CONSTRUCTION SPECIFICATION

NF91 – Mc MASTER UNIVERSITY

The SM Group (Ontario) Inc.

SEPTEMBER 2018

SUBMITTED TO:

Mc Master University

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REVISION INDEX

DOC. NUMBER	REVISION	DATE	DESCRIPTION
F1731664-0000-CS-0001	00	2018-09-28	Issued to client

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1 Scope

1.1 General

McMaster University requires a successful proponent to replace the end of life equipment at station NF91. The station was built in the early 1960s and is non-standard. Reliability of the station is also an issue due to the transformers nearing the end of their life.

To address these issues, it is proposed to:

- Replace all end-of-life 115 kV equipment and the associated circuits of the station;
- Replace transformers T1 and T2 with two new units rated 30/40/50 MVA, 115/13.8 kV;
- Replace all AC and DC station services;
- Replace existing E-house;
- Replace fences and station surface grading.

The proposed asset replacement will be accomplished by outsourcing the work as procurement and construction (PC) contract.

During construction, power supply to customers of NF91 station shall be maintained at all times.

The Contract will be executed as per this Terms of Reference, Commercial Terms and Conditions and other documents that are a part of the Request for Proposal (RFP) package.

The Contractor shall be responsible for the fabrication, supply, delivery, construction, erection, installation, testing, Commissioning and field verification of all of the components of the rebuilt substation to the extent that they are ready for operation.

In Appendix A, Figure 1 shows the existing electrical arrangement at the station while Figure 2 shows the proposed arrangement.

The scope of the proposed work covers, but is not limited to the procurement and construction/installation in respect to the following:

- Replacement of the existing transformers T1 (30/40/48 MVA) and T2 (30/40/48 MVA) with two new 30/40/50 MVA, 115/13.8 kV three-winding, 60 Hz, oil-filled, forced-air cooling transformers equipped with an Under Load Tap Changer (ULTC) step down transformer units (labelled T1 and T2);
- Replacement of Five (5) existing 145 kV disconnect switches with new switches;
- Connecting the secondary's of the new transformers to the appropriate cells of M/C Switchgear with new 3x1250 kcmil, 15 kV XLPE, concentric neutral cables per phase. Existing 15 kV, 500 kcmil cables will be removed;
- Replacement of all 115 kV cap & pin insulators with equivalent station post insulators;
- Replacement of all porcelain/polymeric suspension insulators with glass suspension insulators;
- Replacement of all 115 kV strain bus work including lead and drops;

- Replacement of the existing E-house with new pre-fabricated building;
- Replacement of HV/LV surge arresters;
- Replacement of the Two (2) AC 13.8 kV 120 kVA SS transformers and the associated Manual Transfer Scheme;
- Upgrade the grounding system of the station to meet equipment needs;
- Installation of spill containments, fire barrier and noise attenuation measures around the new transformers;
- Installation of One (1) gravitational Oil water separator;
- Installation of foundations and steel structures as required for installing new equipment, hardware, systems, etc.
- Improvements to the main station;
- Commission new E-house and the associated protection and control schemes.
- Establish and commission all the associated HV & LV switchyard cabling between switchyard equipment and E-House/ET Clarke equipment.
- Re-establish and commission teleprotection scheme between McMaster and the associated Hydro One TS and perform end to end testing prior to put in to service.
- Commission the new AC and DC auxiliary schemes and interface it with all the associated equipment and RTU/SCADA units.

The replaced / obsolete equipment shall be decommissioned, tested as applicable, dismantled and disposed off appropriately.

1.2 Schedule Constraints

The station operation is governed by strict outage constraints. One of the constraints is to provide uninterrupted supply to Mc Master University campus at all times.

McMaster has developed a construction planning which will satisfy these requirements, as described in Appendix B.

According to the plan, the major non recallable transformer outage cannot commence earlier than June 2019. Also, the work associated with new T1 have to be completed by June 2019.

The plan calls for work on T1 to commence November 2018 and be complete by June 2019. These constraints must be built into the schedule for project execution.

The contractor will have to produce a detailed construction planning which will respect the information and milestones indicated in Appendix B of this document. The contractor will need to maintain this planning monthly and provide to Mc Master for review.

1.3 Outage Constraints

Outage will be possible for all sections of the station NF91. However, the Contractor must not interrupt completely the supply to the customer of the station NF91.

The planning work of the Contractor must allow to maintain at all times 2 power transformers available during the construction. The staging plan is described below:

- Install & commission all related equipment to new T1;
- Install & commission all related equipment to new E-House;
- Install & commission all related equipment to the AC and DC services;
- Put in service T1;
- Remove existing T2;
- Install & commission all related equipment to new T2;
- Put in service T2;
- Install & commission all related equipment to 115 kV yard;
- Remove existing T1;
- Install & commission all related equipment to new fence;
- Restore and complete station grading and access road;

During the replacement of existing T2, the contractor will have to maintain operational the existing T1 to be used and energized at all times. When new T2 will be available for operation, the existing T1 will be removed.

Outage planning requirement will need to be proposed by the contractor in the response of this RFP. The contractor should consider outage to be recalled within a period of 8 hours or less to response to any emergency situation that McMaster should encounter or the Contractor.

1.4 In-Service

The required in-service dates for T1 and T2 are June 2019, and September 2019 respectively.

The ready for commissioning date for T1 is May 2019, and for T2 is August 2019.

Failure to meet these ready for commissioning dates may result in cancellation of outages, which can potentially delay the whole project to extent of 9 months or more.

1.5 Engineering Reference Documentation

The engineering documentation will be released for construction and require no further development. If the Contractor believes some aspects of the design could be improved or adjusted, the Contractor will have to identify such improvements or adjustments, get approval from McMaster and produce such additional

engineering and adjust provided engineering documents at the As-Built stage of the project. The complete list of engineering documentation is provided in Appendix C.

1.6 Major Activities of the Contract

The following describes the major activities of the Contract. This description is not intended to be 'all inclusive'.

The quantities and dimensions provided for all equipment, conductors, hardwares, cable routing, foundations, structures, site preparation, etc, are provided in the engineering documents and are expected to be followed.

Any deviation needed or required by the Contractor must get written consent by McMaster via SMi.

The contractor will re-confirm/revise them during detailed design analysis of the proposed work, in accordance with station requirements (voltage level, short circuit rating, etc) and the applicable standards and guidelines.

Any cost associated with revisions resulting from the detailed design is within the scope of the Contract, and therefore, is the responsibility of the Contractor.

1.6.1 Line Work

No line work is expected by the Contractor in this project.

1.6.2 Stations Work

Stations work will, at the outset, include addressing the environmental requirements and electrical arrangement for the proposed scope. Work not specifically listed in this Section, but identified in the rest of this document shall be the responsibility of the Contractor.

1.6.3 Environmental Requirements

The Contractor is required to carry out its activities in a manner that will not cause any adverse impact on the environment.

Project specific environmental specifications are provided in Appendix D for compliance by the Contractor.

The following table is provided to delineate the interface between MCMASTER and the Contractor with respect to the environmental activities.

Environmental Services			
Scope of Work	Contractor	McMaster	Comments
Environmental Management Plan	√		Contractor to prepare environmental management plan as per attached Environmental Specification.
Environmental Services and Monitoring during construction	√		
Environmental Specifications – Compliance Monitoring during construction		√ √	MCMASTER will perform compliance monitoring only
Environmental Compliance Approval – Noise		√	MCMASTER will apply and obtain the Approval
Environmental Compliance Approval – Drainage		√	MCMASTER will apply and obtain the Approval
Site Plan Approval, if Required		√	MCMASTER will provide the site plan to Municipal Authorities.
Building, or other, Permit(s), as required.	√		

1.6.4 Electrical Arrangement

Procurement, construction and commissioning activities related to electrical arrangement will include but not limited to the following:

- Replacement of Five (5) existing 145kV motorised disconnect switches with new ones;
- Replace thirty (30) leads of 795 MCM ACSR between disconnect switches and 115kV strain busses and transformers with appropriate connectors;
- Addition of Four (4) CVT fuse boxes;
- Provide proper mechanical protection for all 115kV control cables. PVC conduit are preferred;
- Addition of new 115kV strain bus between A1 & A2 bus and new disconnect switch 91T1-A location with appropriate connectors;
- Replacement of all 115kV cap & pin insulators with equivalent station post insulators;
- Replacement of all porcelain/polymeric suspension insulators with glass suspension insulators;
- Replacement of all 115kV strain bus work including leads and drops;
- Replacement of the existing transformers T1 (30/40/50 MVA) and T2 (30/40/50 MVA) with two new 30/40/50 MVA, 115/13.8 kV three-winding, 60 Hz, oil-filled, forced-air cooling transformers equipped with an Under Load Tap Changer (ULTC) step down transformer units (labelled T1 and T2);
- Addition of Twelve (12) dobles on each HV and MV bushing of T1 & T2;

- Addition of six (6) 115kV surge arresters at new T1 & T2 locations;
- Addition of Six (6) 1000 MCM leads between surge arresters and T1/T2 HV bushings with appropriate connectors;
- Addition of six (6) 13.8kV surge arresters at new T1 & T2 locations;
- Addition of Three (3) 500 MCM leads between surge arresters and T1 MV Bushing with appropriate connectors;
- Addition of 100 m of 5" Aluminium rigid bus on the MV side of T1/T2 with all appropriate hardware and supports;
- Addition of eighteen (18) leads of 1000 MCM copper cable between MV bus and T1/T2 bushing;
- Addition of Two (2) new neutral reactors for T1 & T2 X0 bushing;
- Addition of 20 m of 2.5" Aluminium rigid bus between X0 and neutral reactor;
- Addition of 40 m (approx.) of 1000 MCM copper cable 600V insulated between neutral reactor and neutral bus of the station;
- Addition of 1000 m of 1250 MCM 15kV power cable between T1/T2 and E-house switchgear with appropriate termination and fixation;
- Addition of Six (6) PT-CT combo 13.8kV ;
- Replacement of the Two (2) AC 13.8 kV 120kVA SS transformers and the associated Manual Transfer Scheme;
- Addition of 150 m of 2/0 15 kV power cables between SS transformer and MV bus support of T1 and T2 with proper termination and fixation;
- Addition of cables trenches between T1, T2 and new E-house;
- Addition of new duct banks between T1,T2 and new E-house and exit lines feeders;
- Addition of One neutral bus;
- Addition of Two (2) VT fuse boxes;
- Addition of AC supply cables between AC panels located in the E-house and outdoor equipment and devices direct buried;
- Install one (1) 600 V, 400 A three phase plug box as connection point of a temporary Emergency Diesel Generator;
- Addition of One network of cable trench between E-house and power transformer T1/T2;
- Upgrade the grounding system of the station to meet equipment needs;
- Addition and replacement of outdoor lighting in the yard;
- Grounding of the all new equipment to the main grid;
- Addition of animal deterrent barrier;
- Removal of all AC outlet and facilities within the 115 kV yard;
- Removal of existing T1/T2 transformer and all related equipment and connections;

The following table is provided to delineate the interface between MCMASTER and the Contractor with respect to the electrical arrangement activities.

Table 1: Electrical Arrangement - McMaster and Contractor Activity Interface

Procurement, Installation & Commissioning			
Scope of Work	**Contractor**	**MCMASTER**	**Comments**
Transformer (Free Issued Material by MCMASTER)	√	√	Transformer will be delivered at site by float. Manufacturer Drawings for Transformers to be provided to Contractor. Transformer will be delivered by the vendor to site on June & September 2018. Second transformer T2 will require temporary installation between September 2018 till December 2018 as a minimum. Contractor to provision temporary location handling including landing log of the transformer at site.
Site Acceptance Tests of Transformer	√	√	The Contractor will witness testing by MCMASTER prior to the Contractor accepting and off-loading transformers at site. These tests include 'core to ground', impact recording and dry air readings.
Lift transformer from the delivery float, install on pad, and assemble	√		Upon acceptable values, the Contractor will off load transformer on pad. The Contractor is responsible for transformer assembly and erection.
Fill Oil in Transformer	√	√	The Contractor will carry out oil filling and testing the oil. The Contractor will provide snow fence to define MCMASTER's working zone for oil filling/testing activities. The Contractor to provide 6mil plastic hoarding and heating around the transformers work area while he is engaged in oil filling/testing activities.
Scaffolding	√		Contractor to provide the scaffolding around the transformer for oil filling and testing activities.
All other Equipment	√		As per MCMASTER's specifications
All Miscellaneous Material	√		As per MCMASTER's specifications

1.6.5 Civil – Site Preparation

Procurement, Construction and commissioning activities related to Site Preparation will include, but not limited, to the following:

- Excavate and remove the equivalent of 200 m^3 of crush stone and dirt for New T1 location and T2 existing location. The excavated material must be considered oil contaminated and required to be treated and disposed of safely. The treatment of the excavated material is the sole responsibility of the Contractor. If the volume of excavation is more or less than provision in this specification, a unit cost in m^3 adjustment is to be proposed by the Contractor.
- In preparation for the containment pits, install and compact, in layers to 98% SPMDD, a 300mm granular A base, approximately 0.5m below the proposed bottom of the pit. The compacted surface will be covered with polyethylene liner over which a 200mm thick reinforced concrete floor and curbing will be installed for the containment pits as shown in the design drawings. Cast in wall a 200mm stainless steel pipe containment outlet.
- Cover the inlet pipe and two 300mm x 200mm openings in the firewall with max. 15mm x 15mm wire mesh to ensure no stone blocks the pipe/wall opening.
- Fill in both containment pits with 19mm-37.5mm crushed fire-quenching stone via slingers to the level of 0.40m approx. below the top of containment pit curb.
- Install two-channel oil-water separator OWS-HT-1 measured internally 8.0mx 2.4mx1.8m with one square concrete riser c/w aluminum hinged access hatch; and 200mm diameter stainless steel drop-leg outlet pipe extended through the access riser to facilitate effluent sampling.
- Connect the containment outlet pipe to the OWS-HT-1 via 150mm diameter stainless steel piping, precast manhole MH-1, a 75mm diameter orifice flow restrictor installed in MH1;
- Connect OWS-HT-1 to the proposed drainage outlet via 150mm diameter HDPE storm sewer.
- Install 150mm diameter perforated HDPE road drain and connect to MH1.
- Remove existing grading of the station down to 200 mm of the finish grading level. Remove any organic component present on the remaining sub base if any. Install 125 mm of granular A in layer 98% SPMDD. Complete the surface of the substation with 80 mm of clear crush stone 3000 ohm/m. Evidence of the stone impedance is required from the contractor;
- 2.4m high station fence to be installed;
- Ensure the surface and sub-surface of the station comply with the civil design instructions and slope are complaint.

The following table is provided to delineate the interface between MCMASTER and the Contractor with respect to the civil site preparation activities.

Table 2: Civil - Site Preparation - McMaster and Contractor Activity Interface

Procurement, Installation & Commissioning			
Scope of Work	Contractor	MCMASTER	Comments
Rough and finished grading, drainage, and upgrading the access road, turning area	√		
Water supply for construction	√		
Waste Disposal	√		As per attached Environmental Specifications
Geotechnical Survey		√	MCMASTER will provide the report
Topographic Survey		√	MCMASTER will provide a copy of the topographic survey report to the Contractor
Legal Survey	N/A	N/A	Included in RFP package

1.6.6 Foundation

Procurement, Construction and Commissioning activities related to foundations/footings will cover, but not limited, to the following:

- Two (2) foundations for neutral reactors;
- Two (2) transformer pads for transformers T1 & T2;
- Two (2) spill containment pits with integrated firewall footings for transformers T1 & T2;
- One (1) Oil water separator cast in place in the 115 kV area;
- One (1) foundation for bus support in the pit for “T1”;
- Two foundations for power cable supports in the pits;
- Eight (8) footings for the new PCT building;
- Two (2) footings, Three (3) slabs for front and rear entrance platforms for PCT building;
- Nighty-five (95) meters of 5’’ diameter concrete encased duct bank;
- Two (2) precast vault station service transformer foundations;
- Fifty-five (55) line post footings, Six (6) corner post footings and Four (4) gate post footings to be installed for the station fence.

The following table is provided to delineate the interface between MCMASTER and the Contractor with respect to the foundation activities.

Table 3: Foundations - McMaster and Contractor Activity Interface

Procurement, Installation & Commissioning			
Scope of Work	Contractor	MCMASTER	Comments
All Concrete foundations for transformers, HV & LV Yard equipment including lightning masts, spill containment, and acoustic enclosure, fire wall, etc	√		

1.6.7 Structural – Steel Structures

Procurement, Construction and Commissioning activities related to steel structures will include, but not limited, to the following:

- Two (2) steel structures for neutral reactors;
- Two (2) steel service platforms for transformers " T1 & T2";
- One (1) manufactured firewall in the pit for transformer "T2";
- One (1) steel structure support for bus in the pit for transformer "T1";
- Two (2) steel structures for power cables supports;
- Two (2) steel structure for PCT building entrance platforms (Front and rear);
- Miscellaneous brackets for small equipment such as fuse box or lighting fixture, etc.

The following table is provided to delineate the interface between MCMASTER and the Contractor with respect to the steel structure activities.

Table 4: Structural - Steel Structures - McMaster and Contractor Activity Interface

Procurement, Installation & Commissioning			
Scope of Work	Contractor	MCMASTER	Comments
All support structures as required.	√		

1.6.8 Major Power Equipment/Material

Material Selection & Procurement:

- The Contractor will select and procure equipment and material of appropriate functionality and quality consistent with MCMASTER standards, from MCMASTER's pre-approved vendors list indicated in material details of the projects part of this contract.
- In addition to the list of major equipment below, a further detailed material list of MCMASTER approved manufacturers and part numbers is included in this RFP. Any deviation from these lists requires prior approval from MCMASTER.

Installation:

- The equipment shall be installed as per manufacturers' instructions and/or MCMASTER Instructions.
- For transformer installation, services of a representative of the Vendor is recommended to the Contractor, as required, to supervise the installation.
- In case, when a MCMASTER Standard, or specified material, is unavailable, equivalent Industry standard, or alternate material, can be used subject to prior approval by MCMASTER. Contractor shall provide a minimum of 15 day notice for review and approval of the request to use an alternate standard or material.

The list of material is indicated and described in the design package is located in the Appendix C of this document.

Procurement and installation of all other equipment and material including miscellaneous structures, cable trays & trenches, conductors, connectors, insulators, heat detectors, etc, as required as per the detailed design shall conform to MCMASTER instructions and listed standard of this document. In the technical documentation, provided quantities are specified. It is the responsibility of the contractor to perform his own quantity estimation prior to providing a price. The quantity provided in the technical documents are for reference only.

1.6.9 E-House

The new building will include, but not limited to, the following:

- Removal of existing 15kV 500 kcmil cable to existing transformers T1 and T2 located in the basement of the existing E-house building as per the scheduled staging of the project.
- Installation of the E-house on the footing;
- Installation of eighteen (18) new 15 kV 1250 kcmil cables from new transformers T1 and T2 through the bottom of the building;
- Connecting the switchgear end of the above cables to the appropriate cells of the switchgear (transformer incoming cells). Cables will enter the cells from the bottom,
- Isolating the concentric neutral of the cables coming from transformers T1 and T2 at the switchgear end (the transformer end of the concentric neutral is grounded),
- Connecting the switchgear end of the above cables to the appropriate cells of the switchgear (capacitor bank cells). Cables will enter the cells from the bottom,
- Terminating the M/C switchgear side of all cables (transformer and capacitor bank) with 15 kV termination kits for indoor installation as described in design documents.
- Providing appropriate cable hangers and supports for all cables before connecting to the buswork of the switchgear cells;
- Installation of AC and DC cables and services inside the E-house with the rest of the station equipment;

- Installation of access platform for the Two (2) entrances of the E-house;
- Perform the grounding of the building to the station grid;

The following table is provided to delineate the interface between MCMASTER and the Contractor with respect to the E-House activities.

Table 5: E-House - McMaster and Contractor Activity Interface

Procurement, Installation & Commissioning			
Scope of Work	Contractor	MCMASTER	Comments
E-house (Free Issued Material by MCMASTER)	√	√	E-house will be delivered at site by float. Manufacturer Drawings for E-house to be provided to Contractor. E-house will be delivered by the vendor to site on March, 2018
Site Acceptance Tests of Transformer	√	√	The Contractor will witness testing by MCMASTER prior to the Contractor accepting and off-loading E-house at site.
Lift E-house from the delivery float, install on pad, and assemble	√		Upon acceptable values, the Contractor will off load E-house on pad. The Contractor is responsible for E-house final assembly and erection.
All other Equipment	√		As per MCMASTER's specifications
All Miscellaneous Material	√		As per MCMASTER's specifications

1.6.10 Protection, Controls, Metering and Teleprotection (PCM&T)

The PCM&T associated construction will comprised with the following major tasks:

- External Switchyard Cabling between Switch Yard equipment and PCT building (As per cable list attached in Appendix C)
- Inter-panel wiring between relay racks and external equipment
- Relay testing & Commissioning with in service settings
- SCADA/RTU point verification (Telemetry Compliance)

- Functional testing of Switchyard equipment and all the associated IEDs

External Switchyard Cabling:

- Provide necessary CT, VT, Control, Metring, AC and DC cabling between relay racks & SWYD equipment ;
- The cable sizes, lengths, and routing shall follow the detail design drawings and the associated utility and CSA standards;
- Ensure cable numbering and point to point interface wiring is in-compliance with utility design guide lines and the associated standards;
- Ensure all the external cabling and connections have been rung out and connected as per design;
- Wire markers shall be used, and the markers shall have sufficient grip on the wire and have permanent printing protected by a clear over coating using heat shrink materials;
- Connections to terminal blocks shall be made readily removable for testing purposes.

The list below provides a few major tasks (but not limited to) that the contractor shall perform under this project:

- Install new Teck and shielded cables as per cable list for five motorized disconnect switches 91-B4, 91-B3, 91A1-A2, 91T1-A and 91T2-A. Terminate at both ends with appropriate connectors and practice, Test and verify operation and interlocking with LV breakers;
- Install, terminate and test shielded cables for capacitive voltage transformer as per attached cable list, verify all wiring and cable grounding compliance with consultants detail drawing package;
- Install, terminate and test new Teck and shielded cables for two power transformers as per cable list verify all wiring and cable grounding;
- Install, terminate and test new shielded cables for Transformer power quality metering (T1 & T2 PQM) as per cable list;
- Install, terminate and test new Teck cables for Revenue Metering cabinet and revenue metering junction boxes as per cable list;
- Install, terminate and test new multi core Fiber cables between E.T Clarke substation and NF-91 E-House, as per cable list;
- Install, terminate fiber patch cables, DC shielded control cable for PCT 19 inch relay rack at E.T Clarke substation and T1Q1 and T2Q3 breakers;
- Install, terminate and test new Teck cable for AC station service as per cable list;

PCM&T Testing and Commissioning:

The following list provides high-level task list (but not limited to) that the Contractor shall execute prior to energization. Based on this, the Contractor shall prepare a detail commissioning plan and schedule and obtain client's approval prior to start of commissioning. This section provides only the PCM&T related and for other HV & LV equipment-commissioning details please refer the associated sections.

The E-house will be free issued to site with all the internal wiring done, tested and certified.

- Megger test all the low voltage power and instrumentation cables as needed;
- Verify all the connections between switchyard equipment and PCT building equipment have been rung out;
- Verify all the correct model number and power supply voltage for each relay;
- Verify correct contact configuration of each switches;
- Ensure proper relay boot up and loading of in-service settings;
- Test each digital input and outputs and perform functional tests as per agreed commissioning plan;
- Verify the measuring elements, timers and communication interface;
- Verify the station telemetry and point verification as per station point list;
- Verify each logic diagram to ensure the associated protection, control, telemetry, metering, and teleprotection elements and scheme operation;
- Ensure the equipment identification, labeling and displays are in compliance with clients' requirements
- Ensure ACSS and DCSS interfaces are as per design and interface with SCADA/RTU;

The following list provides a few major testing and commissioning activities (but not limited to) that the Contractor shall perform:

- Complete Testing and commissioning of new power Transformers T1 &T2, transformer protection (T60 and SEL387E) including line back-up protections functionality;
- Complete Testing and commissioning of NSD570 "A Main" & "B Alt" Tele-protection implemented to send and receive the TT to and from Burlington TS;
- Complete Testing and commissioning of Transformer power quality metering (T1 &T2 PQM);
- Complete Testing and commissioning of two Transformer LV breaker T1Q&T2Q and line differential Protection (SEL-311L) including 13.8KV Line differential protection;
- Test and commissioned Local LAN and SEL 2240 Automation controller within E House(PCM&T building) and interface with 13.8kV switchgear(E.T. Clarke) station HMI (SEL 3355) and LAN;
- Test and commissioned the two CTM SEL 2506 relay, test interface with AIP-1&2 SEL 2100 for tripping of 52-UH2, 52UH1 and 52-G7 Breakers in MUMC Electrical room and E.T Clarke CHP stations;
- Verify the reclosing of T1Q1 and T2Q3 breakers after loss of main.
- Test and commissioned the tripping of 13.8 KV Breaker T1Q1 and T2Q3 breakers and SEL -311L relays at E.T Clarke substation;
- Verify correct operation of each tripping, closing, auxiliary and alarm paths, highlighting the path tested on the ''On site Working Drawing';
- Verify correct system operation for protections such as reclose operation, SCADA and other control circuit (i.e. Tap Changer), highlighting the path tested on the 'On site Working Drawing';
- Perform 'HI-AMP' tests on all CT's, loop test, verifying proper currents in all relays, highlighting the path tested on the 'On site Working Drawing', and filling in the appropriate CT test sheet;
- Verify the teleprotection schemes and end to end testing;

- Install 19 inch free standing PCT relay rack at E.T Clarke substation, test and commissioned PCT relay rack which include SCADA HMI (SEL 3355) and LAN switch along with two line differential SEL 311L relays;
- Install and commission 19 inch free standing PCT relay rack at E.T Clarke substation include SCADA Gateway, HMI and LAN switch; (Provide optional price for this item)

Functional Testing

Perform functional tests for each HV & LV switchgear Equipment. All the tests as per commissioning plan shall be signed off by a Professional Engineer and witnessed by client's representative.

- Ensure that equipment pre-commissioning is complete
- Ensure that point to point cable inspections are complete
- Review documentation from Switchgear/E-House Construction and point to point inspection
- Perform functional tests from each device and protection scheme
- Perform teleprotection scheme and verify the interface with protection IEDs and remote station equipment
- After energization of the equipment, perform I/S readings to verify correct current and potential supply to the protection system;

PCM&T Documentation

The Contractor shall provide following documentations before and after commissioning.

- Commissioning plan and schedule
- Test sheet, report format and rationale
- Commissioning Test sheets, results and Functional test reports
- Field Mark Ups (Commissioning Working copies)

Client (McMaster) will Provide:

The following documentation will be made available to contractor prior to start work:

- Release for Construction Drawings (RFCs) for external and inter-panel wiring;
- RFC Drawings for all the associated Elementary Wiring Diagrams (EWDs);
- Drawings package of PCM&T equipment installed within the E-House;
- Protection settings and logic diagrams for testing & commissioning;
- Protection Description document (PD) for information;
- Alarms list and tabulation of function (TOF) for telemetry verification;

1.6.11 Revenue Metering

The Revenue metering scope requires Installation of two Revenue metering junction Boxes, two revenue metering cabinets and associated cables per cable list. The General contractor is also responsible to provide IESO registration with the authorized Meter service provider, which include:

- Meter single line diagram and SLD table
- Burden calculation for IT secondary cable
- SSLA calculation report
- Emergency instrument transformer restoration report
- IESO submission SSLA, Totalization table, report etc.

1.7 Decommission/Removal

After the project is in service, decommission, remove and dispose off the following consistent with the applicable environmental requirements including the provincial environmental Act.

- Insulators
- Lightning Arresters
- Transformer (T1) 110/14.2/14.2 48 MVA
- Transformer (T2) 110/14.2/14.2 48 MVA
- Station service Transformer (SS1 & SS2)
- Underground cable
- 115kV strain bus and insulators
- 115kV disconnect switches (5)
- 125VDC existing Battery Charger
- 125VDC existing Battery
- Abandoned LV structures and foundations ;
- Existing E-house
- Existing AC outdoor panels

For tendering purposes assume the transformer oil has the PCB concentration of 50ppm or less. Refer to Appendix E for transformer name plates.

The Contractor will be responsible to create an inventory of all P&C equipment that will be removed. This inventory list should include make, model, voltage, quantity, etc, and send to Mc Master Project Manager.

All old cables no longer used as a result of this project shall be removed in their entirety and disposed off according to Environmental Specification. All other material deemed to be surplus shall be disposed off in the same manner.

1.8 Deviation

Any deviation from this specification shall have prior written approval from SMi and McMaster.

2 Work Execution

The Contractor will procure all equipment and material, except the 'free-issue' material and complete the construction/installation as per the drawings issued for construction, specifications and bill of materials to meet the commissioning date.

2.1 Schedule

The Contractor shall provide the schedule included in their bid submission, which shall include the milestones shown below, and tasks identified in MCMASTER's milestone breakdown.

- MCMASTER – Provide PO Award – November 2018
- Contractor – Starts on site Construction Activities – {Contractor to specify} (Note, Contractor NOT to mobilize to site prior to that date without MCMASTER approval)
- MCMASTER – Deliver Autotransformers to Site – June 2018
- Contractor – Equipment Ready for Commissioning – {Contractor to specify} Contractor – Substantial Completion of Contract and Removals – {Contractor to specify}

Within fifteen (15) days of award of Contract, the Contractor shall prepare and submit a detailed project specific schedule of activities based on the milestones, schedule and outage constraints provided.

Routine updates to these schedules shall be provided on a bi-weekly basis. After MCMASTER's review and concurrence with the plan, this baseline schedule will be tracked until the project completion. This shall form the basis for discussions of progress and progress payment.

2.2 Contractor As 'Constructor'

The Contractor understands the proposed contract will be an "Owner" - "Constructor" relationship under the OHSA, whereby Mc Master is the "Owner" and the Contractor is the "Constructor". The Contractor shall be the "Constructor" within the meaning of the OHSA, solely responsible for construction, health and safety at the place of Work and for compliance with the rules, regulations and practices required by the OHSA.

The Contractor shall file the Notice of Project.

2.3 McMaster Site Inspector's Office & Facilities

The Contractor shall provide a site office for the duration of the project, for exclusive use of MCMASTER staff. Such offices shall be fully furnished, contain washroom and HVAC facilities. The Contractor shall provide all necessary cleaning and maintenance services, including labour and consumables (water, electricity).

The Contractor shall provide offices and associated amenities for its site personnel.

Temporary parking area with adequate spaces in close proximity of the site office shall also be prepared and maintained by the Contractor.

These offices shall be provided by the commencement of Site work and shall remain for the duration of site work.

Cost for provision of above offices is deemed to be included in the Contract Price.

2.4 Inspection of the Site

It is the responsibility of the Contractor to inspect and examine the site and its surrounding (including any information available regarding the site and its surroundings).

It is the responsibility of the Contractor to extract and access all necessary information for carrying out the contract.

2.5 Public Inconvenience

The Contractor shall minimize any inconvenience to the general public and affected land owners.

The Contractor shall ensure all measures are taken with respect to public safety.

2.6 Water, Air and Noise Pollution

The Contractor shall, at its expense, provide suitable facilities to prevent the introduction into any sub-surface water bearing strata or reservoirs or other body of water, including the sea, substances or materials which shall pollute the water or be deleterious to life or environment.

The Contractor shall perform its contract so as not to discharge into the atmosphere, from any source whatsoever, smoke dust or other air contaminants in violation of the applicable laws.

The Contractor shall perform the contract without unreasonable noise and disturbance, so as not to interfere unnecessarily or improperly with the use or occupation of adjacent properties, whether in the possession of MCMASTER or of any other party.

2.7 Access, Land and Right of Way

MCMASTER will provide all the land and the right of way into the land for the permanent work and the Contractor may, where approved by MCMASTER use the same for temporary purposes, such as workshops, work yards, offices, or storage of materials (MCMASTER will approve the area that can be used for these purposes).

Should the Contractor find that the land provided for temporary purposes becomes inadequate, he shall apply to MCMASTER, giving details of his extra requirement.

The Contractor shall use the right of way provided by MCMASTER for access to Site. MCMASTER assumes no responsibility for the condition or maintenance of any proposed access route, or of any existing road or structure that may be used by the Contractor for performance of the work under these Tender Documents.

All work required along the route(s) to provide suitable access shall be performed by the Contractor, and all related costs are deemed to be included in the offer.

The construction of additional access roads shall only be performed with the permission of MCMASTER.

Snow removal and grading, as required, of the access roads, yards and parking areas for the Site is at the cost of the Contractor and is deemed to be included in the Contract Price.

2.8 Water and Power Supply

Any power requirement by the contractor during construction shall be at the Contractor's expense. McMaster cannot provide more than 50 kVA 208 V 3 phase from existing installation at NF91. If more power is required the contractor is responsible to procure such additional power.

The Contractor shall provide water required for his construction purposes at his own cost. The Contractor shall be fully responsible to arrange transport for water between the source of water supply and the Site.

The Contractor shall make all necessary arrangements for all temporary storage, distribution and drainage of water as well as to provide all necessary arrangements for the distribution of lighting and power for the proper execution and security of the Works including temporary wiring, fittings, and portable power generating units.

The Contractor shall adapt and maintain the Temporary Works, as necessary and remove it and make good on completion to the satisfaction of MCMASTER.

The Contractor shall provide the necessary portable generators for construction power.

2.9 Locates for Buried or Concealed Utilities

The Contractor shall locate and record underground utilities at the Site. The Contractor shall not proceed with excavation work or drilling until utility locates of all buried or concealed services are complete and protection has been provided.

The Contractor shall provide a locate report showing all located utilities, if an accurate locate can be provided. Otherwise, excavation must be done by hand, and/ or Hydrovac until undisturbed ground is reached prior to commencing drilling activities or by other non-destructive execution techniques. Follow all orders identified in the locate report.

All excavation within the existing station must be done by Hydrovacing to within a minimum of 1m depth.

For work on public road allowances and on other property, the Contractor shall arrange for a utility locate and locate report from each Utility Authority that potentially has services in the vicinity of the proposed Work. Provide MCMASTER with each locate report and follow all orders identified in the locate reports. When the locates are complete, update record drawings showing exposed utilities and return to Utility Authority.

The Contractor shall retain a copy of utility locate reports on Site.

The Contractor shall ensure that any stakeout markings that are disturbed or lost are replaced.

All the above work must be performed in accordance to MCMASTER standards.

2.10 Transportation of Construction Crews

The Contractor shall be responsible for providing transport to and from the Site for his own or his Sub-contractor's personnel.

2.11 Site Security, Lighting and Fence

The Contractor shall, in connection with the contract, provide and maintain at his own cost all lights, guards, fencing and watching when and where necessary or requested by MCMASTER or by any duly constituted authority for the protection of the Works or for the safety and convenience of the public or others.

2.12 Snow Removal

Snow removal during construction shall be carried out by the Contractor.

Snow loading/accumulation shall be as per data from Environment Canada and National Building Code for this geographical area.

The Contractor must assume that all snow clearing from public road entrance to the station will be under this contract.

2.13 Firefighting Equipment

The Contractor shall provide and maintain to the approval Fire Authority adequate portable firefighting equipment on the Site during the performance of its services. The Contractor shall ensure that all supervisors and personnel are adequately trained in the safe usage of such portable firefighting equipment.

2.14 Temporary Construction Fence

The Contractor shall install a temporary construction fence, to create a completely fenced construction area. The area becomes Contractor's Notice of Project site boundary.

Installation of this temporary fence will be the Contractor's responsibility. The Contractor shall install a gate in this fence where appropriate for access to the Works.

After completion of the project the Contractor shall remove the temporary fence.

The Contractor shall submit a drawing with location of temporary construction fence with construction gate. The drawing shall be reviewed and accepted by MCMASTER if no changes required.

2.15 Site Access Plan

In general, MCMASTER's personnel shall not be present in the area inside the temporary construction fence, except for the purpose of Site Inspection and witnessing Site Acceptance Testing and regular maintenance of existing facilities. Once inside the area, MCMASTER personnel must receive Site Orientation from Contractor. Contractor, being "Constructor" in this area is fully responsible for all safety aspects of MCMASTER personnel while inside this area.

The Contractor must develop and manage a Construction Site Access Plan, agreed to by both MCMASTER and Contractor, for site access during working hours and off hours.

2.16 Quality Assurance Requirements

All Contractors/Subcontractors and manufacturers of equipment supplied under this specification shall at the time of bidding and during the design/entire execution period of the Contract, be ISO 9001 or ISO 9002 certified.

ISO Program certification is not mandatory for Contractors/Sub-contractors. However, they will need to be able to demonstrate that they have a verifiable QA program in place.

Furthermore, the Contractor shall, during the project, exercise all his internal quality assurance procedures for which he has received the corresponding certification.

For all site works, the Contractor must establish in addition to his internal quality assurance plan, a site specific quality assurance plan for approval by MCMASTER. The site quality assurance plan shall cover the subjects of material receipt and testing, responsibilities during construction and installation, supervision, countermeasures against faulty execution, testing after installation as well as documentation of all the above.

All documents of any nature shall be clearly identified by reference or drawing numbers, and revisions marked accordingly. The Contractor shall keep and regularly update a record of all drawings submitted for approval, indicating the present status.

2.17 Health, Safety and Environment (HSE) Plan

The Contractor shall comply with the relevant requirements of OHSA.

The responsibility for all safety measures required for the Contract rests solely with the Contractor.

The Contractor shall produce a Site Specific HSE Plan and submit it for review to MCMASTER. The primary objective of the HSE Plan is to demonstrate the capability to carry out the contract work, giving due consideration to the Health, Safety and Environmental management of both his own employees, those of MCMASTER and anyone who may be affected by his activities.

The contractor's HSE Plan shall conform to MCMASTER's 'Requirements for Site Specific Safety Plans for Contractors' attached to this RFP.

The Contractor shall, in undertaking 'Hot Works', conduct the same in a safe manner and in compliance with the applicable provincial and local laws and regulations and OHSA's safety regulations, and shall be solely responsible for obtaining all the necessary permits and licenses required by the said laws and regulations.

'Hot Works' shall be defined as those types of work which shall involve the use of open flame, all types of welding and gas cutting of metals, use of apparatus or machines that could produce sparks, and work which otherwise endangers inflammable environment, existing Structures and Utilities.

The Contractor shall be responsible for adequately protecting all existing utilities, services, systems and structures at the site. The Contractor is responsible for any damages caused to existing utilities, services and structures during construction and will repair/restore them at the Contractor's expense. The Contractor shall arrange for all field stakeouts of existing utilities and will expose any utility deemed necessary by the Contractor.

The Contractor shall contact the utility authorities and satisfy any imposed conditions or requirements.

Should the proposed works be connected to the existing site services the feasibility study of the existing installations, i.e. storm sewers, sanitary drainage and water supply piping shall be conducted at the expense of the Contractor.

2.18 Existing Drainage

The Contractor will maintain the flow in existing pipes, conduits, ditches and water courses. Where this is not feasible, alternative arrangements shall be approved by MCMASTER. The Contractor shall maintain adequate drainage and siltation controls for the duration of the Contract.

2.19 Half Load Season

Any additional costs incurred by the Contractor due to half load restrictions and winter or frost conditions shall be included in the Contract Price.

2.20 Material/Equipment Procurement

2.20.1 General

The Contractor shall be responsible for timely procurement, delivery and onsite storage of all necessary equipment and materials.

Equipment and material procurement will cover all those items that have been identified on approved drawings and associated Bill of Materials (BOM) as required to complete the work. For any deviation from the BOM, the Contractor shall first obtain written approval from a MCMASTER representative.

2.20.2 Equivalence for Materials

Materials for the installation will be specified in the BOM.

The Contractor must follow specifications and instructions on the BOM for procurement and not deviate from it.

If the Contractor is unable to order accordingly, an 'equivalent' must be proposed to the designated MCMASTER representative for approval prior to ordering the material.

Equivalence acceptance will require two (2) working days and the Contractor shall first obtain the designated MCMASTER representative written approval.

2.20.3 Storage of Equipment/Material at Site

The Contractor shall be responsible for storing equipment/material at site in a safe and secure location.

2.21 Construction/Installation Activities

All construction / installation activities shall be conducted according to design drawings, BOM, and instructions for constructions provided with drawings issued for construction.

Explosives shall not be used for any excavation work. Contractor will ensure vibrations from the use of heavy equipment are kept at a very low level so as not to cause damage to the existing structures, utilities, systems or other assets.

Any deviation from the approved documents will require the Contractor to correct the deviations at its own cost.

2.22 Commissioning

The commissioning testing requirements for acceptance shall include, but not limited to the following:

- Contractor will perform visual and functional tests as recommended by manufacturer of the station equipment.
- Designated MCMASTER Representative will witness all acceptance tests.
- Tests not witnessed by MCMASTER representative shall not be acceptable.
- Written proof of the quality assurance performed on the installation will be required for final acceptance.

2.22.1 Civil Work

Contractor will perform functional tests on spill containment, Oil Water Separator, and the drainage system in accordance with MCMASTER instruction.

The containment pits will undergo a 6-hour water leak test for the containment pits to ensure water level drop does not exceed 5mm before being accepted.

2.22.2 Test Reports

Contractor shall prepare two (2) sets of test reports, and an electronic copy, for each piece of equipment and provide to MCMASTER's representative for Review and approval.

2.22.1 Certification of Approval Management

Complete approved construction work, as designed.

Notify designated MCMASTER Representative for pre-approval of any required field changes prior to implementing any design changes.

Update original prints with any approved modifications and send field-marked prints to designated MCMASTER Representative.

Provide QA/QC documentation to designated MCMASTER Representative.

Contractor shall complete 24 hour hydraulic water test of spill pit and will be monitored by Site Inspector or designated MCMASTER Representative. Plug the outlet of spill pit and fill with water to near top of curb and measure water level. Let the water remain in spill pit for a minimum of 24 hours and measure again. The allowable drop in water level is 2mm to pass the 24 hour hydraulic water test.

Send copy of prepared documents to designated MCMASTER Representative for review.

2.23 Construction Documentation

The Contractor shall maintain at Site during the progress of the Work, up to date copies of all reviewed and approved drawings, specifications, supplementary data and latest revisions. These documents shall be available at Site at such early date as to enable MCMASTER Site Inspector to perform inspection. The Contractor will consider the inspections as part of its contractual obligations.

2.24 Site Clean Up

The Contractor shall maintain the site in a tidy condition and free from the accumulation of waste products and debris.

The Contractor shall remove waste products and debris and shall leave the site clean and suitable for handover to the Owner before attainment of Substantial Performance of the Work. The Contractor shall remove products, tools, construction machinery, and equipment not required for the performance of the remaining work.

Prior to application for payment upon Total Performance of the Work, the Contractor shall remove products, tools, construction machinery and equipment, and waste products and debris.

3 Reference Publications

In addition to compliance with all applicable laws and regulations, all components, activities provided within this specification will be designed, tested and installed in accordance with the most recent version of standards. More specifically, the Contractor shall apply the following standards but shall not be limited to:

- AWS D1.1	Structural Welding Code
- ASHRA 90.1 – 2013	Energy standard for building
- Safety act. S.C. 1993	Canada motor vehicle safety
- SOR/86-304	Occupational health and Safety regulation
- SC 1999, C.33	Environmental protection act 1999
- NBC 2012	National building code of Canada
- NFPA 1	Fire code – National Fire protection Association
- NFPA 10	Portable Fire extinguishers
- NFPA 72	National Fire Alarm and signaling code
- Ontario regulation	OBC 2012 or latest 413/90
- OESC 25 th edition	Ont. Electrical safety code 25 th edition
- Y14.15, 14.15a & Y15b	ANSI Standard drafting practices for electrical and electronic diagram
- Y32.16	ANSI Standard reference designations for electrical and electronic parts and equipment
- A36 or A325	ASTM for carbon structural steel or standard specification for structural bolts, steel, heat Treated, 120/105 ksi minimum tensile strength
- A653	Standard specification for steel sheet, zinc coated (galvanised) or Zinc-Iron Alloy-coated by the hot dip process (class to suit building manufacturer
- A325	Design load and connection details
- A123/123M	Standard for Zinc (Hot Dip Galvanised) coating on Iron and Steel product
- C22.1-12	Canadian electrical code, part 1, safety standard for electrical installation
- C22.2 No. 9	General requirements for Luminaries
- C22.2 No. 127	Equipment and lead wires
- C22.2 No 141	Emergency lighting equipment
- C860	Performance of internally lighted exit signs
- C282-09	Emergency electrical power supply for buildings
- G40.20-13	General requirements for rolled or welded structural quality steel
- G40.21-13	Structural quality steel
- G164-M92	Hot-dip galvanizing or irregularly shape articles
- CSA-S16-09	Design of steel structures
- S136-12	North American specification for the design of cold formed steel structures for building
- S136-M	Cold formed steel structural members
- W47.1	Certification of companies for fusion welding of steel
- W47.2	Certification of companies for fusion welding of aluminium

-	W59	Welded steel construction (metal arc welding)
-	W59.2	Welded Aluminium construction
-	Z462-2008	Workplace electrical safety
-	A660-10	Certification of manufacturers of steel building system
-	ISO 9001	Quality management system requirements
-	NEMA VE 2-2013	Cable trays installation guildeline
-	ULC S524	Installation of Fire alarm system
-	ULC S536	Inspection and testing of Fire alarm systems
-	ULC S537	Verification of Fire alarm system
-	UL94	test for flammability of plastic materials for parts in devices and appliances
-	ULC W453/W606	Fire resistance 2 hour rating

3.1 Contract Completion Report

The Contractor is expected to provide MCMASTER a complete copy of all relevant project documentation prior to Final Completion of the contract. This document shall include, but not limited to, the following items:

- Project Safety Log
  - MOL Visits & Orders Summary
  - Incident Summary
  - Etc.
- Equipment Manuals
- As-Built Drawings (Complete Set)
- Environmental Management
  - Oil Testing Results
  - Soil Testing Results
  - Water Testing Results
  - Etc.
- Inspection, Testing, And Acceptance Plan (ITAP) with Results
  - Includes Factory Acceptance Tests
  - Concrete compression test reports
  - Compaction Reports
  - Ground Grid Test
  - High Pot and Partial Discharge test (if preformed)
  - Etc.
- Completed Pre – Service Documentation
- Training recommendations
- Warranty Information

- Bill of Materials with Manufacturer's Warranty Information
- Material supplied

3.2 As-Built Drawings and Documents

The Contractor shall submit a CD-ROM or USB with complete and accurate Field Mark-Up drawings of "As-Built" installation, along with Bill of Materials, Cable List and other documents in MS Office electronic format, one (1) month after the in-service date. In addition, the Contractor shall submit One (1) set of the above listed documentation, as a paper copy, organized in binders with adequate dividers and tabs.

3.3 Manual

The Contractor shall provide One (1) set of Maintenance and Operation Manuals compiled in binders, and One (1) CD-ROM or USB with the same content in electronic format.

Appendix A

Electrical Configuration of the Station

Appendix B

Project Planning

Appendix C

Engineering Documents

Appendix D

Environmental Specifications

Appendix E

Existing Transformer Nameplate