

## **APPENDIX A**

### **ELECTRICAL COMPONENT SPECIFICATIONS**

**Note: All components must meet specifications as outlined and Manitoba Hydro Standards**

**1. Minisubstations – Quantity 3  
(Powersystems Technology or Equivalent)**

**Minimum Technical Specifications**

<b>Item Description</b>	<b>Meets</b>	<b>Not Meet</b>	<b>Cross Reference (with Documentation)</b>
<b>1. Related Work:</b>			
a. Cast-in-place concrete, frost-free pad			
b. Installation of anchor devices, setting templates.			
<b>2. Description of System:</b>			
a. Outdoor unit substation with:			
i. Primary switchgear			
ii. Transformers			
iii. Secondary breakers			
<b>3. Source Quality Control</b>			
a. Submit production test results to engineer.			
b. Substations manufactured and/or factory assembled by one supplier.			
c. Substations to be assembled, tested, and shipped in one section and as one unit.			
<b>4. Shop drawings:</b>			
a. Submit shop drawings that include:			
i. Flow and wiring method			
ii. Dimensioned foundation template			
iii. Dimensioned cable entrance and exit locations			
iv. Dimensioned cable termination and heights			
<b>5. Material:</b>			
a. The substation to be a one piece designed, assembled unit, using SF6 switching and liquid filled padmount transformer, to form a complete unit substation. Unit to be capable of having breakers added without increasing the size.			
b. The substation configurations to follow single line diagram.			
<b>6. Primary Switchgear:</b>			
a. Outdoor, 15kV, 600A, 3 phase, 3 wire, interrupting capacity 40 kA ASYM BIL 95 kV, CSA			

certified as per CSA C22.2 No. 31, CSA 22.2 No. 193, and CSA 22.2 No. 58.			
<b>7. General Construction:</b>			
a. To meet CSA C22.2 No. 31 and EEMAC G8. Total assembly to be solid welded, not bolted. All components to be barriered, segregated and fully interlocked for safety.			
b. Primary and secondary compartment arrangement: primary compartment to be on the left side and secondary to be on the right side as per CSA standard.			
<b>8. Primary Enclosure</b>			
a. Primary enclosure: metal enclosed free standing, pad mounted, dead front, outdoor tamperproof non walk-in EEMAC 3 enclosure 1 cubicle unit. Maximum dimensions: 2010 mm high x 2600 mm wide x 1800 mm deep. Constructed from rolled flat steel sheets 11 gauge thick.			
b. Use non-corrodible bolts and hardware.			
c. Full height outer doors reinforced, heavy duty rubber gasket, three point latch, stops, to open at least 135°. Removable sill to allow placing unit over cables without lifting, provide two penta-head bolts to secure door.			
d. Base channels to be adequate to support weight of unit substation during off loading. Lifting lugs to be provided to off load the substation.			
e. Storage container on inside surface of door compartment.			
<b>9. Primary Switching</b>			
a. The outlined requirements are for SF6 filled load break non fused type switches. The switch shall be supplied in accordance with this specification and the accompanying circuit diagram, including the required number of incoming and outgoing circuits, number of switched ways, closed open, switch tank ground			

wired to the substation main ground bar, fuse interlocking system, type and quantity of cable connections (200A).			
b. Service Ratings: The Switch assembly shall be designed and tested and rated per CSA 22.2 No. 193 and CSA 22.2 No. 58			
i. Design voltage 15.5 kV			
ii. Impulse withstand voltage 95 kV			
iii. AC withstand voltage 35kV			
iv. DC withstand voltage 53kV			
v. Load break continuous 600 amps			
vi. Momentary fault closing 40kA asymmetrical			
vii. Two second rating 25kA symmetrical			
viii. Open gap impulse withstand 200 kV BIL			
ix. Current limiting fuse rating 50kA			
x. Temperature ration -40 to +120 •F			
c. The sealed tank design shall be fully submersible dead front, and corrosion resistant. The tank shall be ¼” milled steel, seam welded to provide a hermetically sealed unit. Construction is designed to withstand 15 PSIG without causing operational problems. Tank flanges shall be welded to prevent leakage and shall be turned to eliminate sharp corners. External fasteners and fittings shall be corrosion resistant stainless steel or bronze. Mounting brackets and covers shall be hot dip galvanized. All bushings shall be welded flange type. Switch tanks to be leakage checked using a helium mass spectrometer. The helium mass spectrometer is calibrated to detect a leak as small as 1x 10 <sup>-7</sup> cubic centimeters per second.			
d. The base frame to be constructed of tubular steel welded to transformer. Side access to cable bushings is provided by a full height bolt on			

<p>cover, minimum 12 gauge.</p>			
<p>e. Switch shall be equipped with an external operating handle for manual operation, and shall include quick make quick break spring operation. The shaft shall have triple o-ring operating design, which can withstand pressure of up to 50 psi without leaking. Positive position indicators, viewing window to confirm contact position for all phases in all positions. Viewing window to show indicators of switch position. Padlock provisions for all positions. Provisions for mounting of key interlocks on all switches, removable handle.</p>			
<p>f. The switch shall include the following minimum construction requirements. Current carrying parts shall be high conductivity copper with plating and assembly for low resistance connectors. Contacts shall be self-aligning, self-cleaning, and designed to increase contact pressure with increasing current. Moving contacts shall be equipped with ½ cycle interrupter assistance to minimize arcing during switching and to eliminate arcing to the main contact surfaces. Contact supports shall be high strength molded polyester with skirts and barriers to prevent tracking and flash over. Flex connector shall prevent contact misalignment due to high current or other mechanical forces.</p>			
<p>g. Switch operation shall be controlled by quick make quick break spring operators with latches to prevent contact blowoff or movement after operation. Spring operators shall be mounted inside the tank to eliminate damage to critical parts. All switches to have provisions for a ground position which is not separate from the switch. Units that have a separate or interlocked ground</p>			

positions are not acceptable.			
h. The switch shall be factory filled with SF6 per ASTM D-2472 and shall include a self-sealing valve and a mechanically protected colour coded pressure gauge to monitor the SF6 gas as needed. A special internal absorbent shall neutralize arc by products.			
i. Cable terminators shall be elbow connector, rated for cable size as required.			
j. Name plates shall include the following properly secured to the tank:			
i. Phase markings			
ii. Factory rating and serial number			
iii. Line diagram of internal switching			
iv. Switch to arcwhipper type			
<b>10. Grounding:</b>			
a. Copper ground bus not smaller than 50x6 mm extending full width of cubicle bottom.			
b. Bond non-current carrying metal parts, including switchgear framework, connectors, enclosure and bases to ground bus.			
<b>11. Interlocks:</b>			
a. Key interlock between the switch operating and fuse cover to be provided to prevent access to fuses while they are live			
<b>12. Primary fuses:</b>			
a. Fuses to be bay 0 net interlocked with the switch.			
b. Back up current limiting fuses to be in series with bay 0 net fuse for high current faults.			
c. Automatic pressure relief is required to prevent hot oil escaping during fuse changing.			
d. Fuse compartment to have drip tray with absorbing materials.			
<b>13. Transformer Characteristics:</b>			
a. CSA C2-M1982, three phase distribution transformers, types ONAN or equivalent.			
b. Transformer to meet CSA C802-94 minimum losses for power transformers			

c. Transformer to meet CSA 227.4			
d. Liquid cooled, primary copper winding, outdoor, distribution transformer			
e. Primary: 15 KV, 60 HZ delta connected, 3 phase, 3 wire			
f. Secondary: 347/500 V, WYE connected, 3 phase, 4 wire, ground neutral			
g. Capacity: 300 KVA			
h. Basic impulse level: 95 KV			
i. Polarity: additive			
j. Impedance: 4% or above			
k. Voltage taps:			
l. Four – 2.5% Taps, 2-FCANN, 2-FCBN			
<b>14. Tap Charger:</b>			
a. Externally operated off-load tap charger, with provision for padlocking on 3 phase unit.			
<b>15. High Voltage Bushings:</b>			
a. Bushings: To ANSI/IEEE 386			
b. Bushings between the transformer and switch to be made to plug directly together and form a submersible sealed connection.			
<b>16. Secondary Compartment:</b>			
a. Spade bushing			
b. 400V main breaker			
c. 400V branch breakers			
<b>17. Accessories:</b>			
a. Liquid Celsius temperature thermometer, maximum indication type, dial size 150 mm with contacts			
b. Liquid level gauge with contacts			
c. Top non-flammable insulating liquid sampling device			
d. Set of (qty-3) lightning arrestors			
<b>18. Shop Fabrication:</b>			
a. Shop assemble and test components of substation.			
b. After completion of factory assembly and high potential test, prepare for shipment to Riding Mountain National Park.			
<b>19. Finishes:</b>			
a. Apply finishes			
b. Cubicle exteriors: Green.			
c. Cubicle interiors: Green.			
d. Provide anti-graffiti coating to allow pressure washing of unwanted materials.			

20. Equipment identification:			
a. Provide equipment identification:			
i. Transformer name plate with ratings			
ii. Switch name plate with ratings			
iii. SF6 Temperature/Pressure name plate			
iv. HV warning signs			
v. Single line diagram			

**Other Information:**

Bidder must provide a detailed list of all items that will be part of the equipment with their bid.

**Proposed equipment (must be completed by bidder):**

Make: \_\_\_\_\_

Model: \_\_\_\_\_

A brochure, technical data sheet, photos and/or any other documentation that demonstrates compliance with the minimum technical criteria identified in Annex “A”.

Proposed equipment must meet the minimum technical criteria identified in Annex A – Requirement

Best delivery date offered: \_\_\_\_\_ (To be completed by bidder)



**2. Switchgear – Quantity 1  
(Eaton/Cutler-Hammer or Equivalent)**

**Minimum Technical Specifications**

Item Description	Meets	Not Meet	Cross Reference (with Documentation)
1. Switchgear Ratings			
a. Gear shall consist of outdoor non-walk-in enclosure containing load interrupter switches and the necessary accessory components all factory assembled (except for necessary shipping splits) and operationally checked. The assembly shall be self-supporting and floor mounted on a level concrete pad. The integrated switchgear assembly shall withstand the effects of interrupting currents up to the assigned maximum short circuit rating.			
b. System voltage: 12.47KV Nominal, 3 Phase, 4 Wire solidly ground neutral, 60 HZ.			
c. Main Bus Ampacity: 600A			
2. Switchgear Construction:			
a. The switchgear shall consist of multiple sections including main incoming load interrupter switch section, utility metering compartment, fusible load interrupter switch compartments.			
b. Compression type lugs shall be furnished. The ground bus shall extend through the full length of the switchgear.			
c. A viewing window shall be installed in the switch enclosure and located so as to enable visible inspection of the			

<p>switch blades and blown fuse indicators from outside the enclosure.</p>			
<p>d. The main bus is to be rated 600 AMPS and be fully insulated for its entire length with an epoxy coating by the fluidized bed process. The conductors are to be silver-plated copper and be of a bolted design. Access to this compartment is gained from the front or rear of the structure by removing a steel barrier. Provide standard provisions for future extension, as applicable.</p>			
<p>e. Instrument Transformers:</p>			
<p>i. Current Transformers: Each load interrupter switch compartment shall have provision for front-accessible mounting of up to four current transformers per phase (ANSI standard relay accuracy), two on bus side and two on cable side of load interrupter switch. The current transformer assembly shall be insulated for the full voltage rating of the switchgear. The current transformer wiring shall be type SIS #12 AWG. Relaying and metering accuracy shall conform to ANSI standards.</p>			
<p>ii. Voltage transformers are draw-out mounted with primary current-limiting fuses and shall have ratio as indicated. The transformers shall have mechanical rating equal to the momentary rating of the circuit breakers and shall have metering accuracy per ANSI standards.</p>			

3. Utility Metering:			
a. Each utility metering vertical section shall contain provisions for current transformers and voltage transformers as required by the utility. The construction shall conform to the utility company’s metering standards. It shall also conform to the general electrical and construction design of the switchgear specified above.			
4. Fuses:			
a. The switchgear shall be equipped with a fuselogic system to provide single-phase protection with the following features:			
i. Direct acting 15 KV, “E” rated fuses to automatically open the manually operated load interrupter switch in the event of a blown fuse. For fuses rated higher than those shown, system shall be shunt trip operated directly from blown fuse contacts (control power required). Blocking the closing of the switch shall further prevent potential single-phasing conditions when a fuse is blown or if a fuse is not installed.			
ii. Prevention of potential single-phase conditions by blocking the closing of the manually operated load interrupter switch when a fuse is blown or if a fuse is not installed.			
iii. Three form C auxiliary switches (1 per phase) for phase blown/missing fuse indication. One form C auxiliary switch (1 for all 3 phases) for blown/missing			

fuse indication.			
iv. Fuses shall be fixed in position in a non-disconnect fuse mounting with provision for removal and replacement from the front of the gear.			
v. Fuses shall be UL listed.			
vi. The blown fuse indicator shall be an "extended travel" type with a minimum of 1 inch of travel.			
5. Components:			
a. Over-center mechanism			
i. The load interrupter switch shall be rated at 600 Amperes continuous and interrupting; fixed mounted on NEMA Class A-20 porcelain standoff insulators; manually operated quick-make, quick-break with the speed of operation independent of the operator. To provide for dependable operation, the device shall not rely on chains or cables to drive the blade assemblies open and closed. The spring operator assemble shall be isolated from high voltage and coupled through a direct drive shaft.			
b. Switches shall separate current carrying paths and arcing interruption paths.			
c. Switch blades shall be mounted on insulators that are attached to grounded metal barriers. Switches that utilize blades mounted on a common shaft with insulation from blade to blade rather than blade to ground are unacceptable.			

<p>d. The switch operating handle shall be covered by a full-height solid door. Removable handles are not acceptable. The handle must operate in the conventional fashion with the switch closes with the handle in the down position. Provisions shall be available for padlocking the switch in either the open or closed position.</p>			
<p>6. Lightning Arrestors:</p>			
<p>a. Provide lightning surge arrestors with rating in accordance with manufacture’s recommendations. Arrestors shall be intermediate class, one per phase rated to protect equipment from potential surges with the following characteristics:</p>			
<p>i. Metal oxide sure arrestor to ANSI/IEEE C62.11 for better performance and high reliability of surge protection schemes. Include information in shop drawings.</p>			
<p>ii. Arrestor housing separable type to meet ANSI/IEEE 386.</p>			
<p>iii. MOV in series with non-linear resistance graded gap structure.</p>			
<p>iv. Voltage rating – 15KV.</p>			
<p>v. Meet ANSI/IEEE standard 142.</p>			
<p>7. Control Power Transformer:</p>			
<p>a. Provided 12.47KV : 120V control power transformer for switchgear control voltage for heaters, lights, etc.</p>			
<p>b. CPT size to be determined by the manufacturer,</p>			

<p>c. Provide 15A, 120V duplex receptacle for maintenance use.</p>			
<p>8. Enclosures:</p>			
<p>a. Enclosures shall be constructed per IEEE/ANSI C37.20.3 outdoor specifications. (exceeds NEMA 3R.)</p>			
<p>b. Each vertical section shall have a flat weatherproof roof with labyrinth shaped joints. Use of gasket or caulking to make roof joints weatherproof shall not be permitted. All exterior openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of snow, sand, etc. A minimum of one (1) 250-watt, 120-volt space heater C/W thermostat and light shall be provided in each vertical section. Power for the space heater(s) and light(s) shall be furnished by a control power transformer mounted in the switchgear.</p>			
<p>c. Each vertical section shall be ventilated at the top, bottom, and front to allow airflow to provide cooling and help prevent buildup of moisture within the structure. The ventilated covers shall be externally removable to allow safe maintenance of the filter media without providing access to live parts.</p>			
<p>d. Enclosure shall be dust resistant. All ventilated openings shall be filtered to inhibit the ingress of dust. The ventilated covers shall be externally removable to allow safe maintenance of the filter media without providing access to live parts. All external doors</p>			

and covers shall be gasketed.			
<b>9. Finish:</b>			
a. Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, then fused-on by baking in an oven. The coating is to have thickness of not less than 1.5 Mils. The finish shall have the following properties:			
i. Impact resistance (ASTM D-2794): 60 direct/60 indirect			
ii. Pencil hardness (ASTM D-3363): H			
iii. Flexibility (ASTM D-522): Pass 1/8-inch mandrel			
iv. Salt spray (ASTM B117-85 [20]): 600 hours			
v. Colour: ANSI 61 gray			

**Other Information:**

Bidder must provide a detailed list of all items that will be part of the equipment with their bid.

**Proposed equipment (must be completed by bidder):**

Make: \_\_\_\_\_

Model: \_\_\_\_\_

A brochure, technical data sheet, photos and/or any other documentation that demonstrates compliance with the minimum technical criteria identified in Annex "A".

Proposed equipment must meet the minimum technical criteria identified in Annex A – Requirement

Best delivery date offered: \_\_\_\_\_ (To be completed by bidder)

**3. Transformers****Minimum Technical Specifications**

Item Description	Meets	Not Meet	Cross Reference (with Documentation)
1. 37.5 KVA Transformers – Quantity 21			
A. Ratings:			
i. 600v : 120/240v, single phase, 3 wire			
ii. Outdoor, weatherproof NEMA 3 enclosure			
iii. Double output lugs.			
B. Transformers to have, but not be limited to, the following characteristics:			
i. Type: ANN, dry type.			
ii. 60 HZ			
iii. Voltage taps: 4 at 2 1/2", 2 FCAN, 2 FCBN.			
iv. Insulation: class 150' c. temperature rise.			
v. Basic impulse level (BIL): standard.			
vi. Hip-pot: standard.			
vii. Sound level: 45-55 db.			
viii. Impedance at 170' c.: to CSA C9 and CSA C22.2 No. 47.			
ix. Enclosure: removable metal front panel for interior, fully weatherproof 3R.			
x. Mounting: pad mounted			
xi. Finish: standard.			
xii. Windings: copper.			
xiii. Sound absorbing, isolation pads.			
C. Install transformers in level, upright position.			
D. Remove shipping supports only after transformer is installed and just before putting into service.			
E. Loosen isolation pad bolts until no compression is visible.			
F. Make primary and			



secondary connections in accordance with manufacturer's wiring diagram.			
G. Energize transformer after installation is complete.			
H. Transformers with configurations open delta or t connection are not accepted.			
I. Electrical contractor to ground transformer.			
J. Electrical contractor to submit shop drawings			
K. Ratings:			
i. 600v : 120/240v, single phase, 3 wire			
ii. Outdoor, weatherproof NEMA 3 enclosure			
2. Splitter Box For Transformers – Quantity 21			
A. 400A			
B. 16 gauge galvanized steel			
C. Wire size #2 GA alum RWU-90 to 250 MCM alum RWU-90			
D. Gasketed slip hinged cover			
E. NEMA 3r enclosure			
F. CSA approval			
3. RV Pedestals – Quantity 135			
A. Approved for use in Canada			
B. 30A-1P circuit breaker			
C. Left position receptacle commercial/industrial grade TT-30R receptacle (120v, JOA).			
D. In-use cover			
E. NEMA JR			
F. Direct buried. Removable covers for ease of installation.			
G. Baked on polyester powder coat finish			
H. Eaton Cutler-Hammer CHU4NP pedestal c/w CHPEDEXT extension or approved equivalent.			

4. Otentik Termination, Waterproof Splitter Box - Quantity 32			
A. 16 gauge galvanized steel			
B. Wire size 1 AWG to 300 MCM, 6-2/0 to 14 AWG			
C. Gasketed slip hinged cover			
D. NEMA 3R enclosure			
E. CSA approval, with retractable sea			
5. Otentik Termination, TUB – 125A - Quantity 32			
A. Voltage 120/240VAC			
B. 2 – 15A single pole breakers			
C. 125A 1ph 2/4 CCT. 3rR non-comb loadcentre			
D. CSA / UL approved			
E. 125 amp			
F. 1 phase 3 wire			
G. NEMA 3R enclosure			
H. 2 circuit			
I. 100 amp main lugs			

**Other Information:**

Bidder must provide a detailed list of all items that will be part of the equipment with their bid.

**Proposed equipment (must be completed by bidder):**

Make: \_\_\_\_\_  
Model: \_\_\_\_\_

A brochure, technical data sheet, photos and/or any other documentation that demonstrates compliance with the minimum technical criteria identified in Annex “A”.

Proposed equipment must meet the minimum technical criteria identified in Annex A – Requirement

Best delivery date offered: \_\_\_\_\_ (To be completed by bidder)