00, Submittal Procedures.

.2 A detailed transformer manufacturing schedule shall be submitted within four (4) weeks after award of Contract. The Schedule shall detail each activity with start and finish dates, duration, etc. for each step of the design, manufacturing, factory and witness testing, delivery, site assembly, testing, and commissioning of the transformer.

.3 Test Plans:

.1 Provide a complete factory inspection and test plan for review and approval within twelve (12) weeks after award of Contract.

.2 Provide notification in advance of all tests and inspections. Provide fourteen (14) days notice advance notice for tests and inspections during manufacturing, and twenty-one (21) days for final witness testing.

.3 Test data and reports shall be submitted within seven (7) days after completion of tests.

.4 Submit final test reports for acceptance prior to the units being shipped.

.5 "As-Manufactured" drawings shall be submitted a minimum of fourteen (14) days prior to the scheduled shipping date. Final "As-Manufactured" package shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Requirements.

.5 Closeout Submittals:

.1 Provide submittals in accordance to Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance (O&M) manual(s) shall be provided the quantities and formats required by Section 01 78 23, Operation and Maintenance Data.

.3 The O&M manual shall include, but not limited to, the following:

.1 Production test certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties,

.2 Certified copies of reviewed test data and reports,

.3 Certified, Signed and Approved drawings,

.4 Product submittals,

1.04 MAINTENANCE

.1 Provide a recommended tools and spare parts list as required by Section 01 33 00, Submittal Procedures.

2 PART 2 PRODUCTS

2.01 TRANSFORMER CHARACTERISTICS

.1 General Characteristics:

.1 Type and Ratings:

.1 Transformer(s) shall be 3 phase, 60 Hz, liquid-filled suitable for pad mounting. The connections, cooling, and ratings shall be as per Transformer Datasheet. The requirements of CSA-C88, Sections 5, 6 and 7 shall apply.

.2 Temperature Rise:

.1 Limits of temperature rise shall be 65 degrees C average and 80 degrees C hottest spot, above ambient as per CSA-C88, Section 9. Other provisions of that section shall also apply.

.3 Impedance:

.1 Impedance shall be expressed on the rated (KNAN) MVA base and shall be as indicated on the Datasheet.

.4 Short Circuit Capability:

.1 Transformers shall be designed in accordance with IEEE C57.12.00, with a primary short circuit level as per Table 11. An acceptable alternative is CSA-C88, Table 3.

.5 Insulation Levels:

.1 Minimum insulation levels for winding and bushing shall be as specified on the Datasheet.

.2 Neutral bushings shall have same insulation as line bushings. All other requirements shall be as per CSA-C88, Section 11.

.6 Overload Capability:

.1 Transformers with 65°C temperature rise shall have overload capabilities in accordance with NEMA Publication TR98.

.7 Sound Level:

.1 Sound levels shall not exceed the values in CSA-C88, Table 8.

.8 Tolerances:

.1 Tolerances shall be as per CSA-C88, Table 9.

.2 Specific Characteristics:

.1 See Transformer Datasheet for Details.

.2 High Voltage Compartment:

.1 Tamper resistant HV enclosure shall be mounted on the front and enclose the HV bushings. The doors shall be secured with penta headed bolts.

.2 High voltage bushings shall be deadfront Pfisterer type suitable for Pfisterer connex separable connectors.

.3 Primary bushings shall be enclosed in a tamper resistant termination box with adequate space provided for termination of incoming 69kV, 1C-500MCM cable.

.3 Secondary Cable Compartment:

.1 Secondary bushings shall be suitable for connecting secondary cable using ANSI 386 bushing wells or one piece bushings complying with deadfront construction.

.2 The neutral bushing shall be brought out and shall be suitable for connection to the neutral grounding resistor.

.3 The phase bushings shall be located in a tamper resistant enclosure. The compartment shall provide sufficient wiring space and cable bending radius for bottom outgoing two (2) runs of 3 conductors, 500 MCM, 15kV, 133 percent insulation copper TECK90 cables per phase.

.4 Provide a 6.35 mm thick x 50.8 mm wide copper ground bus along entire width of the bottom of the compartment for ground connections.

.4 Provide a tamper resistant gauge box with hinged door and 3-point latching pad-lockable handle. The box is to be easily accessible from ground level.

.5 Neutral Grounding Resistor (NGR):

.1 See Datasheet for details.

.2 Rating: 7200 V line-neutral voltage, 100 A, duty rated for 10 seconds.

.3 Maximum permissible temperature rise of the enclosure, components (excepting resistor elements), and discharge air shall not exceed the values shown in Table 8 of CSA C22 No. 295-2015 (R2020) for “Duty Rated Assemblies”.

.4 Temperature rises for resistor materials shall not exceed the values shown in Table 9 of CSA C22 No. 295-2015 for a duty of “> 10 min” and the resistor material utilized.

.5 Temperature rises shall be based on an ambient of 40 degrees C.

.6 The NGR shall be “isolated by elevation” by mounting it on the top of the transformer enclosure.

.7 The NGR shall be insulated for the full transformer secondary line-to-line voltage.

.8 The NGR shall be labelled and marked in accordance with the requirements of CSA C22 No. 295-2015 (R2020), Section 5.

.9 Connections between the transformer neutral X0 bushing and the NGR HV terminal and sensing resistor shall be by the transformer Manufacturer.

.10 Grounding connection between the NGR LV terminal and the substation ground grid shall be by the Contractor. The NGR shall be connected to the substation ground grid by a separate connection

.6 Transformer Accessories:

.1 See Datasheet for details.

.2 Lifting eyes and jacking pad shall be provided at appropriate location on the transformer tank.

.3 Liquid temperature thermometer (in Celsius) with a drag hand for maximum indicated temperature (resettable), alarm and tripping contacts.

.4 Liquid level indicator shall be a magnetic oil level gauge with alarm and tripping contacts.

.5 Winding temperature thermometer (in Celsius) with a drag hand for maximum indicated temperature (resettable), alarm and tripping contacts.

.6 Pressure relief device shall be sized to prevent damage to the tank in case of an internal fault. One (1) sealed tripping contact provided to trip when the pressure relief device operates. Insulating fluid discharged from pressure relief device operation shall be directed downwards towards the oil containment and away from operational area and equipment.

.7 A Rapid Pressure relay shall be installed provided to detect a rapid pressure rise in the transformer tank. The relay shall include a seal-in relay with two (2) output contacts for tripping purposes. Seal-in relay shall be located in the protection and control panel.

.8 Pressure vacuum bleeder control and indication device shall be installed on the transformer tank and located to allow readability at ground level.

.9 For liquid drain, a valve closed with a threaded plug shall be provided.

.10 For liquid sampling, a valve closed with a threaded plug shall be provided. Note that a combination liquid drain/sampling valve c/w threaded plug(s) is also acceptable.

.11 Provide top and bottom connections, closed with threaded plugs for liquid treatment connection.

.12 Lockable indicator type shut-off valves shall be provided on the top and bottom radiator connection pipes if detachable radiators are provided. Radiators shall be provided with drain and vent plugs.

.13 Grounding pads with 4-hole NEMA configuration, drilled and tapped for 13 mm bolt connection shall be provided on opposite sides of the transformer tank. The minimum threaded depth of the holes shall be 13mm.

.14 Transformer core ground connection shall be brought out of the tank to permit core insulation testing if and when required.

2.02 FINISH

.1 Transformer shall be primed and painted to ASA 70 light grey.

.2 Finish tank exterior in accordance with CSA-C88.

2.03 APPROVED MANUFACTURERS AND STANDARD OF ACCEPTANCE

.1 Approved Equipment Manufacturer:

PTI Transformer or approved equal.

2.04 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Basic Electrical Materials and Methods, and as indicated on the Datasheet.

.2 Provide metallic (stainless steel) Transformer Nameplate (Rating Plate) in accordance with CSA-C88 on the outside of the transformer and on the inside of the transformer in the cable compartment.

.3 Equipment (transformer mounted devices, test switches, ratio selection terminal blocks, etc.), nameplates and tags shall be as indicated in the Specifications, Drawings and on Datasheet

.4 Nameplates and equipment tags shall be in accordance with the requirements of Section 26 05 00.

.5 Provide a lamacoid equipment identification on the outside of the transformer, example as follows:

BANK 1
12.5 MVA, 66 kV-12.47kV, 3Ø, 4W
FED FROM MB HYDRO LINE R82

.6 Provide warning nameplates on the front of the control panel which if fed by multiple sources of power. The warning lamacoids shall have white lettering on a red background. The wording shall list all AC and DC power sources including source voltage, source panel and panel circuit numbers, where control compartments are equipped with internal disconnecting fuses list fuses. Wording shall conform to the requirements of the CEC, typical example as follows:

WARNING
120VAC & 125VDC POWER PRESENT
FROM MULTIPLE SOURCES

REFER TO DRAWINGS AND ISOLATE
BEFORE WORKING WITHIN

POWER SOURCES
120VAC - PANEL XXX CCT XX

125VDC - PANEL XXX CCT XX
CONTROL PANEL 125VDC INTERNAL
DISCONNECTING FUSES
FUX-P/FU1-N
FUX-P/FU2-N

.7 Nameplates shall be attached by means of rivets, drive pins, or self-tapping screws. Note that the use of “sheet metal” or other screws having sharp points is NOT acceptable.

.8 Submit a detailed list of all proposed nameplates and equipment tags for review prior to fabrication.

2.05 SOURCE QUALITY CONTROL

.1 Submit to the Contract Administrator standard factory test certificates for each material in accordance with Specification Section 26 08 05, General Electrical Requirements - Electrical.

.2 Transformer shall be completely factory tested and the results certified, proving the performance of the units to provide capacities as listed in these Specifications.

.3 The following tests shall be performed in accordance with CSA C88:

.1 Resistance measurement of all windings.

.2 Ratio test at rated connection and on all taps.

.3 Polarity and phase relation tests.

.4 Sound level test.

.5 No-load loss at rated voltage and losses at 25%, 50%, 75% and 100% load.

.6 Excitation current at rated voltage.

.7 Impedance and load loss test.

.8 Short circuit impedance/leakage reactance.

.9 Frequency response of stray losses.

.10 Demagnetization.

.11 Dielectric frequency response.

.12 Insulating liquid lab test.

.13 Applied potential test.

.14 Induced potential test.

.15 Partial discharge test.

.16 Impulse tests: Primary & Secondary (Type Test).

.17 Pressure test.

.18 Capacitance and power factor dissipation test.

.19 Heat run, temperature rise test (Type Test).

.4 Perform a sweep frequency test (SFRA) in accordance with IEEE C57.149-2012 on all transformer terminals at the Vendor's factory prior to loading the transformer for shipment.

.1 The SFRA test shall be the last test performed immediately before loading on the transport truck/trailer and shipping and shall be performed with the transformer in its "transport" configuration.

.2 The SFRA test shall be the first test performed immediately upon receipt and unloading at the site. This test shall be performed with the transformer in its "transport" configuration and before any other testing or work is undertaken on the transformer.

.3 Record (for each separate test):

.1 Sweep frequency test waveforms and response waveforms,

.2 Complete test equipment data including; Manufacturer, model, serial number of the test equipment, and all test equipment,

.3 Provide details (photographs and detailed sketches or drawings) of the testing configurations, and connections.

.4 Include copies of the above data (both hard copy printouts and electronic files) with the transformer at shipment, forward a separate copy to the Contractor.

.4 Sweep frequency tests will be used to confirm that the transformer has not suffered damage in transport, and if necessary assist in the analysis of transport induced damage, by comparing the results of the test sets in .1 and .2 above.

3 PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 FIELD QUALITY CONTROL

.1 Pre-Commissioning Tests

.1 Demonstrate, in the presence of the City and/or the Engineer, all mechanical and electrical equipment are working properly.

.2 Submit commissioning plan to the Engineer for review fourteen (14 days) before the planned commissioning date.

.3 Vendor shall assist the Contractor when performing initial testing to establish the integrity of the transformer.

.4 Submit relevant equipment repair procedures to the Engineer if repairable defects are identified during testing. Do not repair or use defective parts without prior approval from the Engineer.

.2 Commissioning Tests

.1 Vendor shall assist the Contractor in conducting commissioning tests only after the satisfactory completion of the pre-commissioning tests, and prior to the turnover of the equipment to the City.

.3 Start-Up and Training

.1 Provide suitable field service technician to verify all cable and wiring terminations made by others and advise the City of any errors. Start-up equipment and conduct all required tests.

.2 Vendor to provide training and demonstration to the City covering all aspects of equipment operation, maintenance, troubleshooting and controls.

.3 The Vendor shall assist the Contractor during commissioning of the transformer under his responsibility in the Scope.

.4 Onsite service technician shall be present for the following stages of construction:

.1 Field quality control.

.2 Equipment startup.

.3 All levels of commissioning.

END OF SECTION

Row	Description	Design Requirements	Vendor Confirmation	Rev.
1	**GENERAL**			
2	TRANSFORMER EQUIPMENT NUMBERS	BANK 1		
...	QUANTITY REQUIRED	1		
	VENDOR QUOTATION NUMBER	VENDOR TO SPECIFY		
	VENDOR QUOTATION DATE	VENDOR TO SPECIFY		
	EQUIPMENT MANUFACTURER			
	RATING			
	BASE RATING (MVA)	12.5		
	COOLING	KNAN		
	RATED PRIMARY VOLTAGE (kV)	66		
	PRIMARY WINDING CONNECTION	DELTA		
	SECONDARY WINDING BIL (kV)	350		
	RATED SECONDARY VOLTAGE (kV)	12.47		
	SECONDARY WINDING CONNECTION	WYE, RESISTANCE GROUNDED		
	SECONDARY WINDING BIL (kV)	110		
	VECTOR GROUP	Dyn1		
	OPERATING ENVIRONMENT / PHILOSOPHY			
	ELEVATION ABOVE SEA LEVEL (METERS)	< 237		
	EQUIPMENT LOCATION (INDOORS / OUTDOORS)	OUTDOORS		
	UNUSUAL CONDITIONS (GASSES & DUSTS)	NOT APPLICABLE		
	HAZARDOUS AREA CLASSIFICATION	UNCLASSIFIED		
	AMBIENT DESIGN TEMPERATURE RANGE (°C)	±40		
	SEISMIC CLASSIFICATION	0		
	OPERATING SCHEDULE	CONTINUOUS WITH SCHEDULED MAINTENANCE		
	MEASUREMENT SYSTEM			
	METRIC / IMPERIAL	METRIC		
	REFERENCE SPECIFICATION			
	SPECIFICATION SECTION NUMBER	26 12 13 – LIQUID FILLED, HIGH VOLTAGE POWER TRANSFORMERS		
	APPLICABLE STANDARDS			
	SEE SPECIFICATON 26 12 13, SECTION 1.2	COMPLIANCE REQUIRED VENDOR TO CONFIRM		
	REFERENCE DRAWINGS	E-9000 E-9001 E-9002		
	UTILITY AVAILABLE FAULT LEVELS			
	IN SERVICE VALUES (CURRENT)			
	LINE R82 NORMAL OPERATION (ROSSER STN)	TBA		
	THREE PHASE (KA)	TBA		
	SINGLE LINE TO GROUND (KA)	TBA		
	YEAR HORIZON VALUES (FUTURE)			

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	LINE R82 NORMAL OPERATION (ROSSER STN)	TBA		
	THREE PHASE (KA)	TBA		
	SINGLE LINE TO GROUND (KA)	TBA		
	FUTURE NORMAL OPERATION	TBA		
	THREE PHASE (KA)	TBA		
	SINGLE LINE TO GROUND (KA)	TBA		
	TAPS			
	LOCATION	PRIMARY		
	TYPE	DE-ENERGIZED, (SEE ALSO "TAP SELECTOR SWITCH" BELOW)		
	RATING	2 @ 2.5 % FCAN 2 @ 2.5 % FCBN		
	DESIGN IMPEDANCE	MIN. 7.5%		
	POS. SEQ. IMPEDANCE (%), KNAN	VENDOR TO SPECIFY		
	ZERO SEQ. IMPEDANCE (%), KNAN	VENDOR TO SPECIFY		
	X/R RATIO	VENDOR TO SPECIFY		
	SOUND LEVEL AT 100% LOAD KNAN (dB_a)	PER CSA C88		
	LOAD LOSSES @ 85°C KNAN (kW)	VENDOR TO SPECIFY		
	NO LOAD LOSSES @ 100% RATED VOLTAGE (kW)	VENDOR TO SPECIFY		
	FLUX DENSITY @ 100% RATED VOLTAGE (T)	VENDOR TO SPECIFY		
	SHORT CIRCUIT WITH STAND	(SEE UTILITY FAULT LEVEL DATA ABOVE)		
	MULTIPLE OF KNAN CURRENT	VENDOR TO SPECIFY		
	MAXIMUM FAULT DURATION	VENDOR TO SPECIFY		
	DIMENSIONS AND WEIGHTS			
	DIMENSIONS (EACH TRANSFORMER)			
	OVERALL LENGTH (mm)	VENDOR TO SPECIFY		
	OVERALL WIDTH (mm)	VENDOR TO SPECIFY		
	OVERALL HEIGHT (mm)	VENDOR TO SPECIFY		
	WEIGHTS (EACH TRANSFORMER)			
	CORE AND COILS (kg)	VENDOR TO SPECIFY		
	TANK AND FITTINGS (kg)	VENDOR TO SPECIFY		
	INSULATING LIQUID (kg)	VENDOR TO SPECIFY		
	RADIATORS (kg)	VENDOR TO SPECIFY		
	TOTAL (kg)	VENDOR TO SPECIFY		
	SHIPPING DIMENSIONS (EACH TRANSFORMER)			
	TRANSFORMER – L x W x H (mm)	VENDOR TO SPECIFY		
	RADIATORS – L x W x H (mm)	VENDOR TO SPECIFY		
	ITEMS SHIPPED LOOSE – L x W x H (mm)	VENDOR TO LIST IN DETAIL		
	SHIPPING WEIGHTS (EACH TRANSFORMER)			
	TRANSFORMER SHIPPED (FILLED WITH INSULATING FLUID/WITHOUT INSULATING FLUID)	VENDOR TO SPECIFY		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	MAIN TRANSFORMER /w INSULATING FLUID (kg)	VENDOR TO SPECIFY		
	MAIN TRANSFORMER /wo INSULATING FLUID (kg)	VENDOR TO SPECIFY		
	ITEMS SHIPPED LOOSE (kg)	VENDOR TO LIST IN DETAIL		
	TRANSFORMER CONSTRUCTION			
	LIQUID PRESERVATION	SEALED TANK		
	PROVISIONS FOR VACUUM FILLING/PROCESSING	REQUIRED (FULL VACUUM)		
	INSULATING FLUID	VEGETABLE ESTER BASED (FR3)		
	INITIAL FILL OF INSULATING FLUID	REQUIRED		
	INSULATING LIQUID VOLUME /TRANSFOMER (Liters)	VENDOR TO SPECIFY		
	METHOD OF INSULATING FLUID SHIPMENT (DRUMS, TANKER, TRANSFORMER SHIPPED PRE- FILLED)	VENDOR TO SPECIFY		
	MANUFACTURER	CARGILL		
	TYPE	ENVIROTEMP FR3		
	PRESSURE VACUUM BLEEDER	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE	VENDOR TO SPECIFY		
	TRANSFORMER FILL AND DRAIN/SAMPLING VALVES	REQUIRED		
	FILL VALVE LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	EQUIPPED WITH “SAFETY” PIPE PLUG DRAIN / SAMAPLING VALVE	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	EQUIPPED W ITH “SAFETY” PIPE PLUGS	REQUIRED		
	TANK GROUNDING PADS (QTY 2, ON OPPOSITE CORNERS OF TRANSFORMER)	4-HOLE NEMA STD		
	GASKET MATERIAL	VENDOR TO SPECIFY		
	EXTERIOR FINISH	EPOXY ENAMEL		
	EXTERIOR COLOUR	ASA 70, LIGHT GRAY		
	INTERIOR FINISH	EPOXY ENAMEL		
	INTERIOR COLOUR	WHITE		
	DETACHABLE RADIATORS	VENDOR TO SPECIFY		
	RADIATOR ISOLATION VALVES	REQUIRED IF RADIATORS DETACHABLE		
	TYPE	VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	LOCKABLE	REQUIRED		
	WINDINGS			
	PRIMARY WINDING - MATERIAL	COPPER		
	PRIMARY WINDING - TYPE	DISK		
	SECONDARY WINDING - MATERIAL	COPPER		
	SECONDARY WINDING - TYPE	DISK		
	SECONDARY WINDING - INSULATION	NON-GRADED		
	HIGH VOLTAGE PRIMARY BUSHINGS (H1, H2, H3)			
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	PFISTERER		
	STANDARD OF CONFORMANCE (ANSI, EEMAC)	ANSI/IEEE		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	VOLTAGE RATING (kV)	66 (MINIMUM)		
	CURRENT RATING (A)	VENDOR TO SPECIFY	``	
	BIL LEVEL (kV)	350 (MINIMUM)		
	CREEPAGE DISTANCE (mm)	PER CSA C88		
	NEUTRAL GROUNDING RESISTOR (NGR)			
	LOCATION	MOUNTED ON TOP OF TRANSFORMER, SEE DRAWINGS AND SPECIFICATIONS		
	MANUFACTURER	VENDOR TO SPECIFY		
	RATING, L-N (V)	7200		
	SHORT TIME CURRENT RATING	100A FOR 10 SECONDS		
	RESISTOR MATERIAL	STAINLESS STEEL		
	ENCLOSURE	NEMA 3R, VENTILATED		
	ENCLOSURE MATERIAL	STAINLESS STEEL		
	X_0 BUSHING TO NGR CABLE	15KV INSULATED RW90 CONDUCTOR, BY TRANSFORMER VENDOR		
	SENSING RESISTOR TO X_0 BUSHING CABLE	15KV INSULATED RW90 CONDUCTOR BY TRANSFORMER VENDOR		
	NGR GROUND CABLE	4/0 AWG BARE GROUNDING CABLE (DIRECT TO GROUND MAT), BY CONTRACTOR		
	NGR CURRENT TRANSFORMER			
	LOCATION	IN NGR ENCLOSURE		
	MANUFACTURER	VENDOR TO SPECIFY		
	CT RATIO	200:5A		
	CT ACCURACY	C200		
	NGR SENSING RESISTOR			
	LOCATION	IN NGR ENCLOSURE		
	STANDARD OF ACCEPTANCE (SEE NOTE 1)			

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	MANUFACTURER	***LITTELFUSE STARTCO***		
	PART NO	***ER-15KV***		
	TRANSFORMER SECONDARY COMPARTMENT			
	SECONDARY AND NEUTRAL BUSHING ENTRANCE	VENDOR TO SPECIFY		
	NEUTRAL X_0 BUSHING TO NGR AND X_0 BUSHING TO SENSING RESISTOR CONDUCTOR LOCATION	SIDE OR BACK, (TOP EXIT NOT ACCEPTABLE) VENDOR TO SPECIFY		
	X_0 BUSHING TO NGR AND X_0 BUSHING TO SENSING RESISTOR CONDUCTORS TYPE & SIZE	1c #1 AWG, 15kV, BY TRANSFORMER VENDOR, VENDOR TO SPECIFY		
	TERMINATION COMPARTMENT ACCESS PROVISIONS	CONTINUOUS HINGE, BOLTED, GASKETED DOOR(S) c/w PADLOCKABLE 3 POINT LATCHES (SPLIT DOORS PREFERRED). BOLTS TO BE TAMPERPROOF		
	INTERNAL GROUND BAR	REQUIRED, 6.35 x 50.8 mm, FULL WIDTH, TAPPED FOR WIRE LUGS, DRILLED FOR NEMA STD 2-HOLE LUG @ BOTH ENDS		
	SECONDARY BUSHINGS (X1, X2, X3)			
	LOCATION	SECONDARY COMPARTMENT		
	MANUFACTURER	VENDOR TO SPECIFY		
	STANDARD OF CONFORMANCE (ANSI, EEMAC)	ANSI/IEEE		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	VOLTAGE RATING (kV)	12.47 (MINIMUM)		
	CURRENT RATING (A)	VENDOR TO SPECIFY		
	BIL LEVEL (kV)	110 (MINIMUM)		
	CREEPAGE DISTANCE (mm)	VENDOR TO SPECIFY		
	CABLE TERMINATION REQUIREMENT	SUITABLE FOR 2 RUNS OF 3C-500MCM, 15kV HVTECK 133% TERMINATION		
	SECONDARY NEUTRAL BUSHING (X0)			
	LOCATION	SECONDARY COMPARTMENT		
	MANUFACTURER	VENDOR TO SPECIFY		
	STANDARD OF CONFORMANCE (ANSI, EEMAC)	ANSI/IEEE		
	TYPE	PORCELAIN, FULLY RATED		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	VOLTAGE RATING (kV)	12.47 (MINIMUM)		
	CURRENT RATING (A)	VENDOR TO SPECIFY		
	BIL LEVEL (kV)	110 (MINIMUM)		
	CREEP DISTANCE (mm)	PER CSA C88		
	TERMINAL PAD	4-HOLE NEMA STD		
	TRANSFORMER AUXILIARY EQUIPMENT			

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	TOP INSULATING FLUID TEMPERATURE (ANSI DEVICE 71T)	**REQUIRED**		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	ALARM CONTACT (HI)	1 (N.O.)		
	ALARM SETPOINT (°C)	VENDOR TO SPECIFY		
	TRIP CONTACT (HI-HI)	1 (N.O.)		
	TRIP SETPOINT (°C)	VENDOR TO SPECIFY		
	WINDING TEMPERATURE (ANSI DEVICE 49T)	**REQUIRED**		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	ALARM CONTACT (HI)	1 (N.O.)		
	ALARM SETPOINT (°C)	VENDOR TO SPECIFY		
	TRIP CONTACT (HI-HI)	1 (N.O.)		
	TRIP SETPOINT (°C)	VENDOR TO SPECIFY		
	OIL LEVEL INDICATOR (ANSI DEVICE 71Q)	**REQUIRED**		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	ALARM CONTACT (LO)	1 (N.O.)		
	ALARM SETPOINT	VENDOR TO SPECIFY		
	TRIP CONTACT (LO-LO)	1 (N.O.)		
	TRIP SETPOINT	VENDOR TO SPECIFY		
	PRESSURE RELIEF DEVICE (ANSI DEVICE 63P)	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	QUALITROL		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	OUTPUT CONTACT	1 (N.O.)		
	RAPID PRESSURE RISE RELAY (ANSI DEVICE 63Q)	REQUIRED		
	LOCATION	ON TRANSFORMER, VENDOR TO SPECIFY		
	MANUFACTURER	QUALITROL		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	TAP SELECTOR SWITCH	REQUIRED		
	TYPE (POSITIVE DETENT, DE-ENERGIZED OPERATION w/ TAP POSITION INDICATION)	REQUIRED		
	QUANTITY REQUIRED	1 (PER TRANSFORMER)		
	MANUFACTURER	VENDOR TO SPECIFY		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		

Row	Description	Design Requirements	Vendor Confirmation	Rev.
	PADLOCKABLE	REQUIRED		
	WARNING PLATE INDICATING	REQUIRED, MOUNT AT TAP SWITCH OPERATING		
	" DANGER DO NOT OPERATE TAP SELECTOR SWITCH WITH TRANSFORMER ENERGIZED" OR SIMILAR APPROVED WORDING	HANDLE, BLACK LETTERING ON RED BACKGROUND, MINIMUM 12mm LETTERING		
	RAPID PRESSURE RISE SEAL-IN RELAY (ANSI DEVICE 86Q)			
	SEAL-IN RELAY EQUIPMENT TAGS	SEE DRAWINGS & SPEC.		
	LOCATION	CONTROL PANEL		
	QUANTITY REQUIRED	1 (PER TRANSFORMER)		
	MANUFACTURER	QUALITROL		
	CATALOGUE NUMBER	VENDOR TO SPECIFY		
	NAMEPLATES			
	TRANSFORMER RATING PLATE IN ACCORDANCE WITH CSA-C88-M90 (R2009), CLAUSE 17 – RATING PLATE	REQUIRED		
	TRANSFORMER TAGS & NAMEPLATES	AS INDICATED ABOVE SEE SPECIFICATIONS FOR SPECIFIC REQUIREMENTS AND SIZES		
	EQUIPMENT TAGS & NAMEPLATES	EQUIPMENT TAGS AS INDICATED ABOVE SEE SPECIFICATIONS FOR SPECIFIC REQUIREMENTS AND SIZES		
	CONNECTIONS AND WIRING			
	WIRING	AS PER SPECIFICATIONS		
	COMMUNICATIONS	TBD		
	COMMUNICATIONS PROTOCOL	TBD		
	TESTING			
	TYPE TESTS	AS PER SPECIFICATIONS AND STANDARDS		
	MANUFACTURERS ROUTING TRANSFORMER TESTING	AS PER SPECIFICATIONS AND STANDARDS		
	WITNESS TESTING	AS PER SPECIFICATIONS AND STANDARDS		
	OTHER TECHNICAL REQUIREMENTS	AS SPECIFIED		
	PROVIDE COMPLIANCE STATEMENT TO SPECIFICATION REQUIREMENTS	VENDOR TO PROVIDE		
	ENGINEERING NOTES:			
	1. PROVIDE EXTRA LENGTH BUSHINGS, MOUNT MUSHINGS ON TURRETS, OR BOTH AS REQUIRED TO GIVE SPECIFIED ISOLATION DISTANCE.			

SIGNATURES: (Both signatures below are required)

Authorised Representative at Quoting Agency (Vendor)			
Name [PRINT]	Signature	Position	Date

Row	Description	Design Requirements	Vendor Confirmation	Rev.
Authorised Representative at Manufacturer's Works (Manufacturer)				
Name [PRINT]		Signature	Position	Date

1 PART 1 GENERAL

1.01 RELATED SECTIONS

.1 Section 01 33 00, Submittal Procedures

.2 Section 26 05 00, Basic Electrical Materials and Methods

.3 Section 26 12 13, Liquid filled, High Voltage Power Transformer

1.02 CODES AND STANDARDS

.1 ANSI C37.06 - Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

.2 ANSI C37.010 - Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

.3 ANSI C37.11 - Requirements for Electrical Controls for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

.4 ANSI C37.20.2 - Metal-Clad and Station-Type Cubicle Switchgear

.5 IEEE C37.20.7 - IEEE Guide for Testing Metal Enclosed Switchgear rated up to 38kV for Internal Arcing faults

.6 ANSI C37.23 - Metal-Enclosed Bus and Guide for calculating Losses in Isolated Phase Bus

.7 CSA No. 14 – Industrial Control Equipment

.8 ANSI C57.13 - Requirements for Instrument Transformers

.9 CAN3/CSA C13 - Instrument Transformers

.10 CSA C22.2 No. 31 - Switchgear Assemblies

.11 CAN3/CSA Z299.3 - Quality Assurance Program – Category 3

.12 CSA C22.1 - Canadian Electrical Code - part 1.

.13 ANSI/IEEE C37.100, C37.20, C37.04, C37.09 37.013A.

.14 ANSI/IEEE C37.09

.15 ANSI C37.54, C37.55, NEMA SG4.

.16 EEMAC G8.2 - Switchgear assemblies.

.17 ASTM F855 – Standard Specifications for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment

1.03 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 01, Common Work Results – Electrical. Documents shall be submitted in the quantities and formats required by Section 01 33 00, Submittal Procedures.

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

.3 Provide proof of capabilities and experience for the programming services provider proposed for the configuration, logic development and programming of the protective relays.

.4 Shop Drawings and calculations are to be signed and sealed by a Professional Engineer, licensed in the Province of Manitoba.

.5 Shop Drawings shall include, but not be limited to:

.1 Mounting method and dimensions.

.2 Enclosure construction.

.3 Locations of shipping splits.

.4 Lifting and supporting points.

.5 Electrical single line drawings.

.6 Breaker control schematics.

.7 Breaker internal wiring schematics.

.8 Three-line diagram.

.9 Wiring Diagram.

.10 Elevation drawings.

.11 Component layout drawings.

.12 Bill of materials for all components.

.13 Door details.

.14 IR inspection window details.

.15 Communication system schematic

.16 Controls one-line diagram

.17 Conduit entry / exit locations

.18 Cable terminal sizes

.19 Field cabling requirements

.20 Equipment Electrical Ratings (Nameplates).

.21 Mimic diagram layout.

.22 System energization and startup procedures

.23 Torque specifications for all bolted current carrying connections. For connections (bus bar and cable) employing spring washers (Bellville washers) provide detailed torque calculations including Bellville washer part numbers, and material (signed and stamped).

.24 Details of the key interlock system, including part numbers, and logic diagram / table.

.25 Inspection and test plan and schedules.

1.04 OPERATIONS & MAINTENANCE (O&M) MANUAL

.1 Provide submittals in accordance to Section 01 78 00, Closeout Procedures and Section 26 05 00, General Electrical Requirements.

.2 Prepare installation, operating and maintenance (O&M) manuals in the formats and quantities required by Section 01 78 23, Operation and Maintenance Data.

.3 Each of the O&M Manuals shall include, at a minimum, the following:

.1 All Shop Drawing information.

.2 Signed and sealed equipment “As Manufactured” Drawings.

.3 Certified product test reports.

.4 Certificates of compliance.

.5 CSA certificate of inspection for the complete switchgear lineup, or Manitoba Office of the Fire Commissioner, Inspection and Technical Services Manitoba “Special Inspection” certificate for the complete switchgear lineup.

.6 Handling and installation instructions, including equipment anchorage information and provisions.

.7 Operating and maintenance instructions.

.8 Complete component list.

.9 Recommended maintenance practices and procedures.

.10 Recommended spare parts list.

.11 CT curves and data sheets.

.12 Equipment and component Manufacturer’s detailed instructions, installation and maintenance manuals.

.13 Standard cut sheets for OEM devices.

.14 Component manuals for all devices/equipment/relays incorporated into the equipment.

.15 Metering equipment settings and programming information.

.16 Site Testing & Commissioning Procedures, and recommendations and precautions for setting into operation.

.17 Test plan and inspection records.

.18 Certified copies of all test reports.

.19 Nameplate rubbings.

.20 Such additional information, instructions, data, recommendations, and procedures that the switchgear manufacturer considers to be pertinent.

.21 Relay programming and relays / controller settings (6 copies of software on 6 memory sticks) as well as printed hardcopy. Include a copy of the software needed to view / read / modify the files on each memory stick.

1.05 QUALITY ASSURANCE

.1 Accept equipment on site and inspect for shipping damage.

.2 When long term storage (> 1 week) of switchgear is required, the switchgear shall be stored indoors in a heated environment or shall be covered with a weather-proof heated hording. For short term storage (≤ 1 week) and during installation protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within the enclosure in accordance with Manufacturer's instructions.

2 PART 2 PRODUCTS

2.01 SCOPE

.1 Switchgear shall all be of the same type, class, and manufacture and shall utilize the same make and type of vacuum circuit breaker.

2.02 SWITCHGEAR ASSEMBLY

.1 Switchgear shall consist of outdoor skin-tight weatherproof insulated enclosure containing vacuum circuit breakers and the necessary accessory components all factory assembled (with shipping splits as required) and tested and operationally checked. The circuit breaker shall be arranged in a single high configuration. The assembly shall be self-supporting, and floor mounted on a level floor or concrete housekeeping pad. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned short circuit rating.

.2 System Voltage: 12.47 kV, 3Ø, 3W, 60 Hz, resistance grounded.

.3 Design Voltage Class: 15 kV.

.4 Impulse Withstand (BIL): 95 kV.

.5 Power Frequency Withstand: 36 kV for 1 minute.

.6 Main Bus Current Rating: 1200 Amps, continuous, 100 percent rated.

.7 Momentary Current Rating: Equal to (or greater than) the circuit breaker close and latch rating. Switchgear structures shall be solidly grounded.

.8 Suitable for operating temperature range from -40°C to +40°C.

.9 Space heater shall be size to ensure minimum internal enclosure temperature of 5°C at an outdoor ambient of -40°C.

.10 The switchgear shall be full metal-clad construction.

.11 The depth of the finished equipment shall be sufficient to allow for entrance, bending radius, installation of high voltage power cable terminations (stress cones) and connection of power cables (for size of power cables see Drawings). Internal clearances shall comply with CSA standards.

.12 The product shall have cUL and CSA certification labels applied.

.13 The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, in a rigid metal-clad design. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit.

.14 Each front compartment shall be provided with a formed steel hinged door with hand operated door latches. Doors shall be provided with provisions for padlocking, and a means to permit visual confirmation of the circuit breaker position from outside the door.

.15 Interlocks shall be provided to prevent racking a circuit breaker into or out of a compartment with the circuit breaker compartment door in the open position. This interlock may be manually circumvented for maintenance purposes by a deliberate act on the part of the operator. This override shall require a minimum of two separate and distinct operations, neither of which is part of normal operations.

2.03 COMPONENTS

.1 General

.1 The switchgear shall be compartmentalized and fabricated in sections. The sections shall be divided by metal barriers into the following separate compartments:

.1 MV Circuit breaker,

.2 Instruments,

.3 Low voltage relay and control,

.4 Main bus,

.5 Auxiliary devices, and

.6 Incoming/outgoing cable(s).

.2 Each vertical section shall have one circuit breaker compartment(s) as indicated on the Drawings.

.2 Cable Compartment / Power Connections

.1 The cable compartment shall be able to accept standard customer requirements for cable terminations, including lugs, potheads and stress cones.

.2 Bus supports shall be epoxy based standoff insulators. Provision shall be made for adding cable supports as required.

.3 Cable connection pads shall be supplied with insulating boots sized to accept the cable size indicated on the Drawings. Cable connection pads shall be drilled to NEMA standard 4- hole pattern.

.4 Cable entry shall be bottom entry for all incoming and outgoing feeders.

.5 Space shall be allowed for the mounting of a zero sequence CT around the cables. Include spare terminal blocks and mounting hardware.

.6 Cable entry/exit plates shall be stainless steel. Cable compartment gland plates shall be non-magnetic and removable.

.7 Inter-cell barriers shall be stainless steel.

.8 The cable compartment door shall be hinged and bolted type and shall be key interlocked to prevent opening with the circuit breaker in the “Connected” position.

.9 Provide Infrared (IR) inspection windows on the cable compartment doors. IR windows shall be sized and located to permit thermal (IR) scanning of the cable connection area(minimum 2 windows per cable compartment door termination area).

.1 Manufacturer: IRISS (NO Equals or Substitutions Permitted),

.2 Type: Reinforced polymer IR/Visible window type c/w integral cover,

.3 Series: CAP-ENV (preferred), or VPFR (acceptable),

.4 Minimum Optic Windows Size: CAP-ENV-4 (96.8 x 96.8 mm), VPFR-75 (76 mm Ø),

.3 Ground Bus

.1 The copper ground bus shall extend through the full length of the switchgear. Ground bus supports shall be NEMA Class A-20 epoxy standoff insulators.

.2 Provide a 25mm Ø ball grounding stud c/w removable insulating cover on the ground bus within each cable compartment. The ball ground stud shall be located and oriented to permit the easy installation of grounding cable sets using hot tools. The removable insulating cover shall be designed for removal and installation using hot tools. Ball studs shall be rated 43,000 Amps for 15 cycles and 30,000 Amps for 30 cycles.

.3 The ground bus system shall be capable of carrying the rated short circuit current of any breaker in the assembly for a minimum period of two (2) seconds.

.4 Provide main ground conductor cable termination points for minimum 4/0 AWG grounding cable at opposite ends of the switchgear assembly.

.5 Ground cable attachment shall be NEMA standard spacing, 2-hole pattern, long barrel crimp type lugs.

.4 Main Bus Compartment

.1 The main and vertical bus bars shall be fully rated for 1200 amps per phase, and be fully insulated for its entire length. The bus shall be tin-plated copper and of bolted connection design.

.2 Access to this compartment shall be from the rear within the structure by removing steel barrier(s). Provide for future extension of the main bus from either end, including pre- drilling of the main bus for future extension connectors.

.3 Both the main and vertical bus bars shall be contained in their own compartment within each cell.

.4 Main bus compartment shall be further compartmentalized by means of metal barriers and track resistant, flame-retardant glass polyester through insulators between adjacent compartments.

.5 Buses and joints shall be designed such that the maximum temperature rise of any part shall not exceed 60 degrees C over an ambient temperature of 30 degrees C.

.6 Bolted bus connections shall utilize four bolts minimum and shall employ constant tension devices (Bellville washers) to ensure joint integrity. Joining bolts shall be minimum Grade 5 and shall be plated for corrosion resistance. Note cadmium plating is considered to be carcinogenic and cadmium plated bolts are not acceptable.

.7 Where Bellville spring washers are utilized washer size, thickness and the final bolting torques shall be determined in accordance with the Bellville washer manufacturer’s calculation procedures and recommendations.

.8 Bus orientation shall be A-B-C top to bottom, front to back and left to right, when viewed from the front of the equipment.

.9 Bus joints and cable terminations shall be covered with form-fitting insulating boots

.5 Doors and Panels

.1 Relays, meters, flexi-test switches, control switches, indicating lights etc., shall be mounted on the formed front-hinged panel of each low voltage compartment. Control components (selector switches, control switches, lockout relays, test switches, pilot lights, etc.) shall be as per the Specifications, and as indicated on Drawings. Protective relays shall be Schweitzer Engineering Laboratories (SEL), as indicated on the Drawings.

.2 Provide front cover mimic bus, c/w plastic symbols.

.6 Circuit Breaker Compartment.

.1 The compartment design shall allow the circuit breaker to roll in and out easily.

.2 The stationary primary disconnecting contacts shall be silver-plated for wear resistance. Through-the-door circuit breaker racking shall be provided. One window suitable for viewing the position of the circuit breaker in the cell and the position of the shutters with the circuit breaker out of the cell shall be provided.

.3 A mechanical interlock system shall be provided as follows:

.1 The circuit breaker compartment door cannot be opened once the breaker is in the “Connected” position.

.2 The circuit breaker compartment door cannot be opened while the breaker is “Closed” or “On”.

.3 The circuit breaker compartment door can be opened only with the breaker is in the “Disconnected” or “Test” position only.

.4 Entrance to the stationary primary disconnecting contacts shall be automatically covered by metal shutters when the circuit breaker is withdrawn from the connected position to the “Test” or “Disconnected” position or removed from the circuit breaker compartment.

.5 Extend a ground bus into the circuit breaker compartment to automatically ground the breaker frame with high-current spring type grounding contacts located on the breaker chassis when the circuit breaker is inserted into the compartment sufficiently far that the racking drive system can be engaged, and at all times when the breaker is in the “Test”, “Connected” positions and during racking.

.6 Guide rails for positioning the circuit breaker and all other necessary hardware shall be an integral part of the circuit breaker compartment.

.7 Blocking devices shall interlock breaker frame sizes to prevent the insertion of a breaker of a lower ampere rating or interrupting capacity into a compartment designed for a breaker of a higher rating. The blocking devices shall be permanently attached to the cell and the circuit breaker and shall be non-removable without the use of specialized tools.

.8 Where outdoor switchgear is directly mounted on a concrete pad it shall be possible to remove and install the lower circuit breaker into its compartment without use of a transport truck or lift device

.7 Medium Voltage Circuit Breakers:

.1 The circuit breakers shall be rated 12.47 kV nominal, 15 kV, 60 Hz, rated with a continuous current rating of as shown on drawings and a symmetrical interrupting rating of 25 kA.

.2 The vacuum interrupters in the circuit breaker shall be mounted in a high strength molded glass reinforced polyester insulation support/ housing.

.3 Breakers of same type and rating shall be completely interchangeable.

.4 The circuit breaker shall be operated by means of a stored energy mechanism which is normally charged by a universal motor but can also be charged by the manual handle for manual emergency closing or testing. The closing speed of the moving contacts shall be independent of both the control voltage and the operator.

.5 Circuit breakers shall be “tease proof”.

.6 Provide a full front shield on the breaker.

.7 Secondary control circuits shall be connected automatically with a self-aligning, self-engaging plug and receptacle arrangement when the circuit breaker is racked into the connected position. Provision shall also be made to permit the secondary control plug to be manually connected in test position.

.8 Breaker manual control handle shall be located on each cell door, and allow for full manual operation of each breaker as detailed elsewhere in this Specification.

.9 The racking mechanism to move the breaker between positions shall be operable with the front door closed and position indication shall be visible with door closed.

.10 Each circuit breaker shall have three, clearly-marked definite positions within its enclosure, i.e. "Connected", "Test" and "Isolated" positions.

.11 Mechanical interlocks shall be provided to:

.1 Prevent inserting or withdrawing a “closed” breaker,

.2 Prevent racking a closed-circuit breaker to or from any position,

.3 Prevent closing a circuit breaker unless it is in the "Connected" or "Test" positions within the switchgear, or is fully removed from the switchgear with the secondary control circuits connected by an extension cable.

.4 Automatically discharge the stored-energy operating mechanism springs upon removal or insertion of the breaker.

.12 A shutter system shall automatically cover the fixed line and load bus stabs, when the circuit breaker moves to a disconnected position. The shutters/shutter operating mechanism shall be pad-lockable in closed position from the front of the cell. Pad locking attachment point shall be sized to permit the installation of lock extension devices without compromising the security of the system.

.13 Provide contact wear indicator for each vacuum interrupter unit.

.14 Breakers shall have a trip operation time of ≤ 3 cycles.

.8 Circuit Breaker Controls

.1 All circuit breaker controls, spring charging mechanism, and auxiliaries shall be designed for operation at 120 VAC.

.2 The Trip circuit shall be furnished with capacitor trip unit.

.3 Visible break dead front fuse holders with current limiting fuses shall be provided for each circuit breaker cell in the switchgear. Fuse holders shall be "ganged" so that fuse holders open/close as a pair. The Circuit breaker tripping circuit shall be fed from the cell "master" fuses with separate sub-fusing from the master fuses for:

.1 The circuit breaker closing coil/charging motor circuit, and

.2 The AC protection relay circuit.

.4 120 VAC control/protection power from the 120 VAC distribution panel shall connect to the switchgear at one (1) location only for each switchgear bus section. Internal distribution of the 120 VAC power within the switchgear sections shall be the responsibility of the switchgear Manufacturer.

.5 Manual circuit breaker close/trip shall be by means of a heavy duty, rotary type "pistol grip" handle breaker control switch. The breaker control switch shall be equipped with a mechanical indicator flag which shall indicate the last operated position of the switch. Indicator flag shall colour coded green – Open and red – Close.

.6 All breaker status indicating light assemblies shall be 120 VAC, low burden, high luminosity, long life, LED lamp type with coloured caps. LED lamp and colour cap shall be colour matched. LED Lamps shall be bayonet base type and shall be replaceable by removing the colour cap. Minimum status indicator requirements (plus any additional requirements shown on the Drawings) per breaker shall be as follows:

.1 Red light to indicate breaker is closed (CB CLOSED).

.2 Green light to indicate breaker is open (CB OPEN).

.9 Breaker Auxiliary Devices:

.1 Mechanical Status indicators:

.1 Mechanical status indicator to show circuit breaker main contacts "closed" or "open".

.2 Mechanical status indicator to show stored-energy operating mechanism springs" charged" or "discharged".

.2 Non-resettable mechanical operations counter (may be electrically activated).

.3 Auxiliary contacts:

.1 In addition to those contacts required internally in the switchgear for control, interlocking and indication of the circuit breaker itself, provide a minimum of four (4) NO and four (4) NC Mechanism Operated Contacts (MOCs) wired to terminal blocks as shown on the Drawings.

.2 In addition to those contacts required internally in the switchgear for control, interlocking and indication of the circuit breaker itself, provide a minimum of four (4) NO and four (4) NC Truck Operated Contacts (TOCs) wired to terminal blocks as shown on the Drawings.

.4 Racking provisions:

.1 All breaker racking shall operate "through-the-door" with the breaker compartment door in the closed and latched position

.2 Provide one (1) manual cranking handle with each switchgear assembly for manually racking circuit breakers in and out of the cubicle. A minimum of two (2) handles in total shall be supplied.

.3 Provide one 120 VAC powered portable electrical racking device for each switchgear assembly. The Electrical racking device shall be as follows:

.1 Be provided with a 20 meter long power cord (12 AWG or larger as required) equipped with a CSA 5-15R pattern cord cap,

.2 Be provided with a permanently attached hand-held portable control pendant on a 15 meter long cable. Pendant control shall include (at a minimum), a "power on/off" maintained contact pushbutton (pull "on", depress "off"), a "power on" LED type pilot light, a directional "rack-in/rack-out" selector switch, and a momentary "run/operate" push button,

.3 Securely attach to the breaker cell door by means of mechanical attachments or magnets and shall be positively located to prevent rotation of the device body in operation. The attachment and locating means shall not require any projections or protrusions on the cell or cell door,

.4 Shall be equipped with limit switches and a slip clutch to prevent over-torquing or damaging the circuit breaker racking mechanism, the circuit breaker itself, the switchgear breaker compartment door or internal switchgear components ("stabs" and auxiliary connector),

.5 Shall be specifically designed and manufactured for the make and model of the switchgear equipment.

.4 All auxiliary relays used for controls shall be CSA approved, with heavy duty contacts rated for operation on 120 volts AC, with visual indication of coil energization.

.10 Instrument Transformers

.1 Current Transformers:

.1 Each breaker compartment shall have provision to accommodate four (4) front- accessible mounted current transformers per phase, two CTs on the bus side and two CTs on cable side of circuit breaker. Provide current transformers as indicated on the Drawings.

.2 Where the current transformers are mounted over a fully insulated fixed "stab" bottle, the current transformer assembly shall be insulated to a minimum of 600V.

.3 Where current transformers are mounted over bus or other portions of the switchgear which are not insulated for the full voltage rating of the switchgear the current transformer assembly shall be, either insulated to a minimum of 600V and "spaced" from the live parts to provide the required insulation levels, or the current transformer assembly shall be insulated for the full voltage rating of the switchgear.

.4 Current transformer wiring shall be Type SIS, minimum # 10 AWG, 600 V, 90 degrees C (minimum) and shall terminate on grounding type CT ratio selection terminal blocks (c/w removable shorting jumper(s) and ABB type "Flexitest" blocks for devices.

.5 Current transformers shall be ANSI standard relay class and have their accuracy established in accordance with the connected burden and ANSI C57.13 but shall be at least:

.1 10C200, Thermal factor 130 percent for all phase CTs.

.2 10C50, for all zero sequence CT.

.3 10C200, for all bus bar differential CTs.

.6 Zero sequence CTs shall be Manufacturer's standard design and shall be properly rated and tested for use in medium voltage switchgear installations.

.7 Zero sequence CTs windows shall be dimensioned to allow passage of the specified cables complete with NEMA standard 2-hole pattern long barrel double crimp type lugs and high voltage cable terminations.

.8 Zero sequence CTs shall be mounted in such a manner as to permit its easy removal for installation of cables complete with high voltage terminators and cable gland connectors.

.2 Potential Transformers:

.1 The main bus potential transformers shall be rated as indicated on the Drawings.

.2 The bus PTs shall be rated to withstand 15500 volts to ground on any phase, and to provide an output on healthy secondary phase windings when phase to neutral voltage increases by 173 percent on a phase to ground fault.

.3 Potential transformers shall be of the draw-out or tilt-out type protected by current limiting fuses both on primary and secondary windings. The potential transformer draw-out or tilt-out mechanism shall be designed such that the primary and secondary

.4 transformer connections and fuses shall be automatically grounded in the withdrawn position.

.5 In general potential transformers shall be as follows:

.1 Primary: 14400V,

.2 Secondary: 120V,

.3 Frequency: 60 Hz,

.4 Ratio: 120:1,

.5 Maximum System voltage: 15.5.KV,

.6 Impulse Rating:110KV BIL

.7 Thermal Rating:

.1 1500VA at 30 degrees C ambient,

.2 1000VA at 55 degrees C ambient,

.8 Accuracy Class:

.1 0.3 WXMYZ 1.2 ZZ at 100 percent rated voltage with 120V based ANSI burden,

.2 0.3 WXMY, 1.2Z at 58 percent rated voltage with 69.3V based ANSI burden,

.9 ANSI Group 2.

.11 Control Wiring and Connections.

.1 The switchgear shall be wired with the type SIS, # 14 AWG, 600 V, 90 degrees C, except where larger size wire is required by CSA standard, or specified on Drawings.

.2 The switchgear shall be provided with terminal blocks for incoming and outgoing control connections.

.3 All wiring shall be tagged and identified on both ends of every wire using printed heat

.4 shrink sleeve type wire markers. Handwritten numbering is NOT acceptable. The wire numbering scheme shall be such that the wire numbers change only when going through a device (coil, contact, etc.). Wire numbers at both ends of the same wire shall be identical. All wires on a given terminal block position shall bear the same number, with the exception that at CT shorting type ratio selection terminal blocks, wires may have different wire numbers on opposite sides of the ratio selection CT block.

.5 All wiring originating from a compartment must be first routed to terminal block.

.6 Connections to external circuits shall be brought to modular, asymmetrical DIN rail mounted snap-on construction, pressure type terminal blocks, with marking strips. Approved terminal block types are:

.1 Weidmuller Type SAK 6N (preferred), Wieland type WK 6/U (acceptable), or approved equal in accordance with B8,

.2 Weidmuller type SAK B10C (preferred), Wieland type WKN 16DS (acceptable), or approved equal in accordance with B8.

.7 A minimum of 20 percent spare terminals shall be included (minimum 20 terminal block positions.

.8 The terminal blocks for external connections shall be located in the low voltage compartment, grouped together and easily accessible, visible and shall be positioned near the compartment's field control cable and inter-cell wiring entry/exit points.

.9 All wiring not terminated on devices shall be terminated on terminal blocks. Not more than two (2) wires shall be connected to any device terminal or at any one terminal side. Interconnecting jumpers between terminal block positions shall be counted in the above 2 wire per side limitation. General and control wiring shall utilize self retaining compression type spade lugs where wiring is terminated on hardware (relays, meters, switches, etc).

.10 Spare conductors in cables shall NOT be terminated to terminal blocks, but shall be neatly trimmed, identified, taped, and left in the bottom of the compartment. Spare cable conductors shall be of sufficient length to reach the most remote terminal block position or equipment terminal within in the compartment.

.11 Current transformer secondary circuits shall utilize insulated barrel ring type compression terminals.

.12 Control circuit wiring for circuit breaker "trip" circuit shall incorporate steering/blocking diodes to ensure proper routing and isolation of trip signals from the protection relays, and operator control devices.

.13 Steering/Blocking diodes shall be NTE Electronics type 5817HC axial lead plastic encapsulated silicon rectifier, or approved equal in accordance with B8. Blocking /Steering diode characteristics shall be as follows (TA = +25 degrees C unless otherwise specified):

.1 Maximum Recurrent Peak Reverse Voltage = 1000V,

.2 Maximum RMS Voltage = 700V,

.3 Maximum DC Blocking Voltage = 1000V,

.4 Average Forward Current (TA = +50 degrees C), IF(AV) = 10A,

.5 Peak Forward Surge Current (8.3ms, Half Sine), IFSM = 400A,

.6 Maximum Inst. Forward Voltage (IFM = 10A, TA = +25 degrees C), VF = 1.0V,

.7 Maximum DC Reverse Current at Rated DC Blocking Voltage, IR (TA = +25 degrees C) = 10µA, (TA = +100 degrees C) = 100µA,

.8 Typical Junction Capacitance (Measured at 1.0MHz, VR = 4V), CJ = 150pF,

.9 Operating Junction Temperature Range, TJ = -55 degrees to +125 degrees C,

.10 Storage Temperature Range, Tstg = -55 degrees to +150 degrees C,

.11 Typical Thermal Resistance, Junction- to-Ambient, RthJA = 10K/W.

.14 Where wiring between cells crosses shipping splits the Manufacturer shall supply keyed separable plug and socket type in-line insulated connector(s) to permit separating the cells at the shipping splits without having to un-terminate wiring. The connector shall be sized to accommodate the wire gauge and current carrying capacity of the inter-cell conductors, shall be of a locking design to prevent separation in service due to vibration or other causes and shall be securely screwed or clamped to the structure(s).

.15 Where wiring crosses between structure sections (i.e. inter-cell connections), or where wiring (control cables) exits the switchgear to connect to other equipment it shall be landed on terminal blocks at both ends. Devices external to the cell (contacts, coils, etc.) shall not be “loop” connected but shall be wired back to terminal blocks in the switchgear cell on an individual basis.

.16 Soldered connections and splices in wiring are not permitted.

.12 120 VAC Inter-Cell Power Distribution Wiring and Connections

.1 The 120 VAC inter-cell power distribution wiring shall be type SIS, 600 V, 90 degrees C, and shall be sized to permit simultaneous operation of all circuit breaker spring charging motors as well as all protective relaying and controls without undue voltage drop.

.2 The switchgear shall be provided with terminal blocks in each cell for inter-cell power distribution wiring. The incoming 120 VAC terminal blocks for each switchgear assembly

.3 The 120 VAC inter-cell power distribution wiring shall be tagged and identified on both ends of every wire using printed heat shrink sleeve type wire markers. Hand written numbering is NOT acceptable. The wire at both ends of the same wire shall be identical. All wires on a given terminal block position shall bear the same number.

.13 Protective Relays

.1 Provide protection relays as indicated on Drawings for each circuit breaker. Protection relays shall be manufactured by Schweitzer Engineering Laboratories (SEL).

.2 Protection Relays shall be as follows:

Relay ID	SEL Type No.	Sel Ordering No.	Configuration Key No.	Comments
RLY-E710	SEL-751A Feeder Breaker	TBD	TBD	TBD
RLY-E710-1 RLY-E710-2	SEL-751A Feeder Breaker	TBD	TBD	TBD

.1 All relays shall be capable of being programmed using SEL “acSELerator QuickSet” Software”.

.2 Include software and programming costs in the Bid Amount. It is recommended that the services of the protection relay manufacturer’s Engineering Services Department be used to provide configuration, logic development and programming services.

.1 The personnel engaged to perform the protection relay configuration and programming (Programming Services Provider) shall have demonstrable experience in programming of the protection relays utilized for switchgear protection (minimum of 5 years and 3 equivalent projects),

.2 The choice of Programming Services Provider shall be subject to review and approval by the Contract Administrator.

.3 Breaker coordination settings curves in the form of “Settings Letters” will be supplied to the Switchgear Vendor and are incorporated into the Contract documents. All other settings are to be determined by the Switchgear Vendor.

.14 Ethernet Switches

.1 Provide one (1) Schweitzer Engineering Laboratories (SEL) type SEL-2730U

.2 Unmanaged Ethernet Switches c/w SEL-9330-A power supply unit as indicated on the Drawings.

Relay ID	SEL Type No.	Sel Ordering No.	Configuration Key No.	Comments
RLY-E710	TBD	TBD	TBD	TBD

.3 Wire and connect the switch in accordance with Drawing.

2.04 METERING:

.1 With each main circuit breaker provide a PowerLogic PM8000 manufactured by Schneider Electric. This item is a City of Winnipeg standard requirement, no substitutions or equals will be accepted.

.2 The Meter shall have the following characteristics: 20

.1 Current and voltage inputs.

.2 Modbus TCP communication (over Ethernet).

.3 Data logging options.

.4 I/O (Analog Inputs, Analog outputs, Digital Inputs, Digital Outputs)

.5 Alarm setpoints.

.6 Harmonics analysis

.3 Where specific metering equipment is not provided at a specific breaker, program each SEL relay to display load information on the relay display, including but not limited to Amps, Voltage, VA, VAR, etc.

2.05 FABRICATION

.1 Construction:

.1 Metal-clad switchgear shall be in weather-proof insulated enclosure suitable for temperature range of -40°C to +40°C.

.2 Each equipment bay or cell shall be a separately constructed cubicle assembled to form a rigid freestanding unit. Adjacent bays shall be securely bolted together to form an integrated rigid structure.

.3 The rear doors shall be hinged and bolted closed and shall be mechanically interlocked to prevent opening when the circuit breaker is in the “connected” position.

.4 Breaker compartment front doors shall be equipped with a lockable handle operated multi-point latching system and shall be mechanically interlocked to prevent opening when the circuit breaker is in the “Connected” position. The mechanical interlock shall be equipped with an over-ride provision which requires removal of a bolt or bolts and the use of tools to operate the over-ride.

.5 Breaker compartment doors shall be designed and equipped for breaker racking with the door closed and latched and shall equipped as required to accommodate the powered portable electrical racking device specified above.

.6 Each individual unit shall be braced to prevent distortion.

.7 Sheet steel used shall be minimum 11 gauge.

.2 Dimensions:

.1 Switchgear dimensions shall be as indicated on Drawing (Insert Drawing Number). Any proposed alternate dimensions shall be submitted to the Contract Administrator for consideration and approval in accordance with B8. Any concrete / structural impacts due to dimensional deviations from those shown on the Drawings shall be performed at no additional cost to the Contract.

.2 The metal-clad switchgear shall be fully assembled, inspected, and tested at the factory prior to shipment. Large line-ups shall incorporate shipping splits split to permit normal shipping and handling as well as for ease of rejoining at the jobs site

2.06 FACTORY FINISHING

.1 Where on site finishing is required, prepare and prime surfaces as specified in Section 09 90 00, Painting and Coating.

2.07 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - General Electrical Requirements

.2 Lamcoid for each switchgear to be size 11, example as follows:

SGR–E710 NORMAL POWER 12.47 kV, 3Ø, 3W, 1200A

.3 Lamacoid for each switchgear breaker to be size 5, example as follows:

BREAKER CB-F1 NORMAL POWER 12.47 kV, 3Ø, 3W, 600A

.4 A switchgear identification nameplate for each of the switchgear line ups indicating as a minimum:

.1 Switchgear rated voltage, rated BIL, bus ampere rating.

.2 Switchgear fault interrupting ratings, momentary fault withstand ratings, MVA Class.

.3 Switchgear power frequency AC withstand voltage, Switchgear DC withstand voltage.

.4 Switchgear maximum design temperature rise.

.5 Manufacturer's shop reference and drawing number, contact details.

.6 CSA approval, CSA design standard.

.7 Enclosure NEMA rating.

.8 Switchgear assembly weight.

.5 A lamacoid simplified mimic diagram shall be provided on the front of the switchgear.

.6 A high voltage warning nameplates for the switchgear assemblies on both front and back of the switchgear.

.7 Provide warning nameplates on the front of each control compartment containing multiple sources of power. The warning lamacoids shall have white lettering on a red background. The wording shall list all AC and DC power sources including source voltage, source panel and panel circuit numbers, where control compartments are equipped with internal disconnecting fuses list fuses. Wording shall conform to the requirements of the CEC, typical example as follows:

WARNING

120VAC POWER PRESENT FROM MULTIPLE SOURCES

REFER TO DRAWINGS AND ISOLATE BEFORE WORKING WITHIN

POWER SOURCES
120VAC PANEL XXXX CCT XX
DISCONNECTING FUSES
FU1-X/FU1-X
FU2-X/FU2-X

.8 Nameplates shall be attached by means of rivets, drive pins or self-tapping screws. Note that the use of “sheet metal” or other screws having sharp points is NOT acceptable.

.9 Submit a detailed listing of proposed equipment nameplates for review prior to fabrication and installation.

2.08 ADDITIONAL MATERIAL/ACCESSORIES

.1 Provide one (1) full box of spare control fuses for each size and rating of fuse installed.

.2 Provide one (1) spare vacuum circuit breaker of each frame size.

.3 Provide two (2) spare current and voltage transformers of each size.

.4 Provide four (4) spare pilot lights of each type and rating.

.5 Provide two (2) spare breaker open / close switches.

.6 Provide two (2) handles for manually charging the circuit breaker operating mechanisms.

.7 Provide two (2) hand cranking levers for manual racking of circuit breakers. Handles shall be suitable for “through the door” racking

.8 Provide two (2) sets of test plug assemblies for use with flexitest blocks.

.9 Provide one (1) electrically operated portable racking device complete with a wired hand-held remote control as specified above.

.10 Provide two (2) sets of circuit breaker extension rails per switchgear assembly.

.11 Provide one (1) lifting device for removal of potential transformer drawer units.

.12 Provide one (1) breaker auxiliary connector extension cable to permit electrical test operation of the circuit breaker while withdrawn from its cubicle.

.13 Provide one (1) complete set of tools for mechanical adjustments to the switchgear.

.14 Provide one (1) factory assembled “ball-stud” grounding set for each switchgear assembly (minimum 3 sets total) as follows:

.1 ASTM Type 1, Class A, Grade 3 in accordance with ASTM F855, Standard Specifications for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment,

.2 Fault current ratings: 27,000 amps for 15 cycles, 20,000 amps for 30 cycles,

.3 Suitable for installation with “hot tools” (i.e. “shotgun” type hotstick),

.4 Consisting of:

.1 One (1) three-way copper terminal block,

.2 Four (4) bronze ground clamps suitable for use with 25mm Ø ball-studs,

.3 Four 1828mm lengths of # 2/0 AWG super flex copper clear jacketed ground cable with shrouded threaded-stud ferrules,

.4 All of the above shall be factory assembled and tested.

2.09 APPROVED MANUFACTURER

.1 Eaton, Schneider, ABB, GE or approved equal

2.10 FACTORY TESTING

.1 Provide certified factory test reports for all components.

3 PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

.1 Provide a Manufacturer's certified field service representative for on-site field inspection and testing of switchgear.

.2 Perform start-up tests in accordance with Manufacturer's instruction manual and the Commissioning Procedures.

3.02 TRAINING

.1 Furnish the services of a competent, factory-trained engineer or technician for two sessions (each of a minimum of 8 hours duration) instruct City of Winnipeg electrical maintenance personnel in the operation and maintenance of the equipment, on a date requested by the Contract Administrator. This item shall be specifically confirmed by the Supplier at the time of Bidding.

.1 The contents of the training session to include:

.2 Electrical manual breaker operation.

.3 Breaker rack-out procedures

.4 Operation of the portable electrically operated racking device

.5 Kirk Key interlock system

.6 Power meter use

.7 Protective relay operation, diagnostic and waveform access

.8 Network communications.

.9 Troubleshooting and maintenance, and similar contents to the training session identified above.

.10 And operation of any other relevant systems associated with the switchgear.

3.03 FACTORY TESTING

.1 All testing indicated in this section is supplemental to the requirements of Section 26 05 00 and 26 08 05.

.2 QA Requirements

.1 Submit an Inspection and Test Plan in accordance with this Specification, and NETA Acceptance Testing. This shall be submitted along with, or after acceptance of the Shop Drawings.

.3 Shop Inspection And Testing

.1 Equipment will be subject to inspection at the following stages of manufacture:

.1 Prior to shop testing,

.2 Prior to packaging for shipment.

.2 Test equipment to ensure satisfactory operation prior to shipping. Provide Certification of Satisfactory performance.

.3 Test and inspect all equipment, materials, works in accordance with scope of work,

.4 Specifications, all applicable codes, standards, regulations, laws and provide Certification and Records.

.5 Provide the Contract Administrator with proper access to work, equipment, tools and facilities for carrying out such inspection, test, witness inspection or test points, surveillance or audit, whether it is in preparation or progress.

.1 Provide upon request, the following information:

.1 Non-destructive test records/results,

.2 Welding procedures and welder qualifications,

.4 Factory Tests

.1 Test the equipment per applicable standards and provide test data.

.2 The Contract Administrator reserves the right to witness any or all tests.

.3 Prior to proceeding with the tests, provide in writing, a list of the tests to be performed at least two weeks before the tests are scheduled to begin, and an approximate schedule, with dates anticipated for the tests.

.4 The equipment shall be tested at the manufacturing plant prior to shipment and in accordance with the latest applicable standards.

.5 Design Tests

.1 For the design tests, include the following:

.1 Dielectric tests,

.2 Power frequency voltage withstand on main contacts,

.3 Power frequency voltage withstand on auxiliary equipment and control circuits,

.4 Partial discharge,

.5 Radio interference,

.6 Temperature rise,

.7 Measurements of the main contact's resistance,

.8 Short-time and peak withstand current,

.9 Current interrupting tests

.2 The tests classified by the standards as optional may be carried out or waived at Contract Administrator's discretion, e.g., tests for radio interference, operational tests in extreme atmospheric conditions, etc.

.3 Perform the design tests in the Manufacturer's plant or elsewhere by an internationally recognized laboratory, carried out on one complete circuit breaker.

.4 Where design type test results have been previously obtained and have been certified by an internationally recognized testing laboratory, they may be acceptable in lieu of the above specified type tests.

.5 In the case of the circuit breaker, ensure these tests have been carried out on 2 circuit breakers of the same type, capacity and characteristics as specified herein.

.6 Routine Tests

.1 Manufacturer's routine tests shall include all tests required by the Standards for Manufactured Switchgear. Routine factory tests shall include but not be limited to the following for all of the equipment supplied:

.1 High potential tests on main circuit contacts and control wiring,

.2 Operational tests on circuit breakers, and control devices; control wiring shall be energized and electrically operated devices shall be electrically operated at normal and minimum control voltage,

.3 Remote control systems shall be tested to demonstrate proper operation under simulated conditions,

.4 Operation of key, electrical and mechanical interlock systems shall be tested. Including verification of circuit breaker racking and positional safety interlocks,

.5 Power frequency voltage dry test and partial discharge measurements,

.6 Resistance measurement of circuit breaker and switch main contacts (Ductor Tests),

.7 Mechanical testing of switching devices,

.8 Primary current injection testing to confirm CT ratios,

.9 Corona inception and extinction tests,

.10 Provide factory test certificates for tests performed on individual switchgear components and on complete switchgear assembly.

3.04 FINAL ACCEPTANCE

.1 If required by final field testing/commissioning results make adjustments/or changes such that an efficient and fully operational installation is achieved. Such adjustments or requirements shall be to the suppliers account. Final acceptance by the Contract Administrator will be conditional upon fulfillment of all requirements.

.2 For equipment subject to inspection by a government ministry, department, or agency, submit original copies of the test data reports and all other documentation required for the final field inspection of the equipment by the government ministry, department or agency.

.3 Following completion of the work, issue a history docket comprised of the quality certificates, inspection and test records, and any other relevant documents related to manufacture and testing for the Contract Administrator's record files.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings for products specified in this Section.

.2 Indicate on shop drawings:

.1 Site installation details, including close coupling with power transformer.

.2 Floor anchoring method and foundation template.

.3 Dimensioned feeders' entry and exit locations.

.4 Dimensioned position and size of bus.

.5 Overall length, height and depth of complete switchboard.

.6 Dimensioned layout of internal and front panel mounted components.

.7 Product data for all components and devices: main circuit breaker, distribution circuit breakers, etc.

.8 Section splits.

.3 Revise equipment ratings to suit coordination study and short circuit calculations reports.

2 PRODUCTS

2.01 SWITCHBOARDS – SWBD-61

.1 Switchboard requirements are specified herein with additional requirements noted on drawings and in other Sections.

.2 Switchboards to be indoor, metal enclosed, sprinkler resistant, standardized switchboards that are CSA approved and ULC listed and labelled as per local governing code requirements. Switchboards are suitable for use in building solidly grounded system with short circuit capacity as scheduled, but in absence of direction, are to suit specific application to local governing electrical code requirements.

.3 ARC FLASH REDUCTION SYSTEM

.1 Provide capability to lower the incident energy level that an operator could be exposed to during maintenance activities on energized switchgear to less than 8 cal/cm2 at 18".

.2 The solution employed for arc flash reduction depends on the breaker and other technologies of various manufacturers. Regardless of manufacturer and technology, arc energy reduction shall be automatic, activate automatically and achieved without sacrificing coordination.

.3 Acceptable technologies for arc flash sensing and incident energy reduction include fiber- optic light sensors, pressure sensors, waveform recognition (WFR), instantaneous zone selective interlocking (I-ZSI), purpose-built relays, or combinations thereof.

.4 Switchgear manufacturer shall provide documentation that details the methods by which it proposes to lower the incident energy level.

.5 System shall be compliant with requirements of CSA Z462-15.

.4 Where applicable, requirements to comply with local governing electrical utility standards and regulations for incoming electrical services.

.5 Switchboards to comply with and be manufactured in accordance with latest editions of following:

.1 CSA 22.2 No.31;

.2 ANSI-C37.20.1/C37.51;

.3 UL 891.

.6 Power circuit breakers (also referred to as air circuit breakers (ACB)) are to comply with:

.1 ANSI-C37.13/C37.16/C37.17/C37.50;

.2 UL 1066.

.7 Moulded case breakers are to comply with and be designed, manufactured and tested in accordance with applicable conditions of:

.1 C22.2 NO. 5;

.2 UL 489.

.8 Structure:

.1 Switchboard consists of individual sections bolted together to form an enclosed, self-contained, self-supporting structure with necessary facilities for proper ventilation. Sections are of modern welded or bolted construction, fabricated from sheet steel in accordance with NEMA and CSA requirements and reinforced wherever necessary to provide adequate strength. Sections to align front and rear. Front doors are formed type, fabricated with cold rolled sheet steel and complete with handle lock operators and locking tabs. Unless otherwise required, rear, top and side panels are bolt-on and secured suitably to a channel type base. Refer to drawings for specific access requirements. After fabrication, switchboard is factory cleaned, bonderized, and finished in ANSI grey enamel.

.2 Entire enclosure to be in accordance with minimum NEMA 1 or NEMA 2 requirements, and with additional sprinkler protection requirements. Top of each cell to be complete with a "drip-shield" designed to shed water without dripping on cell. Enclosures to be designed to prevent penetration of water spray from activated sprinklers, onto live components. Doors and component openings to be gasketed. Conduit entries to be sealed watertight.

.3 Full height and depth fire retardant barriers are provided in sections, from top to bottom and from front to rear to contain faults.

.4 Where required to suit onsite access restrictions, switchboard to be shipped to site in sections, and assembled on site.

.9 Future Cells:

.1 Provide bus terminations for future extensions and gasketed water-tight removable side panels to accommodate installation and connection of future cells.

.2 Where future breakers are indicated, provide bus, stationary element, CT’s, control and metering wiring, such that, only draw-out element is needed.

.3 Where required, drill and plate main bus and switchboard for provision for future extension of additional vertical cell sections at each end of switchboard.

.10 Bus Bars:

.1 Main bus bars are constructed of top quality, 98% pure, rectangular copper bars, silver plated at joints with lap type joints bolted using high strength steel bolts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint. Bus and connections are designed so that maximum temperature rise in any part of switchboard will not exceed 65C° (117F°) over an ambient temperature of 40°C (104°F). Bus is properly isolated and designed to carry currents as required.

.2 Continuous ground bus not less than 6 mm (1/4") x 50 mm (2") cross section area extending length of switchboard and is solidly bolted to steel framework. Ground bus is constructed of same material as main bus and is complete with suitable lugs for grounding connections outlined on drawings. Ground bus is rated for momentary current rating equal to or greater than that of apparatus in switchboard.

.3 Supply required bolts, nuts, and washers for field connection of bus joints between cells.

.11 Control Wiring:

.1 Each cell to be complete with required control wiring and terminal blocks. Control wiring is type "SIS", minimum size No. 14, extra flexible wire with thermoplastic insulation. Neatly harness and suitably secure control wiring.

.2 Terminal blocks are pressure type and complete with removable marking strips.

.3 Shorting blocks are enclosed barrier type within control cubicle.

.12 Switchboard Arrangement and Components:

.1 Switchboard cell arrangements and components are as detailed on drawings.

.2 Do not run main bussing lower than 300 mm (12") above finished floor level.

.3 Where 100% rated breakers are required, include necessary requirements.

.13 Main Breakers:

.1 Power circuit breakers, with electrically operated, stored energy, draw-out breaker assembly mounted behind a full-sized flanged type heavy gauge steel panel with a heavy-duty finger type ground contact, wheels for mounting on rails in cell, a mechanical interlock which prevents moving unit into or out of connected position while breaker assembly is closed, and a nameplate giving breaker rating. Where current limiting is required for greater interrupting rating to suit specific application, provide air circuit breakers with integral current limiting fuses as per manufacturer’s standards.

.2 Breaker assembly consists of an operating mechanism, 3-pole units, and a solid-state adjustable tripping unit. Operating mechanism provides 2-step stored energy closing. One stroke of operating handle charges spring, after which breaker may be closed by pushing a button. A tripping button and a breaker position indicator are provided. Breaker has facilities for padlocking in open position.

.3 Breakers are complete with microprocessor based solid state tripping unit having adjustable tripping functions including but not limited to, long time pick-up, long time delay, short time pick-up, short time delay; instantaneous pick-up; ground fault pick-up; and ground fault delay. Trip settings are to be as determined by distribution system testing and coordination study. Include for required trip settings and settings as required to provide coordinated protective devices throughout electrical distribution system as required by local governing electrical code and authorities.

.4 Tripping unit includes three sensors, one on each phase conductor, arranged such that a trip signal from any sensor opens all three poles of breaker.

.5 Trip unit includes LED indication of mode and trip and a display panel indicating protection function settings and system data. Unit is continuously self-checking and monitoring. Complete system selective coordination is provided with individually adjustable time/current shaping solid-state elements. Unit is with auxiliary power module for power source. Trip unit includes energy monitoring and display of peak demand, present demand and energy consumption.

.6 Main breakers are CSA, cUL ULC listed for application of 100% of its trip setting and are capable of carrying its full rated ampere capacity, indefinitely without tripping. No external source of power is to be necessary to trip breaker in event of a fault or overload. Necessary tripping energy to be derived from monitoring current transformers provided with breaker. Breaker is operated with a two-step stored energy mechanism to provide a maximum five cycle closing and is provided with colour coded breaker status indicators to indicate position of contacts.

.7 Actuator mechanically trips breaker when a tripping pulse is emitted by trip unit. When solid-state unit does not have an instantaneous tripping element, it has a discriminator feature to provide instantaneous tripping only when breaker is being closed into a fault. Trip unit includes test plug terminals to permit convenient field checking of calibration, and is equipped with long, short, instantaneous, time delay, ground fault functions and ground tripping indication determined and required to suit distribution system testing and coordination study.

.8 Draw-out contacts on power circuit breaker consists of a set of contact fingers suitably spaced on breaker studs. In connected position these contact fingers engage stationary contacts forming a current carrying bridge. Assembly provides a multitude of silver-to-silver high pressure point contacts. High uniform pressure on each finger is maintained by individual short coil springs. Entire assembly is full floating and provides ample flexibility between stationary and moving elements.

.9 Secondary disconnecting devices consist of floating fingers mounted on removable units engaging flat contact segments located at rear of compartment. Secondary disconnecting devices are silver plated to ensure permanence of contact, and contact engagement is maintained in connected and test positions. Each breaker has four (4) positions consisting of connected, test, disconnected, and removed. Breaker draw-out element contains a worm gear levering "in" and "out" mechanism with removable lever crank. Mechanical interlocking is provided so that breaker is in tripped position before levering "in" or "out" of cell. Breaker includes a provision for padlocking open to prevent manual or electric closing. Padlocking also secures breaker in connected, test, or disconnected position by preventing levering.

.10 Power circuit breakers are equipped with connection terminals suitable for connections as specifically required for applications. Draw-out cradle includes primary and control wiring disconnects.

.11 Control wiring for connections to breakers to run outside of breaker cell to greatest extent possible. Where running of control wiring is necessary within breaker cubicle, bundle conductors and mechanically secure away from breaker and draw-out mechanisms.

.12 Breakers are provided with 120 V fused secondary control circuit transformer for breaker closing and tripping current.

.13 Provide shunt trip operators, as required.

.14 Provide electrically operated breaker pushbuttons, manual trip button, breaker position indicators, breaker 'open/close' lamps, and "push to test" lights. Breaker open operators to be equipped with safety cover to prevent in advertent operation.

.15 Emergency charging handle provided for manual charging if control power is lost. A manual closing lever is included to permit closing circuit breaker with compartment door closed.

.16 Accessories supplied with breakers consist of manufacturer standard items, including three spare fuses of each type and size used in each switchboard. Control fuses are form II HRC types.

.14 Metering:

.1 PowerLogic PM8000, microprocessor based measuring and digital metering system in compliance with ANSI C12.20 Class 0.2%, to provide complete electrical metering with embedded WEB server. System measures and displays voltage, current, frequency and time, and calculates and displays kW, KWh, KW demand, ampere demand, kVA, kVA demand, kVAr, kVArh and individual current and voltage harmonics.

.2 System includes configurable event triggers that initiate alarm output. Alarm features including voltage phase loss, current phase loss, line voltage phase loss, voltage phase reversal, over voltage, under voltage and time delay.

.3 LCD/LED display is provided on unit. Unit includes inputs/outputs, contacts, RS485/MODBUS/TCP/IP Ethernet interfaces as required for communications to remote monitoring terminal or printer or BAS. Suitable current transformers, potential transformers and control wiring to be provided. Include custom clear acrylic, hinged locking cover over each unit. Review exact requirements with Contract Admnistrator prior to ordering.

.4 Unless otherwise noted, each air circuit power breaker to be provided with above metering system unit.

.15 Circuit Breakers Distribution Section:

.1 Electrically operated draw-out/fixed mounted power circuit breakers as specified for main breakers.

.2 Circuit breaker distribution section consists of moulded case, bolt on circuit breakers with an interrupting capacity as scheduled and frame size to suit application.

.3 Breakers to be NEMA rated types, and for switchboards, breakers when frame sized equal or greater than 200 amperes, or where scheduled or where noted on drawings, to be provided with solid state adjustable trip units with long time, short time and instantaneous time, ground fault protection (LSIG) functions and time delays. Set trip units at ratings as per coordination study as required for proper selective coordination.

.4 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with local governing electrical code.

.16 Switch and Fuse Distribution Section:

.1 Switch and fuse section with quick-make, quick-break, visible contact load break switches with operating handles and facilities for locking in either ON or OFF position, and unless otherwise noted, HRC Form I, Class J current limiting fuses.

.17 Current and Potential Transformers:

.1 Potential transformers (PT's) are of compartment type and incorporate current limiting fuses.

.2 Current transformers (CT's) have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers and be insulated for full voltage rating of switchboard.

.3 Current and potential transformers for local electrical utility metering are to be supplied by utility and are shipped to switchboard manufacturer's factory for factory mounting and connection.

.18 Incoming and Outgoing Conductor Connection Facilities:

.1 Provide required facilities and hardware for cable in conduit and/or bus duct as required.

.19 Surge Protective Devices (SPD):

.1 Switchboards to be complete with integral SPD unit installed in dedicated cell. Unit to be factory installed and connected onto bussing through integral disconnect as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free.

.2 Switchboards to be complete with integral surge protective devices (SPDs). Unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:

.1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;

.2 Type 1;

.3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

.4 minimum nominal discharge current rating of 10 kA;

.5 minimum short circuit current rating of 100 kA;

.6 peak surge current 250 KA per phase;

.7 high-performance EMI/RFI noise rejection filter;

.8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;

.9 diagnostic package with status indicators on each phase;

.10 LCD surge counter display;

.11 audible alarm with silence button;

.12 Form C alarm contacts;

.13 maintenance free and not require any user intervention throughout its life;

.14 standard manufacturer's minimum 5 years parts and labour warranty.

.20 Accessories:

.1 Manufacturer's standard accessories, spare parts and maintenance tool kit.

.2 Breaker lift truck (for draw-out breakers).

.3 Wall mounting spare fuse rack.

.4 Manufacturer's installation drawings.

.21 Factory Testing:

.1 Manufacturer technician to:

.1 perform standard factory testing and submit copy of detailed reports to Contract Administrator for review;

.2 The factory acceptance testing (FAT) of the switchboard will be witnessed by two City's representatives prior to shipment. The travel and accommodation cost for the witnessing party shall be included in the cost of equipment and services for the low voltage switchboard.

.3 Notice of factory test date shall be provided thirty (30) days prior to the test date.

.4 A step-by-step Factory Acceptance Test Plan shall be prepared by the Vendor in collaboration with the manufacturer and submitted to the Engineer for review and approval not less than two (2) weeks prior to the scheduled test date. This Plan shall include the following, as a minimum:

.1 Description of test bed

.2 Elementary wiring diagram drawings

.3 Bill of material and description of the simulator equipment (if applicable)

.4 Procedure for performing the shop tests

.5 Method of collecting test data, including forms for recording checks and test results

.6 Sample test report complete with sample results and list of acceptable values.

.5 The Vendor shall attend any meetings necessary in order to explain, adjust and complete this Plan, to the satisfaction of the Design Engineer.

.6 The test facility shall be adequately equipped and staffed to perform all tests to the satisfaction of the witnessing party and within the time frame allotted and agreed upon during the bid award process.

.7 The Supplier shall provide all equipment, devices and circuitry required to simulate all operating conditions necessary to test inputs, outputs, monitoring functions and confirmation signals corresponding to the specified operations. The following documentation shall be available for reference during the factory witness test: Operation and Maintenance Manuals, Shop Drawings, Sequence of Operations and all Bid Documents.

.8 Equipment shall be inspected and completely tested operationally at the Supplier's factory to demonstrate conformance with specification requirements.

.9 Any repeated tests that require more than one (1) additional testing day beyond the mutually agreed upon base test schedule will be billed to the Contractor.

.10 All equipment shall be set up for factory testing in a spacious, well-illuminated environment to permit convenient and unobstructed operation and observation of all features, equipment and testing devices.

.11 The City and/or the Engineer reserve the right to modify the submitted Test Plan and request additional tests at the factory.

.12 The switchboard shall be factory tested to simulate a complete and integrated system. The circuit breakers shall be installed in their actual positions and shall be electrically and mechanically tested. The tests and inspections shall include, but not necessarily be limited to, the following:

.1 Megger test with a 1000 V DC megger. The minimum acceptable value obtained shall be 100 megohms on the switchboard, with all fuses, switches, circuit breakers, and contactors in the open position.

.2 Dielectric test at 2200 V AC for one minute between live buses and ground, and between live buses, in accordance with manufacturer's standard practice.

.3 Dielectric test of wiring and control circuits at 1500 V AC for one minute, or 1800 V AC for one second, between live parts and ground

.4 Circuit continuity and wiring

.5 Mechanical equipment adjustment and operation of all moveable equipment and devices

.6 Equipment arrangements, types, and ratings for conformance with approved drawings

.7 Bus bar phasing and bracing

.8 Integrity of all electrical connections, including those between wiring connected through un-pluggable connectors

.9 Conformance with the nameplate and circuit identification indicated on the Drawings and the approved manufacturer's drawings

.10 Demonstration of switchboard functions.

.13 Dismantling and shipment from factory test bay shall not occur until deficiencies have been corrected and the system has been re-tested to the satisfaction of the Engineer, and certified as being acceptable for shipment.

.14 The Vendor shall complete and submit full report following the completion of the factory testing, and before commencing the equipment functional testing on site.

.1 Provide maintenance data for distribution switchboard for incorporation into maintenance manual,

.2 Refer to Part 3 for additional requirements.

.22 Acceptable manufacturers are:

.1 Eaton Electric

.2 Schneider Electric (Square D);

.3 ABB

2.02 STANDARD SWITCHBOARDS – SWBD-41

.1 Indoor, metal enclosed, standardized service entrance switchboard for use in a solidly grounded system with a short circuit capacity as scheduled. Switchboard is shown and scheduled on drawings and complies with latest editions of following:

.1 CSA Standard CAN/CSA C22.2 No. 31;

.2 UL 891.

.2 Moulded case breakers are to comply with and be designed, manufactured and tested in accordance with applicable conditions of:

.1 C22.2 NO. 5;

.2 UL 489.

.3 Switchboard conforms to local governing electrical authority requirements.

.4 Structure:

.1 Switchboard consists of individual sections bolted together to form an enclosed, self-contained, self-supporting structure with necessary facilities for proper ventilation. Switchboard is front accessible type needing no access from rear. Sections to align front and rear. Each section is of modern welded construction, fabricated from sheet steel in accordance with NEMA and CSA requirements and reinforced wherever necessary to provide adequate strength. Front panels or doors are formed type, fabricated with cold rolled sheet steel. Unless otherwise required, rear, top and side panels are bolt-on and secured suitably to a channel type base. After fabrication, switchboard is factory cleaned and finished with ANSI grey enamel.

.2 Entire enclosure to be in accordance with NEMA 1 or NEMA 2 requirements, and with additional sprinkler protection requirements. Top of each cell to be complete with a "drip-shield" designed to shed water without dripping on cell. Enclosures to be designed to prevent penetration of water spray from activated sprinklers, onto live components. Doors and component openings to be gasketted. Conduit entries to be sealed watertight.

.5 Future Cells:

.1 Where shown, provide bus terminations for future extensions and gasketed water-tight removable side panels to accommodate installation and connection of future cells.

.6 Bus Bars:

.1 Main bus bars are constructed of top quality, 98% pure, rectangular copper bars, silver flashed, or silver plated at joints with lap type joints bolted using high strength steel bolts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint. Bus and connections are designed so that maximum temperature rise in any part of switchboard will not exceed 65C° (117F°) over an ambient temperature of 40°C (104°F). Bus is properly isolated and designed to carry currents as required.

.2 Ground bus not less than 6 mm (1/4") x 50 mm (2") cross section area extending length of switchboard and is solidly bolted to steel framework. Ground bus is constructed of same material as main bus and is complete with suitable lugs for grounding connections outlined on drawings. Ground bus is rated for momentary current rating equal to or greater than that of apparatus in switchboard.

.3 Supply required bolts, nuts, and washers for field connection of bus joints between cells.

.7 Control Wiring:

.1 Each cell to be complete with required control wiring and terminal blocks. Control wiring is type "SIS", minimum size No. 14, extra flexible wire with thermoplastic insulation. Neatly harness and suitably secure control wiring.

.2 Terminal blocks are of pressure type and complete with removable marking strips.

.8 Switchboard Arrangement and Components:

.1 Switchboard cell arrangement and components are as detailed on drawings.

.2 Where 100% rated breakers are required, include necessary requirements.

.9 Metering:

.1 PowerLogic PM8000, microprocessor-based multifunction, power and energy meters with features as follows:

.1 accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions; meet accuracy requirements of IEC687 (class 0.2%) and ANSI C12.20 (Class 0.2%);

.2 provide per phase % THD (Total Harmonic Distortion) monitoring to the 40th order for voltage (reference to neutral only) and current, and provide Volts, Amps, kW, kVAR, PF, kVA, Frequency, kWh, kVAh, kVARh and 1 KYZ pulse output, on board meter limit exceeded alarms, and 512 Megabytes for data logging;

.3 include a three-line, bright red LED display;

.4 include serial communications: RS-485; of Modbus RTU, Modbus ASCII, DNP 3.0 protocols;

.5 include network communications: RJ-45 10/100 Base-T Ethernet Network port; Ethernet TCP/IP, Modbus TCP, BACnet/IP, SNMP v1 & v3 (Network), SMTP (email), HTTP, HTTPS, Atom Feed protocols;

.6 historical trend logging for graphical viewing from an embedded WEB server;

.7 to be configured and viewed from the on-board web server without the need for external software;

.8 I/O expandability through option card slot.

.2 Review exact requirements with Contract Administrator prior to ordering.

.10 Current and Potential Transformers:

.1 Potential transformers (PT's) are of compartment type and incorporate current limiting fuses.

.2 Current transformers (CT's) have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers and insulated for full voltage rating of switchboard.

.3 Current and potential transformers for local governing electrical utility metering are supplied by local governing electrical utility and are shipped to switchboard manufacturer's factory for factory mounting and connection.

.11 Main Breakers:

.1 Frame type as scheduled and as required for application, sized as scheduled, fixed mounted, solid state moulded case circuit breaker with adjustable trip unit. Provide minimum interrupting capacity as scheduled.

.2 Insulated case, frame type as scheduled and as required for application, sized as scheduled, fixed mounted, solid state circuit breaker with adjustable trip unit. Provide minimum interrupting capacity as scheduled.

.3 Breakers to be complete with "Digitrip-310" RMS sensing solid state trip unit having following adjustable tripping functions: long time pick-up, long time delay; short time pick-up; short time delay; instantaneous pick-up; ground fault pick-up; and ground fault delay. Trip settings to be as determined by distribution system testing and coordination study. Tripping unit to have three (3) sensors, one (1) on each phase conductor, arranged such that a trip signal from any sensor opens all three (3) poles of breaker.

.4 Breaker to be ULC listed for application of 100% of its trip setting and is be capable of carrying its full rated ampere capacity, indefinitely without tripping.

.12 Circuit Breaker Distribution Section:

.1 Circuit breaker distribution section consists of Series "C" moulded case, bolt on circuit breakers with an interrupting capacity as scheduled and frame size to suit application.

.2 Breakers to be NEMA rated types, and for switchboards, breakers when frame sized equal or greater than 200 amperes, or where scheduled or where noted on drawings, to be provided with solid state adjustable trip units with long time, short time and instantaneous time, ground fault protection (LSIG) functions and time delays. Set trip units at ratings as per coordination study as required for proper selective coordination.

.3 Size breakers as per drawings and/or schedules, but in absence of direction, size breakers to suit intended application, to suit coordination study requirements and in accordance with local governing electrical code.

.13 Surge Protective Devices (SPD):

.1 Switchboards to be complete with integral SPD unit installed in dedicated cell. Unit to be factory installed and connected onto bussing through integral disconnect as recommended by manufacturer. Unit to include diagnostic package with status indicators on each phase, LCD surge counter display, audible alarm with silence button and Form C alarm contacts. Unit to be maintenance free.

.2 Switchboards to be complete with integral surge protective devices (SPDs). Unit to be factory installed into separate cubicle section and connected onto bussing through integral disconnect as recommended by manufacturer. SPD features include following:

.1 in accordance with ANSI/UL 1449 3rd Edition, IEEE C62.41, C62.45, UL 1283, and CSA Standards;

.2 Type 1;

.3 maximum voltage protection rating to not exceed 700 V (120/208 V) or 1500 V (600/347V): L-N, L-G, N-G; 1200 V (120/208 V) or 3000 V (600V): L-L;

.4 minimum nominal discharge current rating of 10 kA;

.5 minimum short circuit current rating of 100 kA;

.6 peak surge current 250 KA per phase;

.7 high-performance EMI/RFI noise rejection filter;

.8 indicator LED on units to identify protection integrity status of metal-oxide varistors; indicator to be visible on front of switchgear/switchboard;

.9 diagnostic package with status indicators on each phase;

.10 LCD surge counter display;

.11 audible alarm with silence button;

.12 Form C alarm contacts;

.13 maintenance free and not require any user intervention throughout its life;

.14 standard manufacturer's minimum 5 years parts and labour warranty.

.14 Incoming and Outgoing Conductor Connection Facilities:

.1 Provide required facilities and hardware including cubicle for incoming feeder, and outgoing cable in conduit feeders.

.15 Mimic Bus, Nameplates and Labelling:

.1 Red, single line vinyl bus approximately 3 mm (1/8") thick x 9 mm (3/8") wide, representing internal bussing and components, riveted to front of switchboard and extending through handles of respective breakers.

.2 Engraved Lamacoid nameplates to be secured with stainless steel screws, adjacent each panel component and identifying each component.

.3 Warning labels affixed on face of compartment doors that allow access to live components.

.4 Internally mounted devices labelled with designation matching drawings.

.5 Door mounted components suitably labelled to convey their function to operations personnel.

.6 Equipment rating plates identifying certifications and approvals and standards of compliance.

.7 Review finish colours, sizes, and nomenclature with Contract Administrator prior to ordering.

.16 Accessories:

.1 Manufacturer's standard accessories, spare parts and maintenance tool kit.

.2 Manufacturer's installation drawings.

.17 Acceptable Manufacturers are:

.1 Eaton Electric

.2 Schneider Electric (Square D);

.3 ABB

3 EXECUTION

3.01 INSTALLATION OF SWITCHBOARDS

.1 Not applicable

3.02 FIELD QUALITY CONTROL (SITE ACCEPTANCE TESTING - SAT)

.1 Testing Agency: Engage a qualified factory trained representative to perform specified acceptance testing.

.2 Include in bid price performance of Site Acceptance Test (SAT) before switchboard is permanently put into service, in the presence and to the satisfaction of the Engineer and the City. Allow for possible repeats of tests or supplementary requests of any of these parties.

.3 Visual and Mechanical Inspection

.1 Compare equipment nameplate data with drawings and specifications.

.2 Inspect physical and mechanical condition, and note any deficiencies.

.3 Verify appropriate anchorage, required area clearances and correct alignment.

.4 Inspect all doors, panels, and sections for corrosion, dents, scratches, fit, and missing hardware.

.5 Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study.

.6 Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12. Do not loosen bolts to re-torque. Verify proper tightness only. This is to include all bus connections of switchboard sections and external connections.

.7 Compare equipment nameplate data with latest one-line diagram when available.

.8 Confirm correct operation and sequencing of electrical and/or mechanical interlock systems.

.9 Make key exchange with devices operated in off-normal positions.

.10 Lubrication

.1 Verify appropriate contact lubricant on moving current-carrying parts.

.2 Verify appropriate lubrication on moving and sliding surfaces.

.11 Inspect insulators for evidence of physical damage or contaminated surfaces.

.12 Exercise all active components.

.13 Verify that filters are in place and/or vents are clear.

.14 Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

.15 Verify that ratings of circuit breakers match drawings.

.4 Electrical Tests

.1 Perform resistance tests through all bus joints. Perform resistance tests through each circuit breaker, including the primary disconnects, with the following procedure: Racking the circuit breaker into the cell, close it and measure the resistance of each phase from the bus to the load side landing lugs. All measurements are to be made with a 100 Amp low-resistance ohmmeter.

.2 Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute in accordance with NETA ATS Table 100.1.

.3 Perform an AC overpotential test on each bus section, each phase to phase and phase to ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with NETA ATS Table 100.2. The test voltage shall be applied for one minute. A DC overpotential test is not an acceptable substitution; the overpotential test is to be performed with AC voltage at the power frequency.

.5 Verify correct phasing rotation and perform a voltage check across the tie breaker on double-ended switchboard to insure correct bus phasing rotation and phasing from each source.

.6 Test Values:

.1 Compare bus connection resistances to values of similar connections.

.2 Bolt-torque levels shall be in accordance with NETA ATS Table 100.12 unless otherwise specified by manufacturer.

.3 Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar bus by more than 50 percent of the lowest value.

.4 Insulation-resistance values for bus, control wiring, and control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance higher than this table or manufacturer's minimum shall be investigated. Overpotential tests should not proceed until insulation-resistance levels are raised above minimum values.

.5 The insulation shall withstand the overpotential test voltage applied.

.7 Perform the following individual tests, verification and calibration on the switchboard and its components, prior to the final acceptance test:

.1 Operation of breakers, manual and automatic

.8 Circuit breaker tests:

.1 Test for continuity of phase and ground connections and insulation resistance (Megger) for each phase to phase and phase to ground.

.2 Verify all acceptance tests as per NETA test procedure.

.3 Any malfunctioning of the units shall be corrected and retested to demonstrate compliance.

.9 Replace defective components with new ones and correct all defects at no additional cost to the City.

.10 Demonstrate the following during the site acceptance test:

.1 Breaker operation

.11 Infrared Scanning: Contractor shall perform an infrared scan of all switchboard during commissioning.

.1 Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

.2 Prepare a certified report identifying equipment checked and describing results of scanning. Include deficiencies detected, remedial action taken, and rescanning observations after remedial action.

.12 Demonstrate functions.

3.03 INSTALLATION ASSISTANCE

.1 Assist installing Contractor in installation of equipment and to inspect installation, test equipment, perform start-up and verify work: coordinate work with Contractor;

.1 be present to assist during third party testing;

.2 perform testing at times reviewed with Contract Administrator;

3.04 TRAINING

.1 Provide total 16 hours of training to the City's representatives instructions at the City's designated location in Winnipeg on system operating and maintenance.

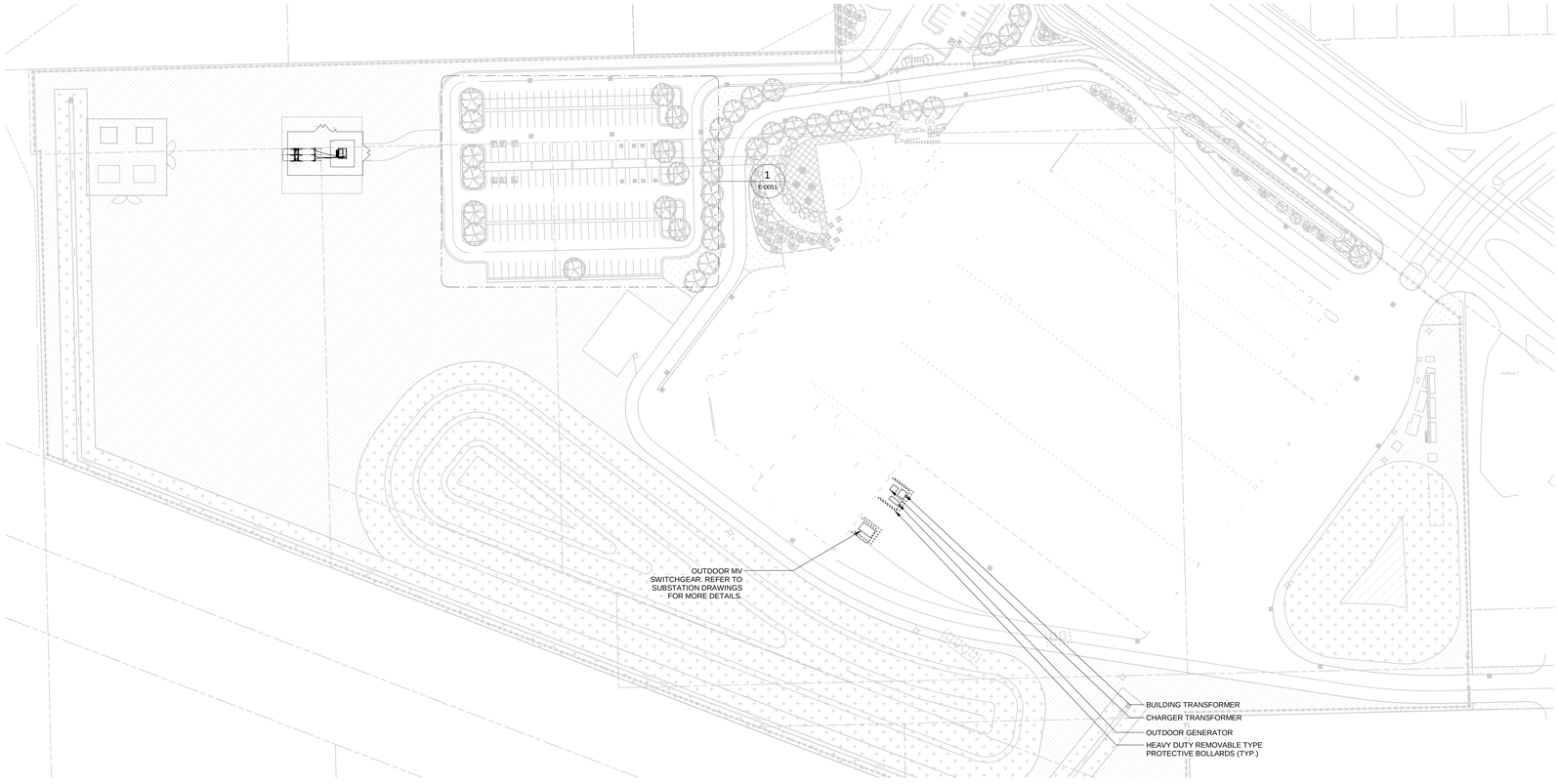
END OF SECTION

APPENDIX A -
LONG LEAD ITEMS SCHEDULE

Long Lead Items Schedule					
Item	**Description**	**Specification**	**Drawings**	**Unit**	**Quantity**
1	Building Power Transformer TX-61, 5000kVA 12.47kV-347/600V	E-26 12 00 Power Transformers (Building and Charger Transformers)	E-0050 Electrical Site Plan, E-1000 Single Line Diagram 1	each	1
2	Charger Power Transformer, TX-41, 1500kVA 12.47kV-277/480V	E-26 12 00 Power Transformers (Building and Charger Transformers)	E-0050 Electrical Site Plan, E-1001 Single Line Diagram 2	each	1
3	66kV Disconnect Switch and Fuses	E-26 12 11 High Voltage Disconnect Switch and Fuse	E-0050 Electrical Site Plan, E-9000 66kV/12.47kV Distribution Single Line Diagram, E-9001 66/12.47kV Substation General Arrangement, E-9002 66/12.47kV Substation Elevation	each	1
4	High Voltage Padmount Type Transformer, 12.5MVA 66kV-12.47kV	E-26 12 13 Liquid Filled High Voltage Padmout Transformer, Transformer Datasheet	E-0050 Electrical Site Plan, E-9000 66kV/12.47kV Distribution Single Line Diagram, E-9001 66/12.47kV Substation General Arrangement, E-9002 66/12.47kV Substation Elevation	each	1
5	Outdoor Medium Voltage Switchgear, 1200A, 15kV, 25kA	E-26 13 18 12.47kV Switchgear	E-0050 Electrical Site Plan, E-9000 66kV/12.47kV Distribution Single Line Diagram, E-9001 66/12.47kV Substation General Arrangement, E-9002 66/12.47kV Substation Elevation	each	1
6	Indoor Low Voltage Switchgear, SWBD-61, 5000A, 347/600V, 85kA	E-26 23 00 Low Voltage Switchboards	E-0050 Electrical Site Plan, E-0501 Enlarged Floor Plan - Main Elec Room (Elec Room 03) - Power and Systems, E-1000 Single Line Diagram 1	each	1
7	Indoor Low Voltage Switchgear, SWBD-41, 2000A, 277/480V, 65kA	E-26 23 00 Low Voltage Switchboards	E-0050 Electrical Site Plan, E-0501 Enlarged Floor Plan - Main Elec Room (Elec Room 03) - Power and Systems, E-1001 Single Line Diagram 2	each	1

APPENDIX B - ELECTRICAL DRAWINGS

Designer: M.Adel Checked: M.Adel Approved: W.Hung A0 33.1"x46.8"



2 GROUND FLOOR - ELECTRICAL SITE PLAN
E-0050 | 1 : 750

GENERAL NOTES:

1. REFER TO SINGLE LINE DIAGRAM DRAWINGS FOR MORE INFORMATION OF ELECTRICAL SIZES OF OUTDOOR ELECTRICAL EQUIPMENT

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1	2024/08/12	ISSUED FOR 66% DESIGN

PROJECT NUMBER
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SHEET TITLE
ELECTRICAL SITE PLAN

SHEET NUMBER
E-0050

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E-0050 ELECTRICAL SITE PLAN
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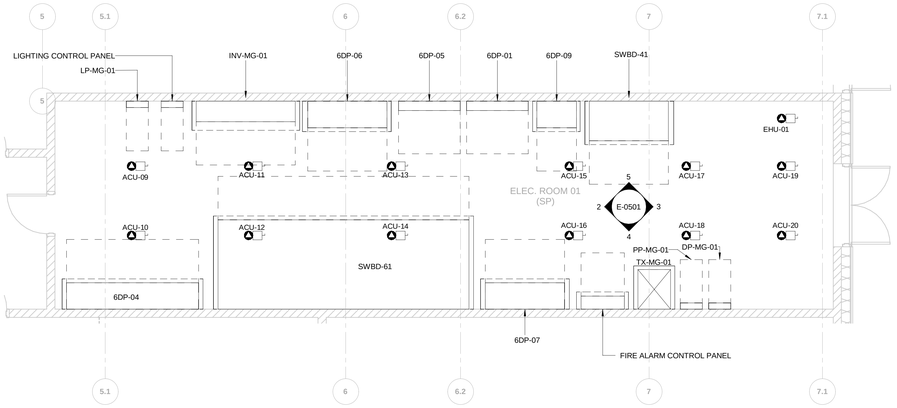

1 E-0501 **GROUND FLOOR PLAN - MAINTENANCE GARAGE - POWER AND SYSTEMS - ELEC ROOM 01 (SP)**
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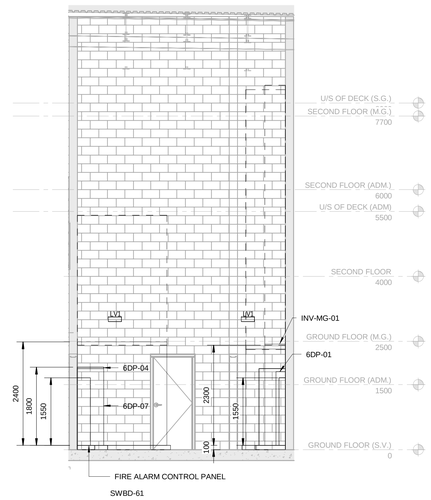

2 E-0501 **GROUND FLOOR PLAN - MAINTENANCE GARAGE - ELEC ROOM 01 (SP) ELEVATION 1**
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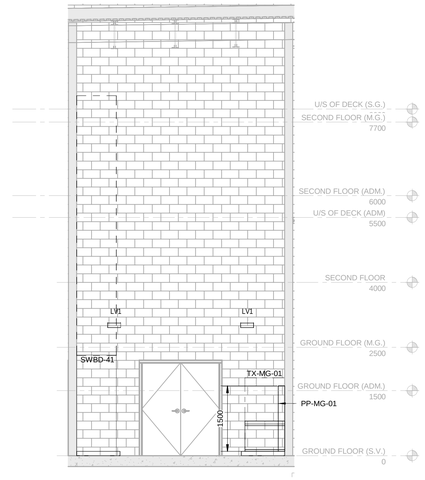

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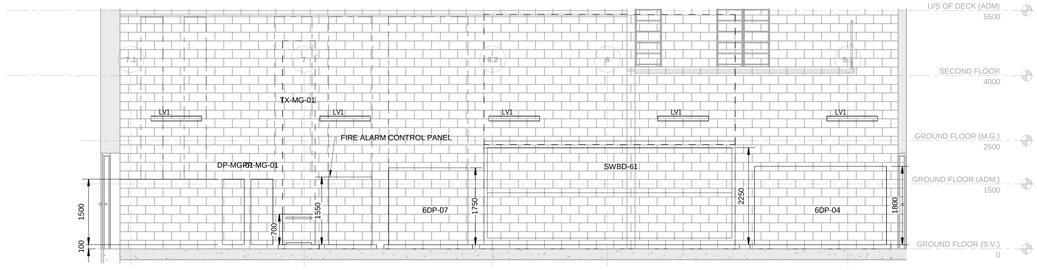

4 E-0501 **GROUND FLOOR PLAN - MAINTENANCE GARAGE - ELEC ROOM 01 (SP) ELEVATION 3**
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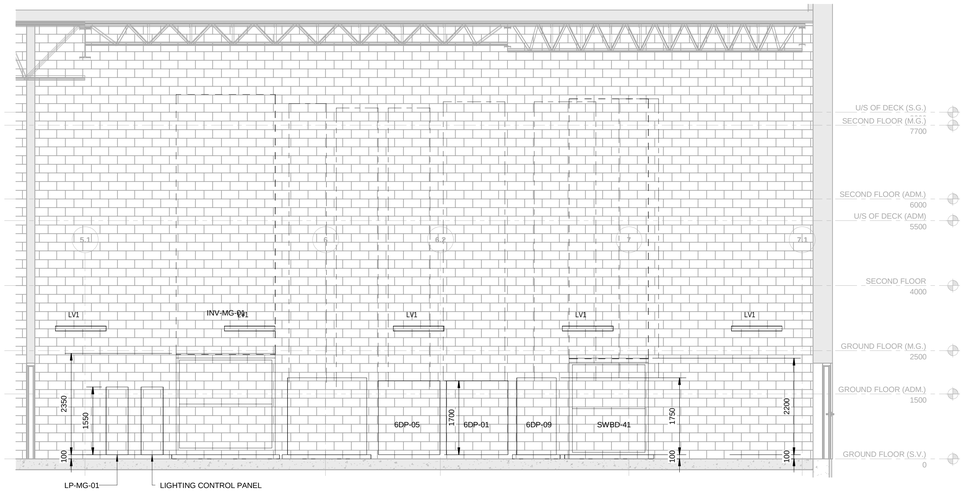

5 E-0501 **GROUND FLOOR PLAN - MAINTENANCE GARAGE - ELEC ROOM 01 (SP) ELEVATION 4**
1 : 50

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PROJECT NUMBER
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SHEET TITLE
ENLARGED FLOOR PLAN - MAIN ELEC ROOM (ELEC ROOM 03) - POWER AND SYSTEMS

SHEET NUMBER
E-0501

E-0501-ENLARGED FLOOR PLAN - MAIN ELEC ROOM (ELEC ROOM 03) - POWER AND SYSTEMS
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NOTES:

1. CIRCUIT BREAKER WITH FRAME SIZES 200A AND LARGER SHALL BE LSIG TYPE.

2. REFER TO FLOOR PLANS FOR PROPOSED EQUIPMENT LOCATIONS.

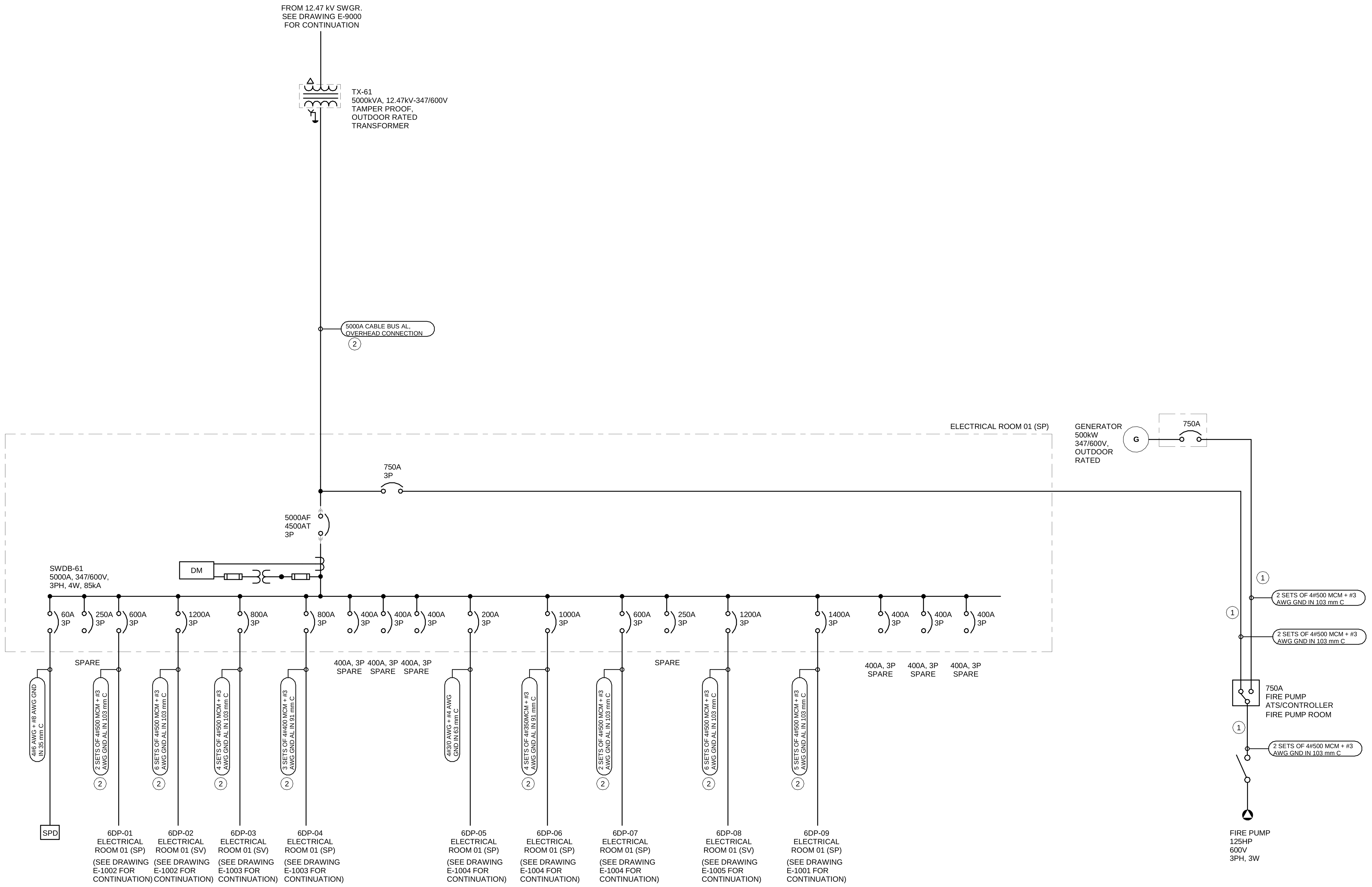
3. REFER TO PANEL SCHEDULES FOR BREAKER QUANTITY AND SIZE. TYPICAL FOR ALL PANELS.

4. CABLE TYPE FOR FEEDERS TO BE COPPER UNLESS OTHERWISE NOTED.

KEY NOTES:

(1) PROVIDE 2H FIRE RATED FEEDERS.

(2) CABLE TYPE FOR THIS FEEDER TO BE ALUMINUM.



1 SINGLE LINE DIAGRAM 1
E-1000 NTS

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SINGLE LINE DIAGRAM 1

SHEET NUMBER
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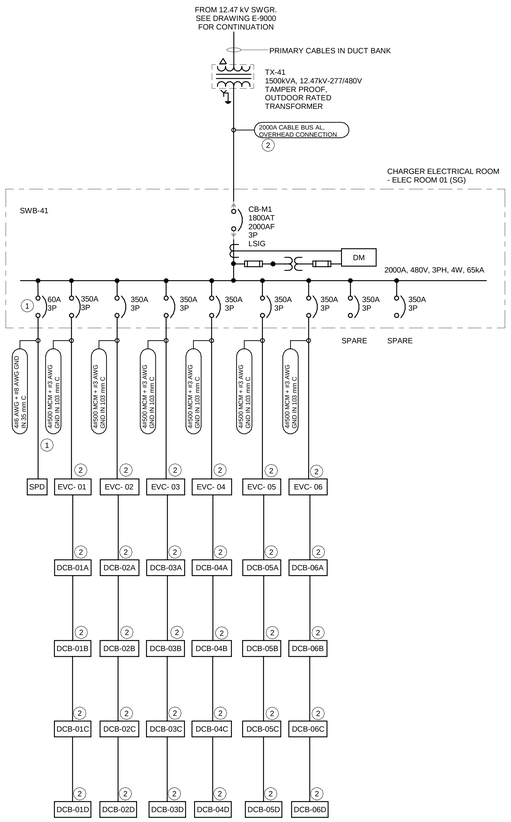

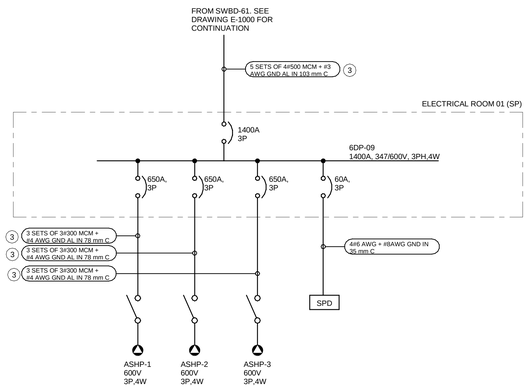

1	SINGLE LINE DIAGRAM 2
E-1001	NTS

GENERAL NOTES:

1. REFER TO DRAWING E-0003 FOR GENERAL NOTES.

2. REFER TO FLOOR PLANS FOR PROPOSED EQUIPMENT LOCATIONS.

3. REFER TO PANEL SCHEDULES FOR BREAKER QUANTITY AND SIZE. TYPICAL FOR ALL PANELS.

4. CIRCUIT BREAKER WITH FRAME SIZES 200A AND LARGER SHALL BE LSIG TYPE

5. CONTRACTOR TO PROVIDE ALL CIVIL WORK INCLUDING DUCT BANKS, SWITCHGEARS AND HYDRO TRANSFORMERS. CONCRETE FOUNDATIONS FOR ALL NEW AND FUTURE EQUIPMENT. REFER TO SITE PLAN DRAWINGS FOR DETAILS.

6. CABLE TYPE FOR FEEDERS TO BE COPPER UNLESS OTHERWISE NOTED.

KEY NOTES:

(1) CIRCUIT BREAKER RATING AND CONDUCTOR SIZE SHALL BE AS PER SPD MANUFACTURER RECOMMENDATION.

(2) ELECTRICAL VEHICLE CHARGING CABINETS BY OTHERS.

(3) CABLE TYPE FOR THIS FEEDER TO BE ALUMINUM.

AECOM

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SHEET TITLE

SINGLE LINE DIAGRAM 2

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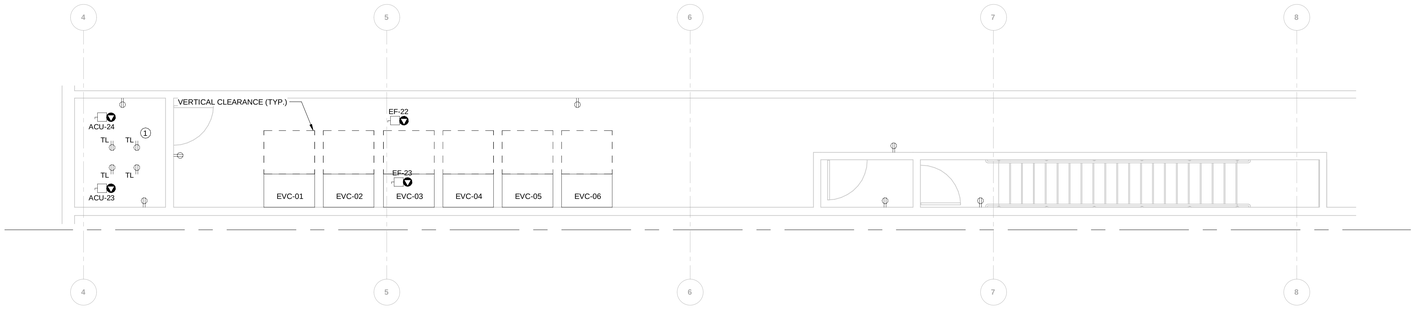

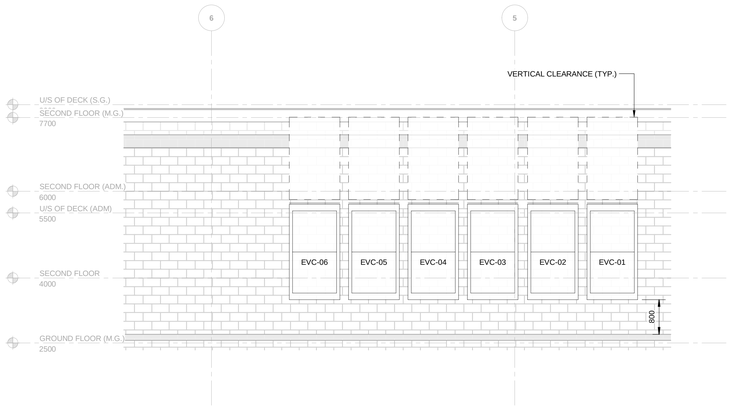

2 **ELEVATION OF EVC - ELEC AND COMM ROOM - WEST SIDE**
E-2201 | 1 : 50

KEY NOTES:

(1) PROVIDE 2 X L5-20R RECEPTACLES FOR EACH CABINET IN COMMS ROOM MOUNTED ON THE UNDERSIDE OF CABLE TRAY.

E-2201-SECOND FLOOR PLAN - STORAGE GARAGE - POWER AND SYSTEMS - ELECTRICAL AND COMMUNICATION ROOM
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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION
2	2024/12/06	ISSUED FOR 66% DESIGN RESUBMISSION
1	2024/08/12	ISSUED FOR 66% DESIGN

PROJECT NUMBER
60721079

SHEET TITLE
SECOND FLOOR PLAN - STORAGE GARAGE - POWER AND SYSTEMS - ELECTRICAL AND COMMUNICATION ROOM

SHEET NUMBER
E-2201

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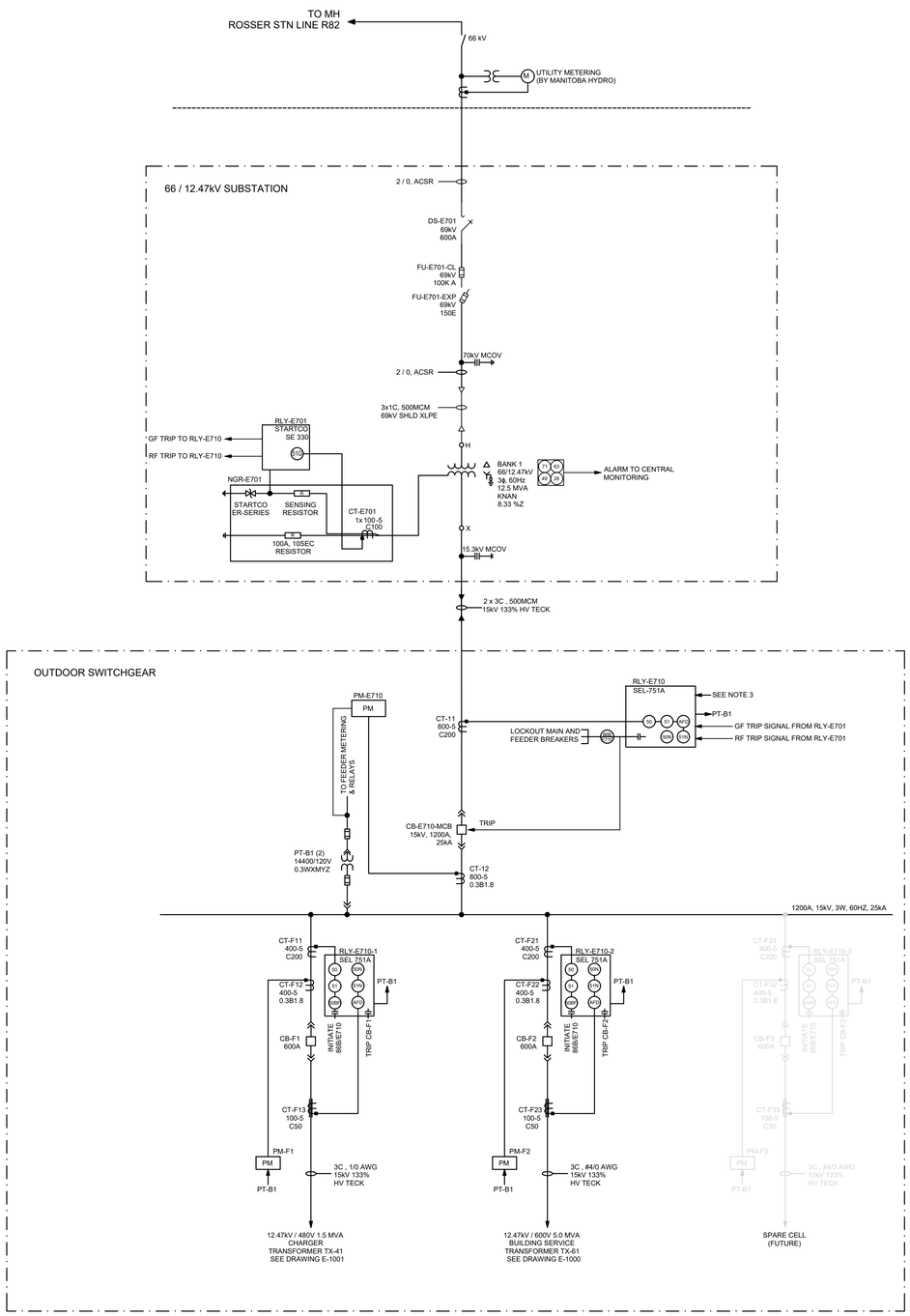
A0 33.1"x46.8"
Approved:
Checked:
Designer: KO
Project Management Initials:



1 SINGLE LINE DIAGRAM
E-9000
SCALE: NTS

NOTES:

1. ALL POWER CABLES ARE HV/TECK TYPE, SHIELDED WITH COPPER CONDUCTORS AND 15kV-133% INSULATION UNLESS OTHERWISE SPECIFIED.
2. ALL POWER METERS SHALL DISPLAY AS A MINIMUM: Hz, PF, V, A, kVA, kVAh, kW, kWh, VAR, kVARh.
3. INPUT INSTANTANEOUS (50) ELEMENT FEEDER RELAYS INTERLOCK SIGNAL TO THE MAIN INCOMING RELAYS FOR FAST BUS TRIPPING SCHEME TO BE SHOWN IN SUBSEQUENT PHASE.
4. THE 69KV DISCONNECT SWITCH SHALL BE KEY INTERLOCKED WITH THE 12.47KV MAIN BREAKER.

LEGEND:

	DISCONNECT SWITCH WITH WHIP TYPE ARCING HORN
	DRAWOUT BREAKER
	BUSHING TYPE CURRENT TRANSFORMER
	CURRENT TRANSFORMER
	RESIDUAL CURRENT TRANSFORMER
	VOLTAGE TRANSFORMER
	DUAL SECONDARY VOLTAGE TRANSFORMER
	POWER TRANSFORMER
	DELTA CONNECTION
	GROUNDED WYE CONNECTION
	FUSE
	RESISTOR
	CABLE TERMINATION
	INSULATOR
	ARRESTER
	KEY INTERLOCK
25	SYNCHRO CHECK
26	TRANSFORMER OIL TEMPERATURE
27	UNDERVOLTAGE
32	POWER DIRECTION
49	TRANSFORMER WINDING TEMPERATURE
50	INSTANTANEOUS OVERCURRENT
50BF	BREAKER FAIL
50N	INSTANTANEOUS GROUND OVERCURRENT (RESIDUAL)
50PAF	ARC-FLASH INSTANTANEOUS OVERCURRENT
51	TIME OVERCURRENT
51G	TIME GROUND OVERCURRENT
51N	TIME GROUND OVERCURRENT (RESIDUAL)
59	OVERVOLTAGE
59G	GROUND OVERVOLTAGE
59Q	NEGATIVE SEQUENCE OVERVOLTAGE
63	TRANSFORMER GAS PRESSURE
71	TRANSFORMER OIL LEVEL
86	LOCKOUT RELAY
87B	BUS DIFFERENTIAL
87R	RESTRICTED EARTH
87T	TRANSFORMER DIFFERENTIAL
AFD	ARC FLASH DETECTION
CB	CIRCUIT BREAKER
DGA	DISSOLVED GAS ANALYZER
M	REVENUE METER
NGR	NEUTRAL GROUNDING RESISTOR
OLTC	ON-LOAD TAP CHANGER
PM	POWER METER
RLY	RELAY
SGR	SWITCHGEAR
TCM	TRIP COIL MONITOR
XMFR	TRANSFORMER

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REGISTRATION

ISSUE/REVISION

MR	DATE	DESCRIPTION
C	2025-01-24	ADDED SPARE CELL
B	2024-12-06	ISSUED FOR 66% DESIGN RESUBMISSION
A	2024-08-12	ISSUED FOR 66% DESIGN

PROJECT NUMBER
60721079

SHEET TITLE
66kV / 12.47kV DISTRIBUTION SINGLE LINE DIAGRAM

SHEET NUMBER
E-9000

Last Plotted:
Filename: C:\USERS\MARKUS\PYHAD\AECOM\WINNIPEG NORTH GARAGE REPLACEMENT - GENERAL\A40_TECHNICAL\441_ELECTRICAL\HIGH VOLTAGE PORTION\DRAWINGS\E-9000 - 66kV - 12.47kV DISTRIBUTION SINGLE LINE DIAGRAM
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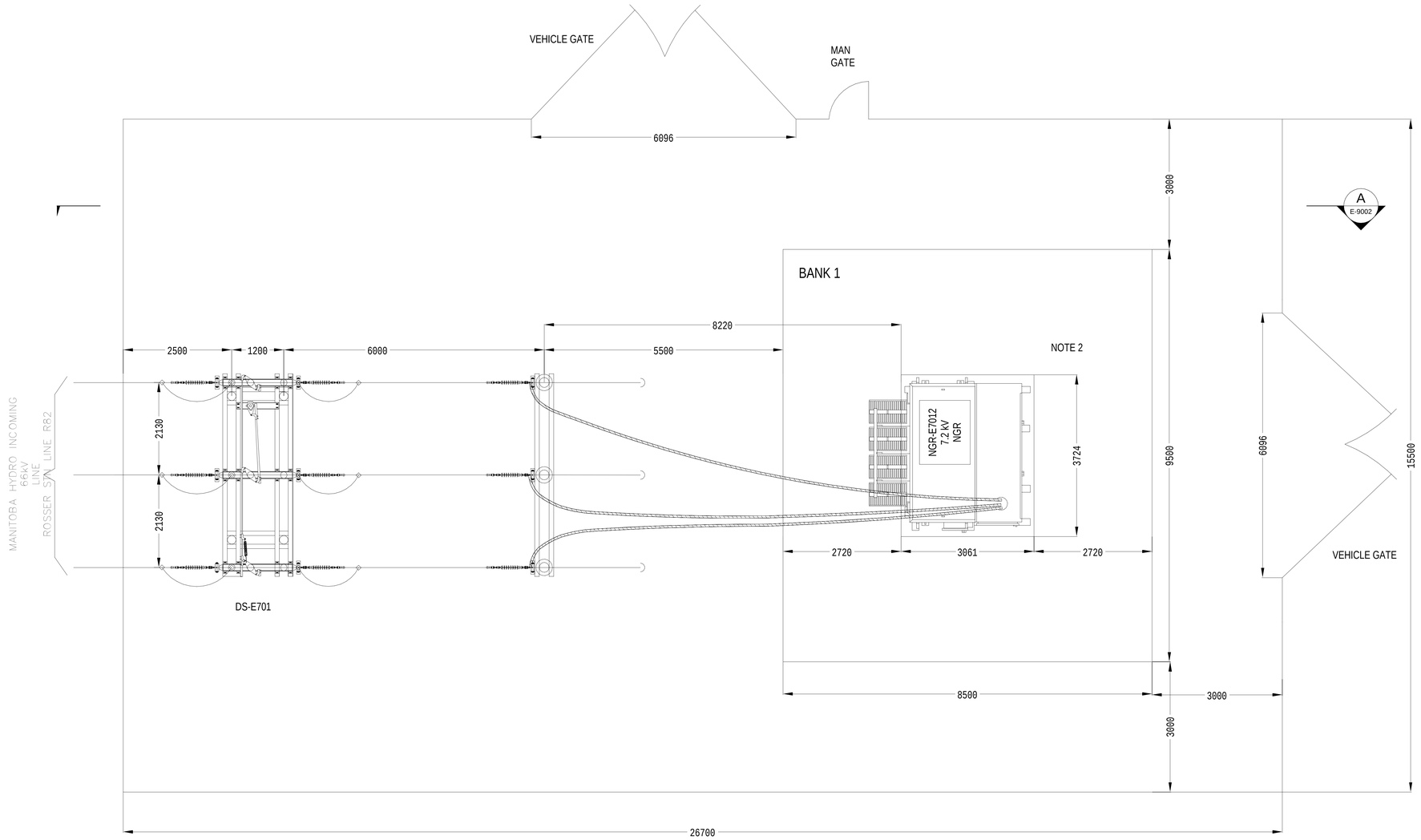

2 **66 / 12.47kV SUBSTATION GENERAL ARRAGEMENT**
E-9001 N.T.S

NOTES:

1. CONCEPTUAL LAYOUT ONLY.EQUIPMENT, BUS DETAILS TO BE DETERMINED.
2. ESTIMATED AREA FOR THE TRANSFORMER OIL SECONDARY CONTAINMENT. SIZE TO BE CONFIRMED IN SUBSEQUENT PHASE.

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ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	2024/08/12	ISSUED FOR 66% DESIGN
A	2024-XX-XX	ISSUED FOR 33% REVIEW
1	2024/12/06	ISSUED FOR 66% DESIGN RESUBMISSION

PROJECT NUMBER
60721079

SHEET TITLE
66 / 12.47kV SUBSTATION GENERAL ARRAGEMENT

SHEET NUMBER
E-9001

E-9001 66 / 12.47kV SUBSTATION GENERAL ARRAGEMENT
Last Plotted: 2024-12-11 2:00:30 PM
Filename: Autodesk Docs://IBP-AMER (CAN) 60721079 Winnipeg North Transit Garage Replacement/60721079-Winnipeg Transit North Garage-E.rvt
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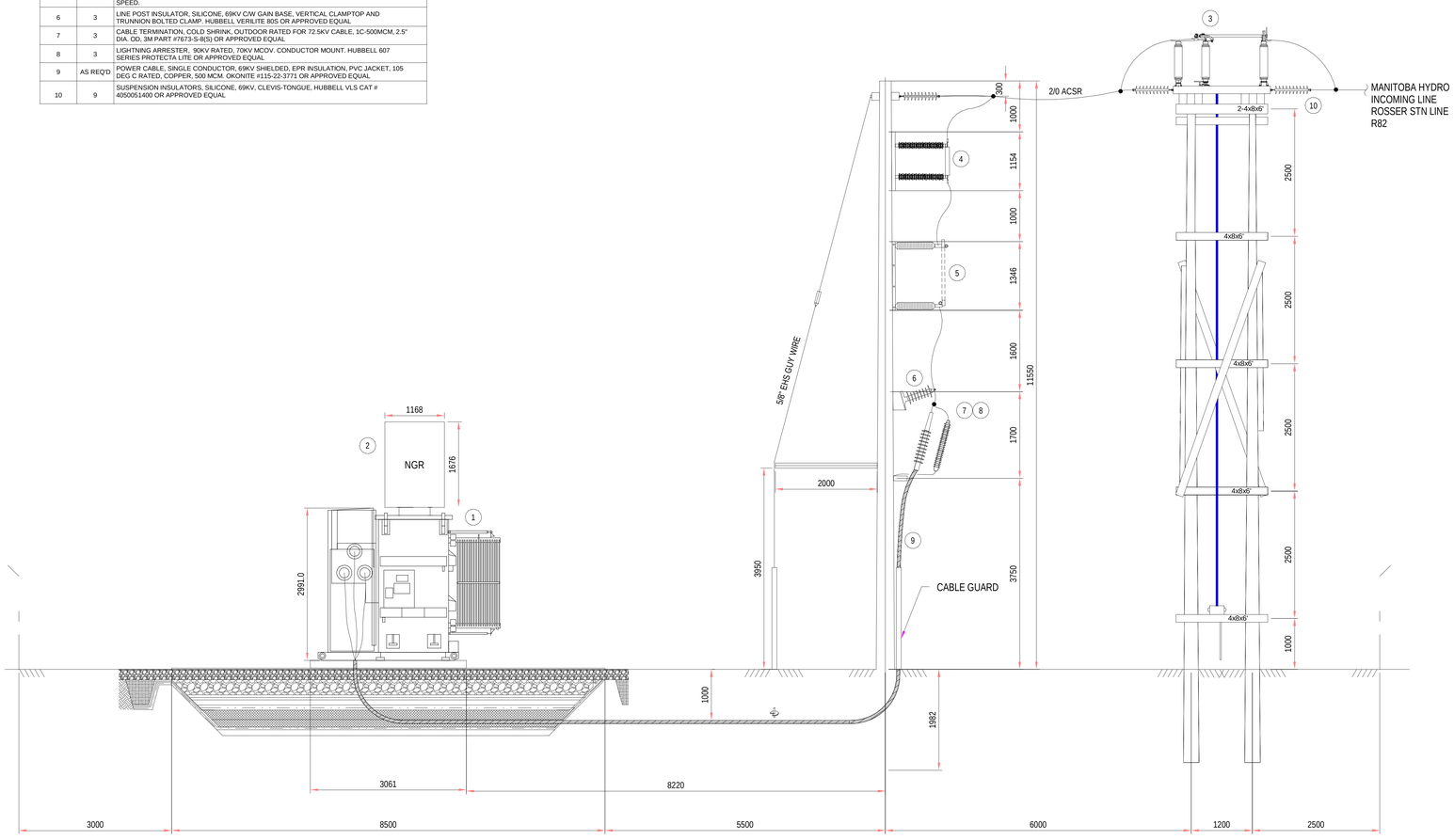
BOM No.	QTY	DESCRIPTION
1	1	LIQUID FILLED HIGH VOLTAGE PADMOUNT TRANSFORMER, 66/12.47KV, 12.5 MVA, KNAN, 3 PHASE, 60 HZ, DELTA-WYE (DYN1), COPPER WINDING, 350KV BIL ON PRIMARY, 110KV BIL ON SECONDARY AND NEUTRAL, 2 - 2.5% FCAN/FBNB TAPS, 65 DEG C TEMP RISE COMPLETE WITH INTERNAL TRANSFORMER PROTECTIONS.
2	1	NEUTRAL GROUNDING RESISTOR, 7200V L-N, 100 A FOR 10 SECONDS DUTY CYCLE, MAX. 760 DEG C TEMPERATURE RISE ABOVE 30 DEG C AMBIENT, 72 OHMS AT 20 DEG C, EDGE WOUND RESISTIVE ALLOY C/W CURRENT SENSOR, OUTDOOR RATED NEMA 3R ENCLOSURE.
3	1	DISCONNECT SWITCH, 3 PHASE GANG-OPERATED, 72.5KV 1200A, 350KV BIL C/W WHIP ARCING HORN AND MANUAL OPERATING HANDLE.
4	3	CURRENT LIMITING FUSE, 69KV RATED, ABB #HTDE37X100, 100KA RATING C/W BASE MOUNT AND INSULATORS.
5	3	EXPLUSION FUSE ASSEMBLY, 72.5KV MAX RATING, 350KV BIL, 300E MAX. VERTICAL MOUNTING, S&C PART #186926R1 AND #186926R1-P C/W 150E FUSE REFILL STANDARD SPEED.
6	3	LINE POST INSULATOR, SILICONE, 69KV C/W GAIN BASE, VERTICAL CLAMPTOP AND TRUNNION BOLTED CLAMP. HUBBELL VERILITE 80S OR APPROVED EQUAL
7	3	CABLE TERMINATION, COLD SHRINK, OUTDOOR RATED FOR 72.5KV CABLE, 1C-500MCM, 2.5" DIA, OD, 3M PART #7673-S-8(S) OR APPROVED EQUAL
8	3	LIGHTNING ARRESTER, 90KV RATED, 70KV MCOV. CONDUCTOR MOUNT. HUBBELL 607 SERIES PROTECTA LITE OR APPROVED EQUAL
9	AS REQ'D	POWER CABLE, SINGLE CONDUCTOR, 69KV SHIELDED, EPR INSULATION, PVC JACKET, 105 DEG C RATED, COPPER, 500 MCM. OKONITE #115-22-3771 OR APPROVED EQUAL
10	9	SUSPENSION INSULATORS, SILICONE, 69KV, CLEVIS-TONGUE, HUBBELL VLS CAT # 4050051400 OR APPROVED EQUAL

NOTES:

1. TREATED WOOD POLE SHALL HAVE MINIMUM CLASS 1.
2. CHAIN LINK FENCE SHALL HAVE HEIGHT OF 1829mm PLUS 305mm OF BARBED WIRES.
3. TRANSFORMER FOUNDATION AND CONTAINMENT AREA REQUIREMENT SHALL BE DETERMINE IN THE SUBSEQUENT PHASE.



1 **66 / 12.47kV SUBSTATION ELEVATION - SECTION A**
E-9002 N.T.S

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION
1	2024/12/06	ISSUED FOR 66% DESIGN RESUBMISSION

PROJECT NUMBER
60721079

SHEET TITLE
66/ 12.47kV SUBSTATION ELEVATION- SECTION A Copy 1

SHEET NUMBER
E-9002

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E-9002.66/ 12.47kV SUBSTATION ELEVATION- SECTION A Copy 1
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