



SPECIFICATIONS

SOLICITATION #: 15-22066

BUILDING: U-66
Uplands Campus
Ottawa, Ontario

PROJECT: U-66 115kv Outdoor Substation

PROJECT #: U66-5078

Date: July 2015

Directions to the Ottawa Research Facilities – Uplands

NRC Institute for Aerospace Research (NRC-IAR)

Research Road
Ottawa, Ontario, Canada

Tel: 613-991-5738

NRC Centre for Surface Transportation Technology (NRC-CSTT)

2320 Lester Road
Ottawa, Ontario, Canada

Tel: 613-998-9639

NRC Institutes/Branch/Program	Buildings
NRC Administrative Services and Property Management (NRC-ASPM)	U-62
NRC Institute For Aerospace Research (NRC-IAR)	U-61, U-66, U-67, U-69, U-70
NRC Centre for Surface Transportation Technology (NRC-CSTT)	U-84, U-86, U-87, U-88, U89, U-90, U-91

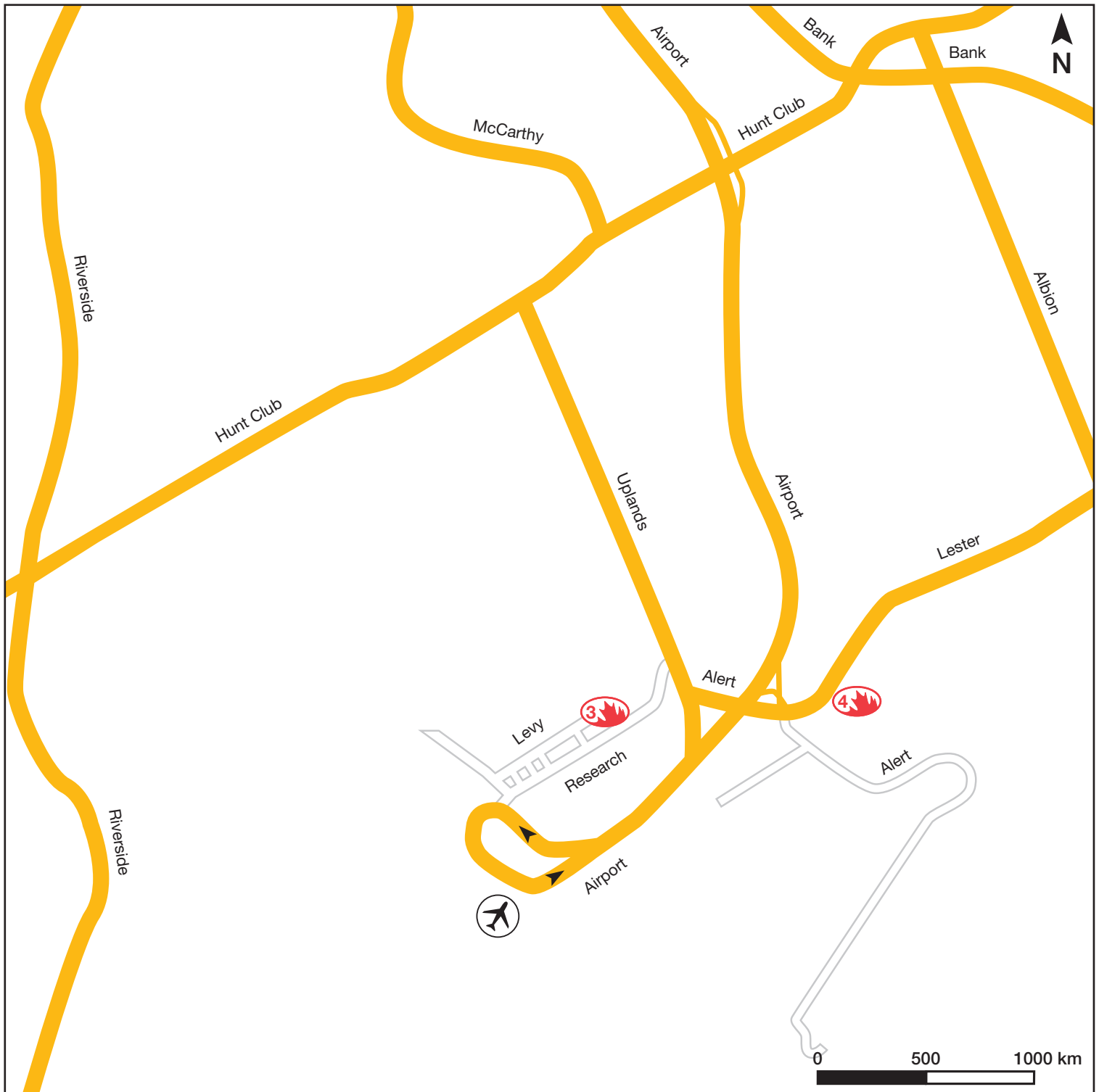
By Road, from the MONTREAL RD FACILITIES to NRC-CSTT, 2320 Lester Road

1. Drive EAST on MONTREAL RD
2. Turn RIGHT on BLAIR RD, cross OGILVIE RD
3. Take the ramp and follow Highway 174 WEST
4. Keep RIGHT and take first exit on ramp Highway 417 EAST towards Cornwall/Montreal
5. Exit at WALKLEY RD, merge RIGHT on WALKLEY
6. Turn LEFT at CONROY RD
7. Turn RIGHT at DAVIDSON RD, cross BANK ST – name changes to LESTER RD
8. Continue on LESTER RD and watch for NRC Research Facilities signs

By Road, from the MONTREAL RD FACILITIES to NRC-IAR, Research Road

1. Drive EAST on MONTREAL RD
2. Turn RIGHT on BLAIR RD, cross OGILVIE RD
3. Take the ramp and follow Highway 174 WEST
4. Keep RIGHT and take first exit on ramp Highway 417 EAST towards Cornwall/Montreal
5. Exit at WALKLEY RD, merge RIGHT on WALKLEY
6. Turn LEFT at HAWTHORNE RD
7. Turn RIGHT at HUNT CLUB RD, cross CONROY RD, ALBION RD, BANK ST
8. Turn LEFT at UPLANDS DR. Continue and watch for NRC Research Facilities signs





NRC Institute



Major HWY



Airport



Ferry



Metro



Trans Canada HWY



Secondary HWY



Train Station



Bus Station

SPECIFICATION

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National Research Council Conseil national de recherches
Canada Canada

Administrative Services Direction des services
& Property management administratif et gestion
Branch (ASPM) de l'immobilier (SAGI)

Construction Tender Form

Project Identification **U-66 115kv Outdoor Substation**

Tender No.: **15-22066**

1.2 **Business Name and Address of Tenderer**

Name _____

Address _____

Contact Person(Print Name) _____

Telephone (_____) _____ **Fax:** (_____) _____

1.3 **Offer**

I/We the Tenderer, hereby offer to Her Majesty the Queen in Right of Canada (hereinafter referred to as "Her Majesty") represented by the National Research Council Canada to perform and complete the work for the above named project in accordance with the Plans and Specifications and other Tender Documents, at the place and in the manner set out therein for the Total Tender Amount (to be expressed in numbers only) of: \$_____. _____ **in lawful money of Canada (excluding GST/HST)**

The above amount is inclusive of all applicable (*) Federal, Provincial and Municipal taxes except that in the event of a change in any tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property, that occurs

- .1 after the date this tender was mailed or delivered, or
- .2 if this tender is revised, after the date of the last revision

the amount of this offer shall be decreased or decreased in the manner provided for in GC22 of the General Conditions of the Contract Documents.

National Research Council Canada	Conseil national de recherches Canada
Administrative Services & Property management Branch (ASPM)	Direction des services administratif et gestion de l'immobilier (SAGI)

1.3.1 Offer (continued)

(*) For the purpose of this tender, the Goods and Services Tax (GST) is not to be considered as an applicable tax.

In the province of Quebec, the Quebec Sales Tax is not to be included in the tender amount because the Federal Government is exempt from this tax. Tenderers shall make arrangements directly with the provincial Revenue Department to recover any tax they may pay on good and servives acquired in the performance of this contract. However, tenderers should include in their tender amount Quebec Sales Tax for which an Input Tax Refund is not available.

1.4 Acceptance and Entry into Contract

I/We undertake, within fourteen (14) days of notification of acceptance of my/our offer, to sign a contract for the performance of the work provided I/we are notified, by the Department, of the acceptance of my/our offer within 30 days of the tender closing date.

1.5 Construction Time

I/We Agree to complete the work within the time stipulated in the specification from the date of notification of acceptance of my/our offer.

1.6 Bid Security

I/We herewith enclose tender security in accordance with Article 5 of the General Instruction to Tenderers.

I/We understand that if a security deposit is furnished as tender security and if I/we refuse to enter into a contract when called upon to do so, my/our security deposit shall be forfeited but the Minister may, if it is in the public interest, waive the right of Her Majesty to forfeit the security deposit.

I/We understand that if the security furnished is not in the approved form as described in Article 5 of the General Instructions to Tenderers, my/our tender is subject to disqualification.

National Research Council Conseil national de recherches
Canada Canada

Administrative Services Direction des services
& Property management administratif et gestion
Branch (ASPM) de l'immobilier (SAGI)

1.7 Contract Security

Within fourteen (14) days after receipt of written notification of the acceptance of my/our offer, I/we will furnish contract security in accordance with the Contract Conditions "F" of the Contract Documents.

I/We understand that the contract security referred to herein, if provided in the form of a bill of exchange, will be deposited into the Consolidated Revenue Fund of Canada.

1.8 Appendices

This Tender Form includes Appendix No. ____N/A_____.

1.9 Addenda

The Total Tender Amount provides for the Work described in the following Addenda:

NUMBER	DATE	NUMBER	DATE

(Tenderers shall enter numbers and dates of addenda)

National Research Council Canada	Conseil national de recherches Canada
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Administrative Services & Property management Branch (ASPM)	Direction des services administratif et gestion de l'immobilier (SAGI)
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1.10 Execution of Tender

The Tenderer shall refer to Article 2 of the General Instructions to Tenderers.

**SIGNED, ATTESTED TO AND DELIVERED on the _____ day of
_____ on behalf of**

(Type or print the business name of the Tenderer)

AUTHORIZED SIGNATORY (IES)

(Signature of Signatory)

(Print name & Title of Signatory)

(Signature of Signatory)

(Print name & Title of Signatory)

SEAL

BUY AND SELL NOTICE

U-66 115kv Outdoor Substation

The National Research Council Canada, Uplands Campus, Ottawa, ON has a requirement for a project that includes:

Provide new outdoor 115kv substation at building U66

Bidders must provide two envelopes, first envelope is labeled as "technical qualification submission", second envelope is labeled as "tender submission".

The first envelope is to contain a detailed description of three reference projects in which the contractor has completed previously describing the work performed, the approximate project cost, project time line and the project manager who completed the work. Project descriptions must pertain to work completed on systems with an operating voltage greater than 69kV and the work performed must include work on equipment with a voltage rating greater than 69kV. Also a letter of recommendation from the owner for at least one of the projects must be provided.

In addition to the three reference projects, the first envelope must confirm the contractor has the following qualifications:

- Confirmation of registration under WSIB classification 4124-001 'Power and Telecommunication Transmission Lines'
- Listing of full time personnel that are currently directly employed by the company, and their qualifications that meet the following training and/or certifications, listing in decreasing levels of importance:
 - IHSA 'Utility Work Protection Code'
 - Red Seal 7244 or Ontario Colleges 434A Powerline Technician Certification
 - Medium voltage cable stress cone terminations training and/or experience
 - Medium voltage phasing and phase rotation training and/or experience
 - Medium voltage cable pulling and installation training and/or experience
 - Medium voltage switchgear operation training and/or experience
 - Journeyman Lineman Certification

The first envelope must include all the requirements detailed above, failing to do so will be considered not qualified, the contractors bid will be rejected and the second envelop will remain sealed and returned to the respective contractor, unopened.

The second envelope is to contain the tender form required by "instructions to bidders" section.

1. GENERAL

Questions regarding any aspect of the project are to be addressed to and answered only by the Departmental Representative (or his designate) or the Contracting Authority.

Any information received other than from the Departmental Representative (or his designate) or the Contracting Authority will be disregarded when awarding the contract and during construction.

Firms intending to submit tenders on this project should obtain tender documents through the Buyandsell.gc.ca TMA services provider. Addenda, when issued, will be available from the Buyandsell.gc.ca TMA service provider. Firms that elect to base their bids on tender documents obtained from other sources do so at their own risk and will be solely responsible to inform the tender calling authority of their intention to bid. Tender packages are not available for distribution on the actual day of tender closing.

2. MANDATORY SITE VISIT

It is mandatory that the bidder attends one of the site visits at the designated date and time. At least one representative from proponents that intend to bid must attend.

The site visits will be held on August 12th and August 14th, 2015 at **9:00**. Meet Maurice Richard at Building U-66, Main Entrance, Uplands Campus, Ottawa, ON. Bidders who, for any reason, cannot attend at the specified date and time will not be given an alternative appointment to view the site and their tenders, therefore, will be considered as non-responsive. **NO EXCEPTIONS WILL BE MADE.**

As proof of attendance, at the site visit, the Contracting Authority will have an Attendance Form which **MUST** be signed by the bidder's representative. It is the responsibility of all bidders to ensure they have signed the Mandatory Site Visit Attendance form prior to leaving the site. Proposals submitted by bidders who have not attended the site visit or failed to sign the Attendance Form will be deemed non-responsive.

3. TENDER CLOSING DATE

Tender closing date is September 4th, 2015 at 14:00.

4. TENDER RESULTS

Following the Tender closing, the tender results will be sent by facsimile to all Contractors who submitted a tender.

5. SECURITY REQUIREMENT FOR CANADIAN CONTRACTORS

5.1 MANDATORY SECURITY REQUIREMENT:

This procurement contains a mandatory security requirement as follows:

- 1 The Contractor must, at all times during the performance of the Contract, hold a valid Designated Organization Screening (DOS), issued by the Canadian Industrial Security Director (CISD), Public Works Government Services Canada.
- 2 The Contractor personnel requiring access to sensitive work site(s) must EACH hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC.
- 3 The Contractor must comply with the provisions of the:
 - a. Security Requirements Checklist attached at Appendix "D"
 - b. Industrial Security Manual (Latest Edition) available at: <http://ssi-iss.tpsgc-pwgsc.gc.ca/msi-ism/msi-ism-eng.html>

5.2 VERIFICATION OF SECURITY CLEARANCE AT BID CLOSING

- 1 The Bidder must hold a valid Designated Organization Screening (DOS) issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC), **TO BE INCLUDED WITH THEIR TENDER OR PROVIDED WITHIN 48 HOURS FROM THE DATE AND TIME OF TENDER CLOSING**. Verifications will be made through CISD to confirm the security clearance status of the Bidder. Failure to comply with this requirement will render the bid non-compliant and no further consideration will be given to the bid.
- 2 Within 72 hours of tender closing, the General Contractor must name all of his sub-contractors, each of whom **must hold a valid RELIABILITY STATUS**, granted or approved by CISD/PWGSC, or any other Federal Department or Agency along with the names and birthdates or security clearance certificate numbers of all personnel who will be assigned to the project.
- 3 It is to be noted that any subcontractor required to perform any part of the work during the performance of the subsequent contract must also adhere to the mandatory security requirement of the contract. As well, no personnel without the required level of security will be allowed on site. It will be the responsibility of the successful bidder to ensure that the security requirement is met throughout the performance of the contract. The Crown will not be held liable or accountable for any delays or additional costs associated with the contractor's non-compliance to the mandatory security requirement. Failure to comply with the mandatory security requirement will be grounds for being declared in default of contract.
- 4 For any enquiries concerning the project security requirement during the bidding period, the Bidder/Tenderer must contact the Security Officer @ 613-993-8956.

6.0 WSIB (WORKPLACE SAFETY AND INSURANCE BOARD)

- 1 All Bidders must provide a valid WSIB certificate with their Tender or prior to contract award.

7.0 OFFICE OF THE PROCUREMENT OMBUDSMAN

- 1 **Dispute Resolution Services**
The parties understand that the Procurement Ombudsman appointed pursuant to Subsection 22.1(1) of the *Department of Public Works and Government Services Act* will, on request or consent of the parties to participate in an alternative dispute resolution process to resolve any dispute between the parties respecting the interpretation or application of a term and condition of this contract and their consent to bear the cost of such process, provide to the parties a proposal for an alternative dispute resolution process to resolve their dispute. The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca.
- 2 **Contract Administration**
The parties understand that the Procurement Ombudsman appointed pursuant to Subsection 22.1(1) of the *Department of Public Works and Government Services Act* will review a complaint filed by [*the supplier or the contractor or the name of the entity awarded this contract*] respecting administration of this contract if the requirements of Subsection 22.2(1) of the *Department of Public Works and Government Services Act* and Sections 15 and 16 of the *Procurement Ombudsman Regulations* have been met, and the interpretation and application of the terms and

conditions and the scope of the work of this contract are not in dispute. The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca.

3 The Office of the Procurement Ombudsman (OPO) was established by the Government of Canada to provide an independent avenue for suppliers to raise complaints regarding the award of contracts under \$25,000 for goods and under \$100,000 for services. You have the option of raising issues or concerns regarding the solicitation, or the award resulting from it, with the OPO by contacting them by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca. You can also obtain more information on the OPO services available to you at their website at www.opo-boa.gc.ca.

The Departmental Representative or his designate for this project is: **Maurice Richard**
Telephone: **613 993-9299**

Contracting Authority for this project is: **Marc Bédard** marc.bedard@nrc-cnrc.gc.ca
Telephone: **613 993-2274**

INSTRUCTIONS TO BIDDERS

Article 1 – Receipt of Tender

- 1a) Tenders must be received not later than the specified tender closing time. Tenders received after this time are invalid and shall not be considered, regardless of any reason for their late arrival.
- 1b) A letter of printed telecommunication from a bidder quoting a price shall not be considered as a valid tender unless a formal tender has been received on the prescribed Tender Form.
- 1c) Bidders may amend their tenders by letter or printed telecommunication provided that such amendments are received not later than the specified tender closing time.
- 1d) Any amendments to the tender which are transmitted by telefax must be signed and must clearly identify the tenderer.

All such amendments are to be addressed to:
National Research Council of Canada
Marc Bedard, Senior Contracting Officer
Building M-22
Montreal Road, Ottawa, Ontario
K1A 0R6

Fax: (613) 991-3297

Article 2 – Tender Form & Qualifications

- 1) All tenders must be submitted on the Construction Tender Form and the tender must be signed in compliance with the following requirements:
 - a) Limited Company: The full names of the Company and the name(s) and status of the authorized signing officer(s) must be printed in the space provided for that purpose. The signature(s) of the authorized officer(s) and the corporate seal must be affixed.
 - b) Partnership: The firm name and the name(s) of the person(s) signing must be printed in the space provided. One or more of the partners must sign in the presence of a witness who must also sign. An adhesive coloured seal must be affixed beside each signature.
 - c) Sole Proprietorship : The business name and the name of the sole proprietor must be printed in the space provided. The sole proprietor must sign in the presence of a witness who must also sign. An adhesive coloured seal must be affixed beside each signature.
- 2) Any alterations in the printed part of the Construction Tender Form or failure to provide the information requested therein, may render the tender invalid.
- 3) All space in the Construction Tender Form must be completed and any handwritten or typewritten corrections to the parts so completed must be initialed immediately to the side of the corrections by the person or persons executing the tender on behalf of the the tenderer.
- 4) Tenders must be based on the plans, specifications and tender documents provided.

Article 3 - Contract

- 1) The Contractor will be required to sign a contract similar to the Standard Contract Form for Fixed Price Construction Contracts, a blank specimen of which is enclosed in the package for reference purposes.

Article 4 – Tender Destination

- 1a) Tenders are to be submitted in sealed envelopes to:
National Research Council Canada
Administrative Services and Property Management Branch
1200 Montreal Road
Building M-22
Ottawa, ON
K1A 0R6

Endorsed "Tender for (insert title of work as it appears in the drawings and specifications)" and must bear the name and address of the tenderer.

- 1b) Unless otherwise specified, the only documents required to be submitted with the tender are the Tender form and the Bid Security.

Article 5 - Security

- 1a) Bid Security is required and must be submitted in one of the following forms:
 - i) a certified cheque payable to the Receiver General for Canada and drawn on a member of the Canadian Payments Association or a local cooperative credit society that is a member of a central cooperative credit society having membership in the Canadian Payments Association; **OR**
 - ii) bonds of the Government of Canada, or bonds unconditionally guaranteed as to principal and interest by the Government of Canada; **OR**
 - iii) a bid bond.
- 1b) Regardless of the Bid Security submitted, it should never be more than \$250,000 maximum, calculated at 10% of the first \$250,000 of the tendered price, plus 5% of any amount in excess of \$250,000.
- 2a) Bid Security shall accompany each tender or, if forwarded separately from the tender, shall be provided not later than the specified tender closing time. Bid Security must be in the **ORIGINAL** form. Fax or photocopies and **NOT** acceptable. **FAILURE TO PROVIDE THE REQUIRED BID SECURITY SHALL INVALIDATE THE TENDER.**
- 2b) If the tender is not accepted, the Bid Security submitted pursuant to Article 8 shall be returned to the tenderer.
- 3a) The successful tenderer is required to provide security within 14 days of receiving notice of tender acceptance. The tenderer must furnish **EITHER**:
 - i) a Security Deposit as described in 1(b) above together with a Labour and Material Payment Bond in the amount of at least 50% of the amount payable under the contract, **OR**

- ii) a Performance Bond and a Labour and Material Payment Bond – each in the amount of 50% of the amount payable under the contract.
- 3b) Should it not be possible to obtain a Labour Material Payment Bond as required under 3(a) above, on making application thereof to at least two acceptable Bonding Companies, an additional Security Deposit of a straight 10% of the amount payable under the contract must be furnished.
- 3c) Where a tender has been accompanied by a Security Deposit, as described in 1(b) above, the amount of the Security Deposit required under 3(a) above may be reduced by the amount of the Security Deposit which accompanied the tender.
- 3d) Bonds must be in an approved form and from the companies whose

bonds are acceptable to the Government of Canada. Samples of the approved form of Bid Bond, Performance Bond and Labour and Material Payment Bond and a list of acceptable Bonding Companies may be obtained from the Contracting Officer, National Research Council, Building M-22, Montreal Road, Ottawa, Ontario, K1A 0R6.

Article 6 – Interest On Security Deposits

- 1) Tenderers are notified that they must make their own arrangements with their bankers as to the interest, if any, on the amount of the certified cheque accompanying their tender. The Council will not pay interest on said cheque pending the awarding of the contract nor be responsible for the payments of interest under any arrangement made by the tenderers.

Article 7 – Sales Tax

- 1) The amount of the tender shall include all taxes as levied under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act or the Customs Tariff, in force or applicable at the time.
- 2) In Quebec, the Provincial Sales Tax should not be included in the Tender Price as the Federal Government is exempt. Tenderers should contact the Provincial Revenue Minister to recover all taxes paid for goods and services rendered under this contract.

Tenderers must include in their Tender Price the amount of Provincial Sales Tax for which the exemption does not apply.

Article 8 – Examination of Site

- 1) All parties tendering shall examine the sites of the proposed work before sending in their tender and make themselves thoroughly acquainted with the same and obtain for themselves any and all information that may be necessary for the proper carrying out of the Contract. No after claim will be allowed or entertained for any work or material that may be requisite and necessary for the proper execution and completion of this Contract with the exception of that provided for under GC 35 in the General Conditions of the General Specification.

Article 9 – Discrepancies, Omissions, Etc.

- 1a) Bidders finding discrepancies in, or omissions from, drawings, specifications or other documents, or having any doubt as to the meaning or intent of any part thereof, should at once notify the Engineer who will send written instructions or explanation to all bidders.
- 1b) Neither the Engineer nor the Council will be responsible for oral instructions.
- 1c) Addenda or corrections issued during the time of the bidding shall be covered in the proposal. However, the contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work and made prior to the date of the contract.

Article 10 – No additional Payments for Increased Costs

- 1) The only other adjustments in the contract price allowed are those specified in the General Conditions of the General Specification. The contract price will not be amended for change in freight rates, exchange rates, wage rates or cost of materials, plant or services.

Article 11 – Awards

- 1a) The Council reserves the power and right to reject tenders received from parties who cannot show a reasonable acquaintance with and preparation for the proper performance of the class of work herein specified and shown on plans. Evidence of such competence must be furnished by the tenderers if required to do so.
- 1b) A tenderer may be required to furnish to the Contracting Office, National Research Council of Canada, Building M-22, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6, Canada, unsigned copies of the insurance requirements as covered by the Insurance Conditions of the General Specification.
- 1c) The Council does not bind itself to accept the lowest or any tender.

Article 12 – Harmonized Sales Tax

- 1) The Harmonized Sales Tax (HST) which is now in effect shall be considered an applicable tax for the purpose of this tender. However, the bidder shall NOT include any amount in the bid price for said HST. The successful contractor will indicate on each application for payment as a separate amount the appropriate HST the Owner is legally obliged to pay. This amount will be paid to the Contractor in addition to the amount certified for payment under the Contract in addition to the amount certified for payment under the Contract and will therefore not affect the Contract Price. The Contractor agrees to remit any HST collected or due to Revenue Canada.

Non-resident contractors

RST guide 804

Published August 2006

ISBN: 1-4249-2007-8 (Print), **1-4249-2009-4 (PDF)**, **1-4249-2008-6 (HTML)**

Publication Archived

Notice to the reader: For Retail Sales Tax (RST) – On July 1, 2010 the 13 per cent Harmonized Sales Tax (HST) took effect in Ontario replacing the existing provincial Retail Sales Tax (RST) and combining it with the federal Goods and Services Tax (GST). As a result, RST provisions described on this page and in other publications ended on June 30, 2010.

Effective July 1, 2010 this publication was archived for RST purposes **only**. Use caution when you refer to it, since it reflects the law in force for RST at the time it was released and may no longer apply.

- The information in this Guide explains the Retail Sales Tax (RST) responsibilities of a non-resident contractor who is awarded a construction contract to perform work in Ontario and their Ontario customers. Please note that this Guide replaces the previous version dated March 2001.

Non-Resident Contractor Defined

A non-resident contractor is a contractor located outside Ontario who has been awarded a construction contract to perform work in Ontario, and who has not maintained a permanent place of business in Ontario continuously for twelve months immediately prior to signing the contract, or which is not a company incorporated under the laws of Ontario. A construction contract is a contract for the erection, remodelling or repair of a building or other structure on land.

A contractor is a person who is in the business of constructing, altering, repairing or improving real property and includes, but is not limited to,

1. a general contractor and subcontractor,
2. a carpenter, bricklayer, stonemason, electrician, plasterer, plumber, painter, decorator, paver, and bridge builder,
3. a sheet metal, tile and terrazzo, heating, air conditioning, insulation, ventilating, papering, road, roofing and cement contractor, who installs or incorporates items into real property. (See RST [Guide 206 - Real Property and Fixtures](#)).

Registration and Guarantee Deposit

Non-resident contractors who are awarded a construction contract in Ontario are required to register with the Ministry of Finance (ministry), Centralized Programs Unit and post a guarantee equal to 4 per cent of the total of each Ontario contract. The guarantee can be paid in cash, by certified cheque (payable to the Minister of Finance), letter of credit or by a guarantee bond.

To register with the ministry and to obtain further information on posting a guarantee, contractors should contact the ministry's Centralized Programs Unit, 33 King Street West, PO Box 623, Oshawa, Ontario, L1H 8H7, toll-free 1 866 ONT-TAXS (1 866 668-8297) or fax to 905 435-3617.

Non-resident contractors who sell taxable goods on a supply only basis to Ontario customers, or provide taxable services in Ontario, may obtain a regular Vendor Permit to collect and remit RST on their sales. Non-resident contractors who have been issued a regular Vendor Permit must still register separately with the ministry and post a guarantee if they are awarded a construction contract in Ontario.

Letter of Compliance

After receiving the guarantee, the ministry mails out two copies of a "letter of compliance" to the contractor certifying the Retail Sales Tax (RST) requirements have been met. Contractors must give a copy of the letter to their customers.

If a copy of the compliance letter is not provided, the customer must withhold 4 per cent of all amounts payable to the non resident contractor and pay the withheld amounts to the Minister of Finance (minister). Details relating to the contract should be sent along with the payments to the Centralized Programs Unit. Customers may give the minister a guarantee bond equal to 4 per cent of the total contract price instead of making the 4 per cent payments.

Note: Customers who do not follow these requirements may be held liable for 4 per cent of all amounts payable to the non resident contractor or any other amount that the Ministry deems to be the RST payable resulting from the performance of the contract.

Calculation of RST

Fair Value

RST is payable on the "fair value" of materials, purchased or brought into Ontario, to be used for work performed in Ontario. "Fair value" includes:

- the purchase price in Canadian funds;
- all charges by the supplier for handling and delivery, and
- any federal customs duties and excise taxes paid (but not the federal Goods and Services Tax (GST)).

Contractors are also required to pay RST to Ontario suppliers on the purchase, rental or lease of taxable services, materials, machinery, or equipment.

Machinery and Equipment - Leased

If machinery or equipment is leased from a supplier outside Ontario and brought into the province, RST is payable on the lease payments for the period the machinery or equipment is in Ontario.

Machinery and Equipment - Owned by Contractor

If machinery or equipment is owned by the contractor, RST may be calculated in one of the following ways:

- a. If a contractor brings machinery and equipment into Ontario for less than 12 months' use, RST is to be calculated using the following formula:

$$1/36 \times \text{net book value at date of import} \times \text{number of months in Ontario} \times \text{tax rate}$$

For the purpose of this formula, RST is payable for each month or part of a month that the goods are in Ontario. A month is considered 31 consecutive days and a part month is considered more than 12 days. The RST payable is based on the number of days the machinery and equipment are located in Ontario and not the number of days the items are actually used.

Example: Equipment is brought into Ontario on March 28 and taken out on May 8. The items were in the province for 41 days. RST is payable on the first 31 days' temporary stay in Ontario vs. use of the equipment. Since the remainder (10 days) is not considered part of a month, no RST is payable on this portion.

- b. If, at the time the goods are brought into Ontario, it is expected that the machinery or equipment will be in Ontario for more than twelve months, contractors must pay Retail Sales Tax (RST) on the following basis:

net book value at date of import × tax rate

If, at the time of import, the length of time is not known, vendors may use the formula under (a). If they later find it necessary to keep the machinery and equipment in Ontario for more than 12 months, the RST paid under (a) may be deducted from the RST payable under (b).

Using formula (a) or (b) above, contractors will calculate and remit the RST payable on the return that is filed when the contract is finished.

(See Completion of Contract section)

M a n u f a c t u r i n g f o r O w n U s e

Contractors may need to manufacture items, such as doors and windows, for their construction contracts. Manufacturing is work done in a factory away from a construction site, or in a mobile unit or workshop that is on or near the construction site. Manufacturing occurs when raw materials are changed into manufactured goods for use in real property contracts.

Contractors are considered to be manufacturing contractors if they produce goods:

1. for their own use in real property contracts, and
2. the manufactured cost of the goods is more than \$50,000 a year.

(See RST Guide 401 - Manufacturing Contractors)

C o n t r a c t s w i t h t h e F e d e r a l G o v e r n m e n t

Where a non-resident contractor enters into a construction contract with the federal government, for the construction of a building and/or the installation of equipment, the nature of the equipment will determine whether the contract should be let on a tax-included or tax excluded basis.

Contracts for the construction of a building and the installation of equipment that directly services that building (i.e., elevators, escalators, light fixtures, central heating and air conditioning, etc.) should be tendered on a tax -included basis. Contractors are the consumers of the materials used in fulfilling these contracts and must pay or account for RST on the materials used to complete the contracts. There is NO exemption just because the contract is with the federal government.

Contracts for the installation of equipment that becomes a fixture and does not directly service a building (i.e., material handling equipment, production machinery, communication equipment, training equipment) may be tendered on a tax-excluded basis. Contractors engaged in contracts of this nature are permitted to make tax exempt purchases of such equipment by issuing a valid Purchase Exemption Certificate (PEC) to their supplier. Only non-resident contractors who have registered with the ministry and posted a guarantee may issue a PEC.

E x e m p t i o n s

Contractors may supply and install equipment or materials for certain customers that may be entitled to an exemption from RST (e.g., manufacturers, Indian band councils, farmers and diplomatic organizations). The equipment or materials, when installed, becomes real property if it is permanently attached to land, or a fixture if it is permanently attached to a building or real property structure. Since

contractors are liable for RST, they should contact the ministry to find out if the customer qualifies for exemption before tendering the contract on a tax-excluded basis.

Status Indians, Indian Bands and Band Councils

Non-resident contractors may purchase building materials exempt from Retail Sales Tax (RST) for certain buildings and structures situated on reserves. The cost of such projects must be paid by the band council, and the buildings must provide a community service for the reserve. Contracts for the construction of an exempt community building project should be made on an RST-excluded basis. Non-resident contractors may purchase the materials exempt from RST by providing suppliers with a valid Purchase Exemption Certificate (PEC). As noted previously, only non-resident contractors who have registered with the ministry and posted a guarantee may issue a PEC. (See RST Guide [204 - Purchase Exemption Certificates](#)).

Non-resident contractors must pay RST on items purchased for incorporation into a building or structure built for individual status Indians on a reserve. (See RST [Guide 808 - Status Indians, Indian Bands and Band Councils](#)).

Completion of Contract

When a contract is completed, non-resident contractors who were required to post a guarantee must complete a [Non-Resident Contractor Retail Sales Tax Return \[PDF - 92 KB\]](#) that is provided by the ministry.

If a contractor's guarantee was given in cash or by certified cheque, the amount of the deposit can be deducted from the RST liability owed by the contractor. If the liability is greater than the deposit, the amount remaining must be paid by the contractor. If the deposit is more than the liability, the contractor will receive a refund.

If a guarantee bond was posted instead of cash, the bond will be discharged once the RST liability is paid in full.

All returns are subject to audit.

Legislative References

- Retail Sales Tax Act, Subsections 19(2) and 39(3)(4) and (5)
- Regulation 1012 under the Act, Subsections 15.3(1)(2)(5)(6) and (7)
- Regulation 1013 under the Act, Sections 1 and 3

For More Information

The information contained in this publication is only a guideline. For more information, please contact the Ontario Ministry of Finance at 1 866 ONT-TAXS (1 866 668-8297) or visit our website at ontario.ca/finance.

Acceptable Bonding Companies

Published September 2010

The following is a list of insurance companies whose bonds may be accepted as security by the government.

1. Canadian Companies

- ACE INA Insurance
- Allstate Insurance Company of Canada
- Ascentus Insurance Ltd. (Surety only)
- Aviva Insurance Company of Canada
- AXA Insurance (Canada)
- AXA Pacific Insurance Company
- Canadian Northern Shield Insurance Company
- Certas Direct Insurance Company (Surety only)
- Chartis Insurance Company of Canada (formerly AIG Commercial Insurance Company of Canada)
- Chubb Insurance Company of Canada
- Commonwealth Insurance Company
- Co-operators General Insurance Company
- CUMIS General Insurance Company
- The Dominion of Canada General Insurance Company
- Echelon General Insurance Company (Surety only)
- Economical Mutual Insurance Company
- Elite Insurance Company
- Everest Insurance Company of Canada
- Federated Insurance Company of Canada
- Federation Insurance Company of Canada
- Gore Mutual Insurance Company
- Grain Insurance and Guarantee Company
- The Guarantee Company of North America
- Industrial Alliance Pacific General Insurance Corporation
- Intact Insurance Company
- Jevco Insurance Company (Surety only)
- Lombard General Insurance Company of Canada
- Lombard Insurance Company
- Markel Insurance Company of Canada
- The Missisquoi Insurance Company
- The Nordic Insurance Company of Canada
- The North Waterloo Farmers Mutual Insurance Company (Fidelity only)
- Novex Insurance Company (Fidelity only)
- The Personal Insurance Company
- Pilot Insurance Company
- Quebec Assurance Company
- Royal & Sun Alliance Insurance Company of Canada
- Saskatchewan Mutual Insurance Company
- Scottish & York Insurance Co. Limited
- The Sovereign General Insurance Company
- TD General Insurance Company
- Temple Insurance Company
- Traders General Insurance Company

- Travelers Guarantee Company of Canada
- Trisura Guarantee Insurance Company
- The Wawanesa Mutual Insurance Company
- Waterloo Insurance Company
- Western Assurance Company
- Western Surety Company

2. Provincial Companies

Surety bonds issued by the following companies may be accepted provided that the contract of suretyship was executed in a province in which the company is licensed to do business as indicated in brackets.

- AXA Boreal Insurance Company (P.E.I., N.B., Que., Ont., Man., B.C.)
- AXA Boreal Insurance Company (P.E.I., N.B., Que., Ont., Man., B.C.)
- ALPHA, Compagnie d'Assurances Inc. (Que.)
- Canada West Insurance Company (Ont., Man., Sask, Alta., B.C., N.W.T.) (Surety only)
- The Canadian Union Assurance Company (Que.)
- La Capitale General Insurance Inc. (Nfld. & Lab., N.S., P.E.I., Que.(Surety only), Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- Coachman Insurance Company (Ont.)
- Continental Casualty Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- GCAN Insurance Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- The Insurance Company of Prince Edward Island (N.S., P.E.I., N.B.)
- Kingsway General Insurance Company (N.S., N.B., Que., Ont., Man., Sask., Alta., and B.C.)
- Liberty Mutual Insurance Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- Manitoba Public Insurance Corporation (Man.)
- Norgroupe Assurance Générales Inc.
- Orleans General Insurance Company (N.B., Que., Ont.)
- Saskatchewan Government Insurance Office (Sask.)
- SGI CANADA Insurance Services Ltd. (Ont., Man., Sask., Alta.)
- L'Unique General Insurance Inc. (Nfld. & Lab., N.S., P.E.I., N.B., Que.(Surety only), Ont.(Surety only), Man., Sask., Alta., B.C.(Surety only), Nun., N.W.T., Yuk.)

3. Foreign Companies

- Aspen Insurance UK Limited
- Compagnie Française d'Assurance pour le Commerce Extérieur (Fidelity only)
- Eagle Star Insurance Company Limited
- Ecclesiastical Insurance Office Public Limited Company (Fidelity only)
- Lloyd's Underwriters
- Mitsui Sumitomo Insurance Company, Limited
- NIPPONKOA Insurance Company, Limited
- Sompo Japan Insurance Inc.
- Tokio Marine & Nichido Fire Insurance Co., Ltd.
- XL Insurance Company Limited (Surety only)
- Zurich Insurance Company Ltd

Articles of Agreement

Standard Construction Contract – Articles of Agreement
(23/01/2002)

- A1 Contract Documents
- A2 Date of Completion of Work and Description of Work
- A3 Contract Amount
- A4 Contractor's Address
- A5 Unit Price Table

Articles of Agreement

These Articles of Agreement made in duplicate this day of .

Between

Her Majesty the Queen, in right of Canada (referred to in the contract documents as “ Her Majesty”) represented by the National Research Council Canada (referred to in the contract documents as the “Council”)

and

(referred to in the contract documents as the “Contractor”)

Witness that in consideration for the mutual promises and obligations contained in the contract, Her Majesty and the Contractor covenant and agree as follows:

A1 Contract Documents

(23/01/2002)

1.1 Subject to A1.4 and A1.5, the documents forming the contract between Her Majesty and the Contractor, referred to herein as the contract documents, are

1.1.1 these Articles of Agreement,

1.1.2 the document attached hereto, marked “A” and entitled “Plans and Specifications”, referred to herein as the Plans and Specifications,

1.1.3 the document attached hereto, marked “B” and entitled “Terms of Payment”, referred to herein as the Terms of Payment,

1.1.4 the document attached hereto, marked “C” and entitled “General Conditions”, referred to herein as the General Conditions,

1.1.5 the document attached hereto, marked “D” and entitled “Labour Conditions”, referred to herein as the Labour Conditions,

1.1.6 the document attached hereto, marked “E” and entitled “Insurance Conditions”, referred to herein as the Insurance Conditions,

1.1.7 the document attached hereto, marked “F” and entitled “Contract Security Conditions”, referred to herein as the Contract Security Conditions, and

1.1.8 any amendment or variation of the contract documents that is made in accordance with the General Conditions.

1.1.9 the document entitled Fair Wage Schedules for Federal Construction Contracts referred to herein as Fair Wage Schedules

1.1.10

Articles of Agreement

The Council hereby designates _____ of _____ of the Government of Canada as the Engineer for the purposes of the contract, and for all purposes of or incidental to the contract, the Engineer's address shall be deemed to be:

1.2 In the contract

1.3.1 "Fixed Price Arrangement" means that part of the contract that prescribes a lump sum as payment for performance of the work to which it relates; and

1.3.2 "Unit Price Arrangement" means that part of the contract that prescribes the product of a price multiplied by a number of units of measurement of a class as payment for performance of the work to which it relates.

1.3 Any of the provisions of the contract that are expressly stipulated to be applicable only to a Unit Price Arrangement are not applicable to any part of the work to which a Fixed Price Arrangement is applicable.

1.4 Any of the provisions of the contract that are expressly stipulated to be applicable only to a Fixed Price Arrangement are not applicable to any part of the work to which a Unit Price Arrangement is applicable.

A2 Date of Completion of Work and Description of Work

(23/01/2002)

2.1 The contractor shall, between the date of these Articles of Agreement and the _____, _____, in the careful and workmanlike manner, diligently perform and complete the following work:

which work is more particularly described in the Plans and Specifications.

Articles of Agreement

A3 Contract Amount

(23/01/2002)

- 3.1 Subject to any increase, decrease, deduction, reduction or set-off that may be made under the Contract, Her Majesty shall pay the Contractor at the times and in the manner that is set out or referred to in the Terms of Payment
- 3.1.1 the sum of _____ (GST/HST extra), in consideration for the performance of the work or the part thereof that is subject to Fixed Price Arrangement, and
- 3.1.2 a sum that is equal to the aggregate of the products of the number of units of Measurement of each class of labour, plant and material that is set out in a Final Certificate of Measurement referred to in GC44.8 multiplied in each case by the appropriate unit price that is set out in the Unit Price Table in consideration for the performance of the work or the part thereof that is subject to a Unit Price Arrangement.
- 3.2 For the information and guidance of the Contractor and the persons administering the contract on behalf of Her Majesty, but not so as to constitute a warranty, representation or undertaking of any nature by either party, it is estimated that the total amount payable by Her Majesty to the Contractor for the part of the work to which a Unit Price Arrangement is applicable will be approximately \$N/A
- 3.3 A3.1.1 is applicable only to a Fixed Price Arrangement.
- 3.4 A3.1.2 and A3.2 applicable only to a Unit Price Arrangement.

A4 Contractor's Address

(23/01/2002)

- 4.1 For all purposes of or incidental to the contract, the Contractor's address shall be deemed to be:

Articles of Agreement

A5 Unit Price Table

(23/01/2002)

5.1 Her Majesty and the Contractor agree that the following table is the Unit Price Table for the purposes of the contract.

Column 1 Item	Column 2 Class of Labour Plant Or Material	Column 3 Unit of Measurement	Column 4 Estimated Total Quantity	Column 5 Price per Unit	Column 6 Estimated Total Price
		N/A			

5.2 The Unit Price Table that is set out in A5.1 designates the part of the work to which a Unit Price Arrangement is applicable.

5.3 The part of the work that is not designated in the Unit Price Table referred to in A5.2 is the part of the work to which a Fixed Price Arrangement is applicable.

Articles of Agreement

Signed on behalf of Her Majesty by

as Senior Contracting Officer

and _____

as _____

of the **National Research Council Canada**

on the _____

day of _____

Signed, sealed and delivered by

as _____ and
Position

by _____

as _____ and
Position

of

on the _____

day of _____

Seal

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264101	Primary Lightning Arrestors 2
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Appendices

- Geotechnical Investigation, Proposed Compressor Plant Addition and Substation Expansion, National Research Council Canada, Research Road, Ottawa, Ontario – dated July 9, 2015.

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Appendices

- Geotechnical Investigation, Proposed Compressor Plant Addition and Substation Expansion, National Research Council Canada, Research Road, Ottawa, Ontario – dated July 9, 2015.

Part 1 General

1.1 SCOPE OF WORK

- .1 Work under this contract covers the construction of a new 115kV outdoor substation at the Council's Uplands Campus, Building U66 of the National Research Council.

1.2 DRAWINGS

- .1 The following drawings illustrate the work and form part of the contract documents:

- .1 **Electrical Drawings**

- .1 E00 - Campus plan, project areas, and legend
- .2 E01 - Medium voltage single line diagram - Existing and Phase 1
- .3 E02 - Medium voltage single line diagram - Phase 2 and Phase 3
- .4 E03 - Medium voltage single line diagram - Phase 4 and Phase 5
- .5 E04 - Medium voltage single line diagram - Final
- .6 E05 - 115kV substation layout - Phase 1 demolition
- .7 E06 - 115kV substation layout - Phase 1 new construction
- .8 E07 - 115kV substation layout - Phase 2 demolition
- .9 E08 - 115kV substation layout - Phase 2 new construction
- .10 E09 - 115kV overhead line route and details
- .11 E10 - 6.9kV duct bank route and details
- .12 E11 - 115kV substation elevations
- .13 E12 - 115kV substation details
- .14 E13 - 115kV substation ground grid detail
- .15 E14 - DC controls - existing circuit switcher
- .16 E15 - DC controls - new circuit switcher
- .17 E16 - Transformer protection schematic - demolition
- .18 E17 - Transformer protection schematic - new construction

- .2 **Structural Drawings**

- .1 S01 - General layout and notes
- .2 S02 - Switchgear enclosure pad - sections and details
- .3 S03 - Transformer and Circuit switcher pad - sections and details
- .4 S04 - Gantry structure pad - sections and details
- .5 S05 - 115 kV gantry structure - tower
- .6 S06 - 115 kV gantry structure - girder details

1.3 COMPLETION

- .1 Complete all work within 52 week(s) after receipt of notification of acceptance of tender.

1.4 GENERAL

- .1 The word "provide" in this Specification means to supply and install.
- .2 Provide items mentioned in either the drawings or the specification.

1.5 SPECIFIED ACCEPTABLE & ALTERNATIVE EQUIPMENT & MATERIALS

- .1 Materials and equipment scheduled and/or specified on the drawings or in the specifications have been selected to establish a performance and quality standard. In most cases, acceptable manufacturers are stated for any material or equipment specified by manufacturer's name and model number. Contractors may base their tender price on materials and equipment supplied by any of the manufacturers' names as acceptable for the particular material or equipment.
- .2 In addition to the manufacturers specified or named as acceptable, you may propose alternative manufacturers of materials or equipment to the Departmental Representative for acceptance. For a product to be considered as an alternative product substitute, make a written application to the Departmental Representative during the tender period, not later than ten (10) working days before tender closing.
- .3 Certify in writing that the alternative meets all requirements of the specified material or equipment. In addition, it shall be understood that all costs required by or as a result of acceptance or proposed alternatives, will be borne by the contractor.
- .4 Approval of alternatives will be signified by issue of an Addendum to the Tender Documents. Alternates are not considered acceptable unless confirmed by addendum.
- .5 Any alternative manufacturers or materials submitted which are incomplete and cannot be evaluated, or are later than ten (10) working days before tender closing date or after the tender period, will not be considered.

1.6 MINIMUM STANDARDS

- .1 Conform to or exceed minimum acceptable standards of the various applicable federal, provincial and municipal codes such as The National Building Code, The National Fire Code, Canadian Plumbing Code, Canadian Electrical Code, Canadian Code for Construction Safety and the Provincial Construction Safety Act.
- .2 Work to conform to referenced standards and codes as reaffirmed or revised to date of specification.

1.7 WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

- .1 The general contractor shall comply with Federal and Provincial legislation regarding the WHMIS. The contractor's responsibilities include, but are not limited to the following:
 - .1 To ensure that any controlled product brought on site by the contractor or sub-contractor is labeled;
 - .2 To make available to the workers and the Departmental Representative, Material Safety Data Sheets (MSDS) for these controlled products;

- .3 To train own workers about WHMIS, and about the controlled products that they use on site;
- .4 To inform other contractors, sub-contractors, the Departmental Representative, authorized visitors and outside inspection agency personnel about the presence and use of such products on the site.

The site foreman or superintendent must be able to demonstrate, to the satisfaction of the Departmental Representative, that he/she has had WHMIS training and is knowledgeable in its requirements. The Departmental Representative can require replacement of this person if this condition or implementation of WHMIS is not satisfactory.

1.8 REQUIREMENTS OF BILL 208, SECTION 18(A)

Under the requirements of Bill 208 of the Ontario Ministry of Labour Occupational Health & Safety Act, the following designated substances may be encountered while performing the work described in these contract documents:

- .1 Acrylonitrile, Isocyanates, Arsenic, Lead, Asbestos, Mercury, Benzene, Silica, Coke Oven Emissions, Vinyl Chloride, and Ethylene Oxide
 - .1 It is the responsibility of the general contractor to ensure that each prospective subcontractor for this project has received a copy of the above list.

1.9 COST BREAKDOWN

- .1 Submit, for approval by the Departmental Representative, a cost breakdown of tender 72 hours after the contract is awarded.
- .2 Use the approved cost breakdown as the basis for submitting all claims.
- .3 Request Departmental Representative's verbal approval to amount of claim prior to preparing and submitting the claim in its final form.

1.10 SUB-TRADES

- .1 Submit no later than 72 hours after tender closing, a complete list of sub trades for the Departmental Representative's review.

1.11 PERSONNEL SECURITY AND IDENTIFICATION

- .1 All persons employed by the contractor, or by any subcontractor and present on the site must be security cleared in accordance with the requirements of the Section entitled Special Instructions to Tenderers.
- .2 All such persons must wear and keep visible identification badges as issued by the Security Office of NRC.

1.12 WORKING HOURS AND SECURITY

- .1 Normal working hours on the NRC property are from 8:00 a.m. until 4:30 p.m., Monday to Friday inclusive, except statutory holidays.

- .2 At all other times, special written passes are required for access to the building site.
- .3 Before scheduling any work outside normal working hours, obtain permission from the Departmental Representative to perform the specific tasks.
- .4 An escort may be required whenever working outside normal hours. Contractor to bear the associated costs.

1.13 SCHEDULE

- .1 The contractor shall prepare a detailed schedule, fixing the date for commencement and completion of the various parts of the work and update the said schedule. Such schedule shall be made available to the Departmental Representative not later than two weeks after the award of the contract and prior to commencement of any work on site.
- .2 Notify Departmental Representative in writing of any changes in the schedule.
- .3 20 day(s) before the scheduled completion date, arrange to do an interim inspection with the Departmental Representative.

1.14 PROJECT MEETINGS

- .1 Hold regular project meetings at times and locations approved by the Departmental Representative.
- .2 Notify all parties concerned of meetings to ensure proper coordination of work.
- .3 Departmental Representative will set times for project meetings and assume responsibility for recording and distributing minutes.

1.15 SHOP DRAWINGS

- .1 Submit to Departmental Representative for review, shop drawings, product data and samples specified as per section 013300. Submit to Departmental Representative for review a complete list of all shop drawings, product data and samples specified and written confirmation of corresponding delivery dates within one (1) week after shop drawings, product data and samples approval date. This list shall be updated on a 2 week basis and any changes to the list shall be immediately notified in writing to the Departmental Representative.
- .3 Review shop drawings, data sheets and samples prior to submission.
- .4 Submit electronic copy of all shop drawings and product data and samples for review, unless otherwise specified.
- .5 Review of shop drawings and product data by the Departmental Representative does not relieve the contractor of the responsibility for errors and omissions and for the conformity with contract documents.

1.16 SAMPLES AND MOCK-UPS

- .1 Submit samples in sizes and quantities as specified.
- .2 Where colour, pattern or texture is criterion, submit full range of samples.
- .3 Construct field samples and mock-ups at locations acceptable to Departmental Representative.
- .4 Reviewed samples or mock-ups will become standards of workmanship and material against which installed work will be checked on the project.

1.17 MATERIALS AND WORKMANSHIP

- .1 Install only new materials on this project unless specifically noted otherwise.
- .2 Only first class workmanship will be accepted, not only with regard to safety, efficiency, durability, but also with regard to neatness of detail and performance.

1.18 WORK & MATERIALS SUPPLIED BY OWNER

- .1 Work and materials not included in this contract are described on drawings and in this specification.
- .2 Deliver to a storage place, as directed by the Departmental Representative, all materials returned to the Owner.
- .3 Unless otherwise specified, accept owner-supplied materials at their storage location and provide all transportation as required.
- .4 General Contractor's duties:
 - .1 Unload at site.
 - .2 Promptly inspect products and report damaged or defective items.
 - .3 Give written notification to the Departmental Representative for items accepted in good order.
 - .4 Handle at site, including uncrating and storage.
 - .5 Repair or replace items damaged on site.
 - .6 Install, connect finished products as specified.

1.19 SITE ACCESS

- .1 Make prior arrangements with the Departmental Representative before starting work or moving materials and equipment on site.
- .2 Obtain approval of Departmental Representative for regular means of access during the construction period.
- .3 Obtain approval of Departmental Representative before temporarily suspending operations on site; before returning to the site and before leaving the site at the end of the job.

- .4 Provide and maintain access to site.
- .5 Build and maintain temporary roads and provide snow removal during period of work.
- .6 Make good any damage and clean up dirt, debris, etc., resulting from contractor's use of existing roads.

1.20 USE OF SITE

- .1 Restrict operations on the site to the areas approved by the Departmental Representative
- .2 Locate all temporary structures, equipment, storage, etc., to the designated areas.
- .3 Restrict parking to the designated areas.

1.21 ACCEPTANCE OF SITE

- .1 Inspect the site before commencing work, review any unexpected conditions with the Departmental Representative.
- .2 Commencement of work will imply acceptance of existing conditions.

1.22 SITE OFFICE & TELEPHONE

- .1 Contractor to erect a temporary site office at his own expense.
- .2 Install and maintain a telephone, if necessary.
- .3 Use of NRC phones is not permitted unless in the case of an emergency.

1.23 SANITARY FACILITIES

- .1 Provide sanitary facilities, and bear all associated costs.

1.24 TEMPORARY SERVICES

- .1 A source of temporary power will be made available in the area. Bear all costs to make connections to the power source and perform distribution on site.
- .2 Provide all load centres, breakers, conduit, wiring, disconnects, extension cords, transformers, as required from the source of power.
- .3 Power is to be used only for power tools, lighting, controls, motors, and not for space heating.
- .4 A source of temporary water will be made available if required.
- .5 Bear all costs associated with distributing the water to the required locations.
- .6 Comply with NRC requirements when connecting to existing systems in accordance with the articles entitled "Co-operation" and "Service Interruptions" of this section.

1.25 DOCUMENTS REQUIRED AT WORK SITE

- .1 The contractor shall keep on the site, one (1) up-to-date copy of all contract documents, including specifications, drawings, addenda, shop drawings, change notices, schedule and any reports or bulletins pertaining to the work, in good order, available to the Departmental Representative and to his / her representatives at all times.
- .2 At least one (1) copy of specifications and drawings shall be marked by the contractor to show all work "As Built" and shall be provided to the Departmental Representative with the Application for Payment and for the Final Certificate of Completion.

1.26 CO-OPERATION

- .1 Co-operate with NRC staff in order to keep disruption of normal research work to an absolute minimum.
- .2 Work out in advance, a schedule for all work which might disrupt normal work in the building.
- .3 Have schedule approved by the Departmental Representative.
- .4 Notify the Departmental Representative in writing, 72 hours prior to any intended interruption of facilities, areas, corridors, mechanical or electrical services and obtain requisite permission.

1.27 PROTECTION AND WARNING NOTICES

- .1 Provide all materials required to protect existing equipment.
- .2 Erect dust barriers to prevent dust and debris from spreading through the building.
- .3 Place dust protection in the form of cover sheets over equipment and furniture and tape these sheets to floors, to ensure no dust infiltration.
- .4 Repair or replace any and all damage to Owner's property caused during construction, at no cost to the Owner and to the satisfaction of the Departmental Representative.
- .5 Protect the buildings, roads, lawns, services, etc. from damage which might occur as a result of this work.
- .6 Plan and co-ordinate the work to protect the buildings from the leakage of water, dust, etc.
- .7 Ensure that all doors, windows, etc., that could allow transfer of dust, noise, fumes, etc., to other areas of the building are kept closed.
- .8 Be responsible for security of all areas affected by the work under the Contract until acceptance by NRC. Take all necessary precautions to prevent entry to the work area by unauthorized persons and guard against theft, fire and damage by any cause. Secure working area at the end of each day's work and be responsible for same.

- .9 Provide and maintain adequate safety barricades around the work sites to protect NRC personnel and the public from injury during the construction.
- .10 Post warnings, in all instances where possible injury could occur such as Work Overhead, Hard Hat Areas, etc. or as required by the Departmental Representative.
- .11 Provide temporary protective enclosures over building entrances and exits to protect pedestrians. All enclosures to be structurally sound against weather and falling debris.

1.28 BILINGUALISM

- .1 Ensure that all signs, notices, etc. are posted in both official languages.
- .2 Ensure that all identification of services called for by under this contract are bilingual.

1.29 LAYOUT OF WORK

- .1 Location of equipment, fixtures, outlets and openings indicated on drawings or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with the manufacturer's recommendations for safety, access and maintenance.
- .3 Employ competent person to lay out work in accordance with the contract documents.

1.30 DISCREPANCIES & INTERFERENCES

- .1 Prior to the start of the work, examine drawings and specifications. Report at once to the Departmental Representative, any defects, discrepancies, omissions or interferences affecting the work.
- .2 Contractor to immediately inform the Departmental Representative in writing, of any discrepancies between the plans and the physical conditions so the Departmental Representative may promptly verify same.
- .3 Any work done after such a discovery, until authorized, is at the contractor's risk.
- .4 Where minor interferences as determined by the Departmental Representative are encountered on the job and they have not been pointed out on the original tender or on the plans and specifications, provide offsets, bends or reroute the services to suit job conditions at no extra cost.
- .5 Arrange all work so as not to interfere in any way with other work being carried out.

1.31 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

- .2 Notify the Departmental Representative in writing of any conflict between these specifications and manufacturer's instruction. Departmental Representative will designate which document is to be followed.

1.32 TEMPORARY HEATING AND VENTILATING

- .1 Bear the costs of temporary heat and ventilation during construction including costs of installation, fuel, operation, maintenance, and removal of equipment.
- .2 Use of direct-fired heaters discharging waste products into the work areas will not be permitted unless prior approval is given by the Departmental Representative.
- .3 Furnish and install temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of work.
 - .2 Protect work and products against dampness and cold.
 - .3 Reduce moisture condensation on surfaces to an acceptable level.
 - .4 Provide ambient temperature and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for a safe working environment.
- .4 Maintain minimum temperature of 10 °C (50 °F) or higher where specified as soon as finishing work is commenced and maintain until acceptance by the Departmental Representative. Maintain ambient temperature and humidity levels as required for comfort of NRC personnel.
- .5 Prevent hazardous or unhealthy accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction including also, storage areas and sanitary facilities.
 - .1 Dispose of exhaust materials in a manner that will not result in a harmful or unhealthy exposure to persons.
- .6 Maintain strict supervision of operation of temporary heating and ventilating equipment.
 - .1 Enforce conformance with applicable codes and standards.
 - .2 Comply with instructions of the Departmental Representative including provision of full-time watchman services when directed.
 - .3 Enforce safe practices.
 - .4 Vent direct-fired combustion units to outside.
- .7 Submit tenders assuming existing or new equipment and systems will not be used for temporary heating and ventilating.
- .8 After award of contract, Departmental Representative may permit use of the permanent system providing agreement can be reached on:
 - .1 Conditions of use, special equipment, protection, maintenance, and replacement of filters.
 - .2 Methods of ensuring that heating medium will not be wasted and in the case of steam, agreement on what is to be done with the condensate.

- .3 Saving on contract price.
- .4 Provisions relating to guarantees on equipment.

1.33 CONNECTIONS TO AND INTERRUPTIONS TO EXISTING SERVICES

- .1 Where work involves breaking into or connecting to existing services, carry out work at times and in the manner agreed to by the Departmental Representative and by authorities having jurisdiction, with minimum disruption to NRC Personnel and vehicular traffic and minimum service interruption. Do not operate any NRC equipment or plant.
- .2 Before commencing work, establish location and extent of service lines in area of work and notify Departmental Representative of findings.
- .3 Submit a schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility; allow minimum 72 hours notice. Adhere to approved schedule and provide notice to the Departmental Representative.
- .4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .5 Provide detours, bridges, alternate feeds, etc., as required to minimize disruptions.
- .6 Protect existing services as required and immediately make repairs if damage occurs.
- .7 Remove any abandoned service lines as indicated on the contract documents and as approved by the Departmental Representative; cap or otherwise seal lines at cut-off points. Record and provide a copy to the Departmental Representative of locations of maintained, re-routed and abandoned service lines.

1.34 CUTTING AND PATCHING

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove all items as shown or specified.
- .3 Patch and make good with identical materials, the surfaces that have been disturbed, cut or damaged, to the satisfaction of the Departmental Representative.
- .4 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12mm (1/2") clearance around the pipes or pipe insulation. Do not drill or cut any surface without the approval of the Departmental Representative.
- .5 Obtain written approval of the Departmental Representative before cutting openings through existing or new structural members.
- .6 Seal all openings where cables, conduits or pipes pass through walls with an acoustic sealant conforming to CAN/CGSB-19.21-M87.

- .7 Where cables, conduits and pipes pass through fire rated walls and floors, pack space between with compressed glass fibres and seal with fire stop caulking in accordance with CAN/CGSB-19.13-M87 AND NBC 3.1.7.

1.35 FASTENING DEVICES

- .1 Do not use explosive actuated tools, without first obtaining permission from the Departmental Representative.
- .2 Comply with the requirements of CSA A-166 (Safety Code for Explosive Actuated Tools).
- .3 Do not use any kind of impact or percussion tool without first obtaining permission from the Departmental Representative.

1.36 OVERLOADING

- .1 Ensure that no part of the building or work is subjected to a load which will endanger safety or cause permanent deformation or structural damage.

1.37 DRAINAGE

- .1 Provide temporary drainage and pumping as required to keep excavations and site free of water.

1.38 ENCLOSURE OF STRUCTURES

- .1 Construct and maintain all temporary enclosures as required to protect foundations, sub-soil, concrete, masonry, etc., from frost penetration or damage.
- .2 Maintain in place until all chances of damage are over and proper curing has taken place.
- .3 Provide temporary weather tight enclosures for exterior openings until permanent sash and glazing and exterior doors are installed.
- .4 Provide lockable enclosures as required to maintain the security of NRC facilities and be responsible for the same.
- .5 Provide keys to NRC security personnel when required.
- .6 Lay out the work carefully and accurately and verify all dimensions and be responsible for them. Locate and preserve general reference points.
- .7 Throughout the course of construction, keep continuously acquainted with field conditions, and the work being developed by all trades involved in the project. Maintain an awareness of responsibility to avoid space conflict with other trades.
- .8 Conceal all services, piping, wiring, ductwork, etc., in floors, walls or ceilings except where indicated otherwise.

1.39 STORAGE

- .1 Provide storage as required to protect all tools, materials, etc., from damage or theft and be responsible for the same.
- .2 Do not store flammable or explosive materials on site without the authorization of the Departmental Representative.

1.40 GENERAL REVIEW

- .1 Periodic review of the contractor's work by the Departmental Representative does not relieve the contractor of the responsibility of making the work in accordance with contract documents. Contractor shall carry out his own quality control to ensure that the construction work is in accordance with contract documents.
- .2 Inform the Departmental Representative of any impediments to the installation and obtain his / her approval for actual location.

1.41 INSPECTION OF BURIED OR CONCEALED SERVICES

- .1 Prior to concealing any services that are installed, ensure that all inspection bodies concerned, including NRC, have inspected the work and have witnessed all tests. Failure to do so may result in exposing the services again at the contractor's expense.

1.42 TESTING

- .1 On completion, or as required by local authority inspectors and/or Departmental Representative during progress of work and before any services are covered up and flushing is complete, test all installations in the presence of the Departmental Representative.
- .2 Obtain and hand to the Departmental Representative all acceptance certificates or test reports from authority having jurisdiction. The project will be considered incomplete without the same.

1.43 PARTIAL OCCUPANCY

- .1 NRC may request partial occupancy of the facility if the contract extends beyond the expected completion date.
- .2 Do not restrict access to the building, routes, and services.
- .3 Do not encumber the site with materials or equipment.

1.44 DISPOSAL OF WASTES

- .1 Dispose of waste materials including volatiles, safely off NRC property. Refer to the section entitled "General and Fire Safety Requirements" included as part of this specification.

1.45 CLEAN-UP DURING CONSTRUCTION

- .1 On a daily basis, maintain project site and adjacent area of campus including roofs, free from debris and waste materials.
- .2 Provide on-site dump containers for collection of waste materials and rubbish.

1.46 FINAL CLEAN-UP

- .1 Upon completion do a final clean-up to the satisfaction of the Departmental Representative.
- .2 Clean all new surfaces, lights, existing surfaces affected by this work, replace filters, etc.
- .3 Clean all resilient flooring and prepare to receive protective finish. Protective finish applied by NRC

1.47 WARRANTY AND RECTIFICATION OF DEFECTS IN WORK

- .1 Refer to General Conditions "C", section GC32.
- .2 Ensure that all manufacturers' guarantees and warranties are issued in the name of the **General Contractor** and the National Research Council.

1.48 MAINTENANCE MANUALS

- .1 Provide three (3) bilingual copies of maintenance manuals or two English and two French maintenance manuals immediately upon completion of the work and prior to release of holdbacks.
- .2 Manuals to be neatly bound in hard cover loose leaf binders.
- .3 Manuals to include operating and maintenance instructions, all guarantees and warranties, shop drawings, technical data, etc., for the material and apparatus supplied under this contract.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 GENERAL CONSTRUCTION SAFETY REQUIREMENTS

- .1 The Contractor shall take all necessary steps to protect personnel (workers, visitors, general public, etc.) and property from any harm during the course of the contract.
- .2 The Contractor shall be solely responsible for the construction safety of both its employees and those of its sub-contractors at the work site, and for initiating, maintaining and supervising safety precautions, programs and procedures in connection with the performance of the work.
- .3 The Contractor shall comply with all Federal, Provincial and Municipal safety codes and regulations and the Occupational Health and Safety Act and the Workplace Safety and Insurance Board. In the event of any conflict between any provisions in legislation or codes, the most stringent provisions shall apply.
- .4 Periodic review of the contractor's work by the Departmental Representative, using the criteria of the contract documents, does not relieve the contractor of his safety responsibilities in carrying out the work in accordance with the contract documents. The contractor shall consult with the Departmental Representative to ensure that this responsibility is carried out.
- .5 The Contractor shall ensure that only competent personnel are permitted to work onsite. Throughout the term of the contract, any person will be removed from the site who is not observing or complying with the safety requirements.
- .6 All equipment shall be in safe operating condition and appropriate to the task.
- .7 Following a project and site hazard assessment, the Contractor shall develop a Site Specific Safety Plan based on the following minimum requirements:
 - .1 Provide a safety board mounted in a visible location on the project site, with the following information included thereon:
 - .1 Notice of Project
 - .2 Site specific Safety Policy
 - .3 Copy of Ontario Health and Safety Act
 - .4 Building Schematic showing emergency exits
 - .5 Building emergency procedures
 - .6 Contact list for NRC, Contractor and all involved sub-contractors
 - .7 Any related MSDS sheets
 - .8 NRC Emergency phone number
- .8 The Contractor shall provide competent personnel to implement its safety program and those of any Health and Safety Act legislation applicable at this project location, and to ensure they are being complied with.

- .9 The Contractor shall provide safety orientation to all its employees as well as those of any subcontractors under its jurisdiction.
- .10 The Departmental Representative will monitor to ensure that safety requirements are met and that safety records are properly kept and maintained. Continued disregard for safety standards can cause the contract to be cancelled and the Contractor or sub-contractors removed from the site.
- .11 The Contractor will report to the Departmental Representative and jurisdictional authorities, any accident or incident involving Contractor or NRC personnel or the public and/or property arising from the Contractor's execution of the work.
- .12 If entry to a laboratory is required as part of the work of the Contractor, a safety orientation shall be provided to all his employees as well as those of any subcontractors regarding lab safety requirements and procedures, as provided by the Researcher or the Departmental Representative.

1.2 FIRE SAFETY REQUIREMENTS

- .1 Authorities
 - .1 The Fire Commissioner of Canada (FC) is the authority for fire safety at NRC.
 - .2 For the purpose of this document, "Departmental Representative" will be deemed as the NRC person in charge of the project and who will enforce these Fire Safety Requirements.
 - .3 Comply with the following standards as published by the Office of the Fire Commissioner of Canada:
 - .1 Standard No. 301 - June 1982 "Standard for Construction Operations";
 - .2 Standard No. 302 - June 1982 "Standard for Welding and Cutting".
- .2 Smoking
 - .1 Smoking is prohibited inside all NRC buildings, as well as roof areas.
 - .2 Obey all "NO SMOKING" signs on NRC premises.
- .3 Hot Work
 - .1 Prior to commencement of any "Hot Work" involving welding, soldering, burning, heating, use of torches or salamanders or any open flame, obtain a Hot Work Permit from the Departmental Representative.
 - .2 Prior to commencement of "Hot Work", review the area of hot work with the Departmental Representative to determine the level of fire safety precautions to be taken.
- .4 Reporting Fires
 - .1 Know the exact location of the nearest Fire Alarm Pull Station and telephone, including the emergency phone number.
 - .2 REPORT immediately, all fire incidents as follows:
 - .1 Activate nearest fire alarm pull station and;

- .2 Telephone the following emergency phone number as appropriate:
FROM AN NRC PHONE 333
FROM ANY OTHER PHONE (613) 993-2411
- .3 When reporting a fire by phone, give the location of fire, building number and be prepared to verify location.
- .4 The person activating fire alarm pull station must remain at a safe distance from the scene of the fire but readily available to provide information and direction to the Fire Department personnel.
- .5 Interior and Exterior Fire protection & Alarm Systems
 - .1 DO NOT OBSTRUCT OR SHUT OFF FIRE PROTECTION EQUIPMENT OR SYSTEMS, INCLUDING BUT NOT LIMITED TO FIRE ALARM SYSTEMS, SMOKE/HEAT DETECTORS, SPRINKLER SYSTEM, PULL STATIONS, EMERGENCY CALL BUTTONS AND PA SYSTEMS, WITHOUT AUTHORIZATION FROM THE DEPARTMENTAL REPRESENTATIVE.
 - .2 WHEN ANY FIRE PROTECTION EQUIPMENT IS TEMPORARILY SHUT DOWN, ALTERNATIVE MEASURES AS PRESCRIBED BY THE DEPARTMENTAL REPRESENTATIVE SHALL BE TAKEN TO ENSURE THAT FIRE PROTECTION IS MAINTAINED.
 - .3 DO NOT LEAVE FIRE PROTECTION OR ALARM SYSTEMS INACTIVE AT THE END OF A WORKING DAY WITHOUT NOTIFICATION AND AUTHORISATION FROM THE DEPARTMENTAL REPRESENTATIVE. THE DEPARTMENTAL REPRESENTATIVE WILL ADVISE THE (FPO) OF THE DETAILS OF ANY SUCH EVENT.
 - .4 DO NOT USE FIRE HYDRANTS, STANDPIPES AND HOSE SYSTEMS FOR OTHER THAN FIRE FIGHTING PURPOSES UNLESS AUTHORISED BY DEPARTMENTAL REPRESENTATIVE.
- .6 Fire Extinguishers
 - .1 Provide a minimum of 1-20 lb. ABC Dry Chemical Fire Extinguisher at each hot work or open flame location.
 - .2 Provide fire extinguishers for hot asphalt and roofing operations as follows:
 - .1 Kettle area - 1-20 lb. ABC Dry Chemical;
 - .2 Roof - 1-20 lb. ABC Dry Chemical at each open flame location.
 - .3 Provide fire extinguishers equipped as below:
 - .1 Pinned and sealed;
 - .2 With a pressure gauge;
 - .3 With an extinguisher tag signed by a fire extinguisher servicing company.
 - .4 Carbon Dioxide (CO₂) extinguishers will not be considered as substitutes for the above.

- .7 Roofing Operations
 - .1 Kettles:
 - .1 Arrange for the location of asphalt kettles and material storage with the Departmental Representative before moving on site. Do not locate kettles on any roof or structure and keep them at least 10m (30 feet) away from a building.
 - .2 Equip kettles with 2 thermometers or gauges in good working order; a hand held and a kettle-mounted model.
 - .3 Do not operate kettles at temperatures in excess of 232°C (450 °F).
 - .4 Maintain continuous supervision while kettles are in operation and provide metal covers for the kettles to smother any flames in case of fire. Provide fire extinguishers as required in article 2.6.
 - .5 Demonstrate container capacities to Departmental Representative prior to start of work.
 - .6 Store materials a minimum of 6m (20 feet) from the kettle.
 - .2 Mops:
 - .1 Use only glass fibre roofing mops.
 - .2 Remove used mops from the roof site at the end of each working day.
 - .3 Torch Applied Systems:
 - .1 DO NOT USE TORCHES NEXT TO WALLS.
 - .2 DO NOT TORCH MEMBRANES TO EXPOSED WOOD OR CAVITY
 - .3 Provide a Fire Watch as required by article 2.9 of this section.
 - .4 Store all combustible roofing materials at least 3m (10 feet) away from any structure.
 - .5 Keep compressed gas cylinders a minimum of 6m (20 feet) away from the kettle, protected from mechanical damage and secured in an upright position.
- .8 Welding / Grinding Operations
 - .1 Contractor to provide fire blankets, portable fume extraction devices, screens or similar equipment to prevent exposure to welding flash, or sparks from grinding.
- .9 Fire Watch
 - .1 Provide a fire watch for a minimum of one hour after the termination of any hot work operation.
 - .2 For temporary heating, refer to General Instructions Section 00 010 00.
 - .3 Equip fire watch personnel with fire extinguishers as required by article 2.6.
- .10 Obstruction of access/egress routes-roadways, halls, doors, or elevators
 - .1 Advise the Departmental Representative in advance of any work that would impede the response of Fire Department personnel and their apparatus. This includes violation of minimum overhead clearance, erection of barricades and the digging of trenches.

- .2 Building exit routes must not be obstructed in any way without special permission from the Departmental Representative, who will ensure that adequate alternative routes are maintained.
 - .3 The Departmental Representative will advise the FPO of any obstruction that may warrant advanced planning and communication to ensure the safety of building occupants and the effectiveness of the Fire Department.
- .11 Rubbish and Waste Materials
- .1 Keep rubbish and waste materials to a minimum and a minimum distance of 6m (20 feet) from any kettle or torches.
 - .2 Do not burn rubbish on site.
 - .3 Rubbish Containers
 - .1 Consult with the Departmental Representative to determine an acceptable safe location for any containers and the arrangement of chutes etc. prior to bringing the containers on site.
 - .2 Do not overfill the containers and keep area around the perimeter free and clear of any debris.
 - .4 Storage
 - .1 Exercise extreme care when storing combustible waste materials in work areas. Ensure maximum possible cleanliness, ventilation and that all safety standards are adhered to when storing any combustible materials.
 - .2 Deposit greasy or oily rags or materials subject to spontaneous combustion in CSA or ULC approved receptacles and remove at the end of the work day or shift, or as directed.
- .12 Flammable Liquids
- .1 The handling, storage and use of flammable liquids is governed by the current National Fire Code of Canada.
 - .2 Flammable Liquids such as gasoline, kerosene and naphtha may be kept for ready use in quantities not exceeding 45 litres (10 imp gal), provided they are stored in approved safety cans bearing the ULC seal of approval and kept away from buildings, stockpiled combustible materials etc. Storage of quantities of flammable liquids exceeding 45 litres (10 imp gal) for work purposes, require the permission of the Departmental Representative.
 - .3 Flammable liquids are not to be left on any roof areas after normal working hours.
 - .4 Transfer of flammable liquids is prohibited within buildings.
 - .5 Do not transfer flammable liquids in the vicinity of open flames or any type of heat producing device.
 - .6 Do not use flammable liquids having a flash point below 38 °C (100 °F) such as naphtha or gasoline as solvents or cleaning agents.
 - .7 Store flammable waste liquids for disposal in approved container located in a safe, ventilated area. Waste flammable liquids are to be removed from the site on a regular basis.

- .8 Where flammable liquids, such as lacquers or urethane are used, ensure proper ventilation and eliminate all sources of ignition. Inform the Departmental Representative prior to, and at the cessation of such work.
- .13 Questions and/or clarifications
 - .1 Direct any questions or clarification on Fire or General Safety, in addition to the above requirements, to the Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Shop drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.
- .4 Alternate Materials.

1.2 RELATED SECTIONS

- .1 Section 017800 - Closeout Submittals.

1.3 REFERENCES

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008, Stipulated Price Contract.

1.4 ADMINISTRATIVE

- .1 Submit to Engineer submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
- .6 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent works are coordinated.

- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.
- .10 Keep one reviewed copy of each submission on site.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term 'shop drawings' means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Submit 6 paper copies and 1 electronic copy in Adobe Acrobat .pdf format of the following items requested in specification sections or as requested by the Engineer:
 - .1 Shop drawings of all products required within the project
 - .2 Product data sheets or brochures where shop drawings will not be prepared due to standardized manufacture of product.
 - .1 If standardized product data sheets are being provided due to the standard nature or manufacture of a specific product, ensure that either information on other models or ratings not applicable to project is removed, or circle and/or highlight applicable model or rating information. If not all model or rating information is present on data sheet, supplement standard information to provide details applicable to project.
 - .3 Test reports
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
 - .4 Certificates
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.

- .5 Manufacturers instructions
 - .1 This may consist of pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .6 Manufacturer's Field Reports
 - .1 This may include documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .7 Operation and Maintenance Data
- .8 Programming, settings, and annotation for any electronic or digital control devices
- .4 For the Adobe Acrobat .pdf electronic document, group all related documents into one consistent and logically arranged .pdf document, with the detailed title page indicating which specification sections or item the document covers.
- .5 Allow six (6) business days for Engineer's review of each submission.
- .6 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .7 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.
- .8 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .9 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Specification Section Number
 - .4 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .5 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

- .6 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .10 After Engineer's review, distribute copies.
- .11 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .12 The review of shop drawings by the Engineer is for sole purpose of ascertaining conformance with general concept. This review shall not mean that the Engineer approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.

1.6 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Engineer's business address.
- .3 Notify Engineer in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .6 Make changes in samples which Engineer may require, consistent with Contract Documents.

- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.7 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status and any other specification required documentation.
- .2 Submit transcription of insurance immediately after award of Contract.

1.8 SUBSTITUTIONS

- .1 In the event that, prior to the closing of tenders, the Tenderer wishes to offer a substitution that differs from that named, specified, or otherwise described in contract documents, he/she shall submit a request in writing with enough supporting drawings and technical information to thoroughly evaluate the acceptability of the substitution. This shall be submitted in writing at least ten (10) business days prior to the time for receiving tenders. The request shall include the following:
 - .1 A detailed description of the proposed substitutions;
 - .2 In case of materials, products or systems, a direct comparison between the properties and compliance of the specified materials, products or systems with the properties and compliance of the proposed substitution; and,
 - .3 In the case of materials or products, country of manufacture.
 - .4 If requested by the Client, a list of no less than five (5) projects of comparable size where the proposed substitution has been used in a similar application, subject to climatic conditions similar to those experienced in the location of the client's facility. The list shall include the name and current telephone number of the Consultant and Owner for each project for each project to allow confirmation that the item can be used acceptably.
- .2 In the event that the Consultant deems the information provided with the request for approval of a substitution to be inadequate, the request may be rejected.
- .3 Approval of alternative proposals of work, materials or methods will be signified by the issue of an addendum.
- .4 Cost of additional work and/or modification to the design due to the use of alternative materials, products or systems shall be borne by the Contractor. The acceptance by the Client and the Engineer of said material or products does not relieve the Contractor of any additional costs for additional work and/or modification to the design due to the use of alternative materials, products or systems that may be discovered after the acceptance of said material or products.
- .5 Herein the terms "or equal", "or equivalent" or terms of similar meaning are used in the specifications, this shall not be construed as acceptance of any alternative material, product or system to those specified. The use of these terms does not relieve the Contractor from his responsibility to follow procedures for approval of substitutions specified herein (during tender period) or in accordance with the General Conditions.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 - Submittal procedures.

1.2 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Province of Ontario
 - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, updated 2011.

1.3 GENERAL

- .1 The contractor shall register the project, as required by OHSA and regulations, with the Ministry of Labour before commencing any work on site. A copy of the registration must be provided to the Contract Administrator/Project Manager before starting work on the site and a copy must be posted in a visible location on the work site at all times.
- .2 The contractor shall appoint a competent person, as defined by the OHSA, as the project supervisor.
- .3 The supervisor shall supervise the work at all times either personally or by having an identified assistant do so personally.
- .4 The supervisor shall inspect the work site and equipment associated with the project at least once a week. A copy of the inspection report must be provided to the Contract Administrator/Project Manager.
- .5 The contractor, in consultation with Contract Administrator/Project Manager, shall provide a health and safety management plan which as a minimum will include:
 - .1 A Site Management Plan, which includes a general overview of the project and roles and responsibilities for:
 - .1 Site workers
 - .2 Site safety coordinator
 - .3 Project environmental health and safety coordinator
 - .4 Task managers
 - .2 A Hazard Identification Plan, which includes primary environmental hazards, personal conduct and hygiene, potential site hazards, and others such as:
 - .1 Survey Work in Traffic

- .2 Physical
- .3 Fire and Explosion
- .4 Confined Space Entry
- .5 Cranes, Hoists, and Rigging
- .6 Crane Suspended Personnel Platforms
- .7 Biological
- .8 Stress and Fatigue
- .9 Noise
- .10 Personal Security
- .11 Adverse Weather Conditions
- .12 Other Site Activities
- .3 A Personal Protective Equipment Inventory, which includes;
 - .1 Requirements for all site personnel
 - .2 Selection, maintenance and continual assessment
 - .3 A Emergency Preparedness and Response Plan, which addresses
 - .1 First aid
 - .2 Fire Protection
 - .3 Critical Injury
 - .4 Accident or Incident
- .4 The plan shall be posted in a visible location on the work site prior to the commencement of any work.
- .5 Engineer will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 10 business days after receipt of plan. Revise plan as appropriate and resubmit plan to Engineer within 10 business days after receipt of comments from Engineer.
- .6 Engineer's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .6 The contractor shall post signage in prominent locations identifying the required protective clothing or devices required to be worn on the work site and the contractor shall ensure compliance with these requirements.
- .7 The contractor shall remove waste material and debris from the work site(s) to a disposal area at least once a day or more frequently if necessary to prevent the creation of a hazardous condition.
- .8 The contractor shall ensure that fire extinguishing equipment is provided to ensure compliance with Section 52 to 58, O. Reg. 213.
- .9 The contractor shall ensure all vehicles, machinery, tools and equipment used on the work site are operated and maintained in accordance with Section 93 to 116, O. Reg. 213.

- .10 The contractor shall ensure no worker other than an electrician or apprentice certified under the Trades Qualifications and Apprenticeship Act to do electrical work on the work site, or the meet the qualifications required by CSA Z462 'Workplace Electrical Safety'.

- .11 File Notice of Project with Provincial authorities prior to commencement of Work.

1.4 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise the Departmental Representative verbally and in writing.

1.5 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of the Province having jurisdiction, and in consultation with the Departmental Representative.

1.6 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Engineer.
- .2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

1.7 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

1.8 CHEMICALS

- .1 The contractor must provide a list of all chemicals to be used on site and a copy of the Material Safety Data Sheet (MSDS) for each chemical to the Contract Administrator/Project Manager prior to being brought onto the job site.
- .2 The contractor must ensure each chemical container brought on site is clearly labelled with the identity of the chemical, information for the safe handling of the chemical and the location of the MSDS.

- .3 The contractor must ensure adequate measures are taken to control the distribution, within the application area or throughout the building, of fumes/vapours before applying flammable, noxious or volatile materials.
- .4 The contractor may be required to schedule the application of hazardous materials which might affect the well-being of any workers or disrupt work of other contractors and cannot be adequately controlled to prevent such occurrences to evening or weekend periods.
- .5 The contractor must ensure workers wear the required personal protective equipment (respiratory protection, protective clothing, hand protection, eye/face protection, etc.) when working with chemicals.
- .6 The contractor must ensure the safe use and disposal of all chemicals that they are using. No chemicals and/or chemical waste product shall be disposed of on site without prior approval of Contract Administrator/Project Manager.
- .7 The contractor may not store chemicals and compressed gas cylinders on site without approval of the Contract Administrator/Project Manager. If approved, the contractor must ensure incompatible chemicals are stored separately.

1.9 DESIGNATED SUBSTANCES / HAZARDOUS WASTE

- .1 The contractor shall provide a work plan for the removal of designated substances, in accordance with all applicable legislation, for review and approval to the Contract Administrator/Project Manager.
- .2 The contractor shall provide evidence of competency with regards to the Environmental Protection Act and its regulations, a copy of safe handling work plan prior to commencing with work in the area.
- .3 The contractor shall register the project as a waste generator site, if not already registered, for the waste that will be generated as a result of the work activities related to the project.
- .4 The contractor shall ensure and provide evidence that all hazardous wastes removed from the sites sent to a licensed waste disposal site by a licensed carrier and advise the responsible individual when necessary testing is to be carried out.
- .5 The contractor shall retain copies of all hazardous waste manifests on file.
- .6 The contractor shall inspect the project daily to monitor compliance with designated substances and hazardous waste regulations.
- .7 The contractor shall provide access to the responsible individual for review of all inspection reports.

1.10 FALL PROTECTION

- .1 The contractor shall comply with the requirements of Section 26, O. Reg. 213/91 and Sections 85 and 86, O. Reg. 851.
- .2 The contractor shall provide, upon request, proof of worker training in the use of their fall protection systems.
- .3 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.11 CONFINED SPACE ENTRY

- .1 Access confined spaces only after receipt of written permission from Engineer.
- .2 The contractor shall comply with the requirements of Section 60 to 63, O. Reg. 213/91 as amended by O. Reg. 628/05 and Sections 67 to 71, O. Reg. 851 as amended by O. Reg. 629/05.
- .3 The contractor shall provide, upon request, a copy of their Confined Space Entry Procedure and proof of worker training in confined space entry.
- .4 The contractor shall inform the Contract Administrator/Project Manager prior to entering a confined space to ensure all the isolation of all potential hazards.
- .5 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.12 LADDERS

- .1 The contractor shall comply with the requirements of Section 78 to 84, O. Reg. 213/91 and Sections 73, O. Reg. 851.
- .2 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.13 WELDING/CUTTING

- .1 Use welding and cutting devices only after receipt of written permission from Engineer.
- .2 The contractor shall comply with the requirements of Section 122 to 124, O. Reg. 213/91.
- .3 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.14 SCAFFOLDING

- .1 The contractor shall comply with the requirements of Section 125 to 142, O. Reg. 213/91.
- .2 The contractor shall design, erect, inspect, maintain and use scaffolding equipment, materials, and components in accordance with CAN/CSA-S269.2-M87 (Access Scaffolding for Construction Purposes).
- .3 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.15 ELEVATED WORK PLATFORMS

- .1 The contractor shall comply with the requirements of Section 143 to 149, O. Reg. 213/91 and Sections 51 to 54, O. Reg. 851.
- .2 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.16 CRANES, HOISTING, RIGGING AND ACCESSORIES

- .1 The contractor shall comply with the requirements of Section 150 to 156 and 168 to 180, O. Reg. 213/91.
- .2 The contractor shall comply with the requirements of Section 187, O. Reg. 213/91 if a crane or similar hoisting device is operated near an energized overhead electrical conductor and if it is possible for a part of the equipment or its load to encroach upon the minimum distance permitted under section 186, or when the hoisting device is positioned closer than the length of its boom to an energized overhead electrical conductor.
- .3 The contractor shall provide, upon request, proof of worker training in the safe operation of the crane or similar hoisting device.
- .4 The contractor shall make available all logbooks, inspection records and tests for cranes or similar hoisting devices, upon request.
- .5 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.17 EXPLOSIVE ACTUATED FASTENING TOOL

- .1 Use powder actuated devices only after receipt of written permission from Engineer.
- .2 The contractor shall comply with the requirements of Section 117 to 121, O. Reg. 213/91.

- .3 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.18 EXCAVATING AND TRENCHING

- .1 The contractor shall ensure no person enters an excavation unless another worker is working above ground close to the excavation or to the means of access to it.
- .2 The contractor shall arrange the locating and marking of gas, electrical and other services prior to commencing an excavation.
- .3 The contractor shall obtain approval from Contract Administrator/Project Manager before arranging the shut off and disconnection of a service that may pose a hazard.
- .4 The contractor shall comply with the requirements of Section 230 to 242, O. Reg. 213/91.
- .5 The contractor shall be responsible for supplying and maintaining all equipment needed to perform this role.

1.19 PUBLIC WAY PROTECTION

- .1 The contractor shall comply with the requirements of Section 64 to 66, O. Reg. 213/91.

1.20 TRAFFIC CONTROL

- .1 The contractor shall not block or restrict traffic flow on driveways, laneways or emergency vehicle routes without approval of the Contract Administrator/Project Manager. The contractor must ensure work areas are clearly identified with traffic control devices necessary to provide vehicular traffic with sufficient warning of the work being performed and to protect the workers performing the work.
- .2 The contractor shall not block or restrict pedestrian access to walkways without approval of Contract Administrator/Project Manager. The contractor must provide a safe and clearly identified route for pedestrians in these circumstances

Part 2 Products

2.1 NOT USED.

Part 3 Execution

3.1 NOT USED.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008, Stipulated Price Contract.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative inspection.
 - .2 Departmental Representative Inspection:
 - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in English and French that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted and fully operational.
 - .4 Certificates required by Utility companies: submitted.
 - .5 Operation of systems: demonstrated to Owner's personnel.
 - .6 Work: complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Departmental Representative, and Contractor.
 - .2 When Work incomplete according to Owner, complete outstanding items and request re-inspection.

1.3 FINAL CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 As-built, samples, and specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Spare parts, special tools and maintenance materials.
- .6 Warranties and bonds.
- .7 Final site survey.

1.2 RELATED SECTIONS

- .1 Section 017700 - Closeout Procedures.
- .2 Section 019100 - Commissioning.
- .3 Section 017900 - Demonstration and Training.
- .4 Section 260500 – Electrical General Requirements
- .5 Section 260510 – Electrical Testing

1.3 SUBMISSION

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned with Engineer's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, four final copies of operating and maintenance manuals in English.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.

- .7 Defective products will be rejected, regardless of previous inspections. Replace products at contractor's expense, including costs of removal, transportation, re-installation, and re-commissioning.

1.4 FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets. Minimum 3" thick binder.
- .3 Provide binders labeled on the front cover and on the binder edge with the following information: Building Name and address, project name, project number, completed date (ex. October 2015).
 - .1 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Text: Manufacturer's printed data, or typewritten data.
- .5 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .6 Provide any electronic or digital programming, settings, control, or annotation in both readable paper form in the binder and as original software files on the CD in the required and compatible file format necessary for working with the devices.
- .7 Provide 1:1 scaled AutoCAD files in .dwg format on CD.
- .8 Provide one complete Adobe Acrobat .pdf format file of the complete Operations and Maintenance Manual on CD.

1.5 CONTENTS - EACH VOLUME

- .1 Provide Title Page with the following info: Building name, address, date, general contractor's and consultant' information (name, address, and phone numbers).
- .2 Table of Contents: provide title of project;
 - .1 date of submission; names,
 - .2 addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
 - .3 schedule of products and systems, indexed to content of volume.
- .3 Signed 'Letter of warranty' with activation date, identifying project by name, project number, location as well as warranty period. Any extended warranty of equipment must be identified also.

- .4 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .5 As-built drawings for the project.
- .6 Testing reports for the project.
- .7 Arrange content by systems under sequence of Specification's Section numbers; and
 - .1 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .2 For each product or system:
 - .1 List extended warranty of equipment, if applicable.
 - .2 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .3 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions as specified.
 - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

1.6 AS-BUILTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for Engineer one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Engineer.

1.7 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings provided by Engineer.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .12 Additional requirements: As specified in individual specification sections.

1.9 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

1.10 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.11 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.12 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.

1.13 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Engineer.

1.14 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

- .4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 RELATED SECTIONS

- .1 Section 017800 - Closeout Submittals.
- .2 Section 019100 - Commissioning.

1.4 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.5 QUALITY CONTROL

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.
- .2 Engineer will provide a description of each system and instruction on design philosophy, design criteria and design intents.
- .3 Factory-trained and certified manufacturer's personnel to provide instruction on start-up, operation, shut-down of equipment, components and systems. Instructions to include features of controls, such as reason for, results of, implications on associated systems of, adjustment of set-points of control and limit safety devices. Instructions to include information on servicing, maintenance, adjustment of system equipment and components.

1.6 SUBMITTALS

- .1 Submit a detailed training plan for review and approval by Engineer at least 20 business days before any training. The plan shall include a listing of components, systems, and integrated systems and other topics that will be covered in the training period. The plans shall also include tentative dates and times for each training session. Provide list of persons and their qualifications as instructors.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.7 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with Section 019100 - Commissioning.
- .2 Testing, adjusting, and balancing have been performed in accordance with Section 019100 - Commissioning and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.8 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated personnel are present.
- .3 Training materials to include at least the following:
 - .1 As-built Contract Document
 - .2 Operating Manual
 - .3 Maintenance Manual
- .4 Training materials to be in form permitting future training procedures to same degree of detail.
- .5 Supplement training materials as required with:
 - .1 Transparencies for overhead projectors or powerpoint presentations
 - .2 Manufacturers training video
 - .3 Equipment models

1.9 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the designated location.
- .2 Deliver training during regular business hours, each training session to be a maximum of 4 hours in length (including break of 15 minutes minimum) between 08:00 – 12:00 and 13:00 – 16:00.
- .3 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .4 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.10 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Ensure amount of time required for instruction of each item of equipment or system as follows:
 - .1 New Medium Voltage Switchgear – 3 hours
 - .2 High Voltage Switchgear – 3 hours
 - .3 Control Systems – 4 hours
- .2 Each training session must be complete twice for two different groups on two different days.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Includes general requirements for commissioning facilities and facility systems.
- .2 The scope consists of:
 - .1 Testing of the ‘new’ components installed as defined in the tender document.
 - .2 Testing of system(s) including existing system(s) which has been modified or extended as part of the work as defined in the tender document.
 - .3 Integrated System Performance Testing and fine tuning as defined in the tender document.

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 RELATED SECTIONS

- .1 Section 260510 – Electrical Testing.

1.4 COMMISSIONING SCHEDULE

- .1 Within 20 business days of contract award, the contractor will be responsible for providing an estimated schedule for showing all construction activities. The schedule to include the following milestones as a minimum; switchgear delivery, installation, testing, start-up, training, delivery of O&M Manual, sequencing of commissioning, acceptance, and occupancy.
- .2 At least 40 business days before shipment of switchgear, the contractor will be responsible for providing a detailed schedule for showing all construction and commissioning activities. The schedule to include the following milestones as a minimum; testing, start-up, training, delivery of O&M Manual, sequencing of commissioning, acceptance, and occupancy.
- .3 Contractor to provide schedule using Bar (Gantt) Charts.
- .4 Unless otherwise specified in writing by the Engineer, all testing and related requirements specified herein will be successfully performed prior to the issuance of the Substantial Completion Letter.

1.5 PROCEDURES - GENERAL

- .1 Provide testing organization services under provisions specified in Section 260510 – Electrical Testing.

1.6 FINAL REPORTS

- .1 Organization having managerial responsibility shall make reports, or assemble and compile reports completed by specialist subcontractors.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

1.7 CONTRACTOR RESPONSIBILITIES

- .1 Prepare each system for testing and balancing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization 10 business days prior to time project will be ready for testing, adjusting, and balancing.

1.8 MANUFACTURERS INVOLVEMENT

- .1 Arrange for Manufacturer to submit copies of all production test records for production test required by these specifications prior to shipping.
- .2 Prior to start-up of equipment or systems, obtain manufacturer's installation, start-up and operation instructions and review with Engineer.
- .3 Use manufacturer's trained start-up personnel to maintain integrity of warranty.
- .4 Verify with manufacturer that testing as specified will not void any warranties.
- .5 Manufacturer's personnel to be experienced in design, installation and operation of equipment and systems and be able to interpret test results in clear, concise, logical manner.
- .6 Report in writing to Engineer any deficiencies or defects noted during performance of services.

1.9 WITNESSING OF STARTING AND TESTING

- .1 Provide sufficient notice not less than ten (10) business days prior to commencement.
- .2 Engineer may witness all or any portion of start-up and testing at their discretion.
- .3 General Contractor to be present at all tests performed by sub-trades, suppliers, and equipment manufacturers.

1.10 AUTHORITIES HAVING JURISDICTION

- .1 The contractor will complete initial start-up successfully prior to performance verifications and certification by presiding authorities having jurisdiction.
- .2 To facilitate the turnover of the project, call and arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests. It shall be the responsibility of the Contractor to confirm which tests the presiding authorities having jurisdiction are required to attend. Confirm that the presiding authorities will be present for each test, as required.
- .3 Any cost associated with presiding authorities attending testing during the daytime and during off-hours shall be the responsibility of the Contractor. Include all such cost in your tender.
- .4 Obtain Certificates of Approval, acceptance and compliance with the rules and regulations of authority having jurisdiction. Provide copies to the Engineer within five (5) days of tests with the commissioning report.
- .5 Submit reports generated by special testing agencies to the Engineer prior to the issuance of the Interim Certificate of Completion.
- .6 Special Testing agencies shall be approved by the Engineer with acceptable facilities and qualifications.

1.11 DEFICIENCIES, FAULTS, DEFECTS, REPETITION

- .1 Correct all deficiencies found during start-up and commissioning to satisfaction of the Engineer.
- .2 Report faults, defects affecting commissioning to Engineer in writing as they become apparent. Unless instructed otherwise, halt commissioning until same is rectified.
- .3 Where verification of reported results fail to receive Engineer approval, and where repetition of verification again fails to receive approval, and where Engineer deems Contractor's request for 2nd verification was premature, then all costs incurred by Engineer for 3rd and subsequent verifications to be borne by the contractor.

1.12 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 After commissioning is completed to satisfaction of Engineer, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings, and otherwise return devices back to normal operation conditions.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 033000 – Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O86, Engineering Design in Wood.
 - .3 CSA O121, Douglas Fir Plywood.
 - .4 CSA O151, Canadian Softwood Plywood.
 - .5 CSA O153, Poplar Plywood.
 - .6 CAN/CSA-O325.0-, Construction Sheathing.
 - .7 CSA O437 Series, Standards for OSB and Waferboard.
 - .8 CSA S269.1, Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.1, Falsework for Construction Purposes.
 - .10 CAN/CSA-S269.3, Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
 - .1 COFI Exterior Plywood for Concrete Formwork.

1.3 SHOP DRAWINGS

- .1 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.
- .2 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, or CSA-O153.

- .2 Use 19mm plywood for all framing.
- .2 Form release agent: non-toxic, biodegradable, low VOC.
- .3 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal 15 to 24 mm²/s at 40°C, flashpoint minimum 150°C, open cup.
- .4 Falsework materials: to CSA-S269.1.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Engineer's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.
- .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Remove formwork as soon as possible after concrete has attained adequate strength to support its own weight and superimposed loads, without cracking or deflecting excessively in order to facilitate effective finishing, but not earlier than 30 hours after placement.
- .2 Remove formwork when concrete has reached 75 % of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 033000 - Cast-in-Place Concrete.

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment:
 - .1 No measurement will be made under this Section.
 - .1 Include reinforcement costs in items of concrete work in Section 03 30 00 - Cast-In-Place Concrete.

1.3 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 SP-66, ACI Detailing Manual 2004.
- .2 ASTM International
 - .1 ASTM A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .3 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .4 ASTM A775/A775M, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 CSA International
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3, Design of Concrete Structures.
 - .3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC, Reinforcing Steel Manual of Standard Practice

1.4 SHOP DRAWINGS

- .1 Submit shop drawings including placing of reinforcement in accordance with Section 013300 – Submittal Procedures.

- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .1 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings.
 - .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3,
 - .1 Provide class B unless otherwise indicated.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Engineer.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.
- .4 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .5 Deformed steel wire for concrete reinforcement: to CSA G30.14.
- .6 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .7 Welded deformed steel wire fabric: to CSA G30.15. Provide in flat sheets only.
- .8 Epoxy coating of non-pre-stressed reinforcement: to ASTM A 775/A 775M.

- .9 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
- .10 Mechanical splices: subject to approval of Engineer.
- .11 Plain round bars: to CAN/CSA-G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Engineer's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Engineer, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Engineer with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Engineer.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on approved placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Engineer's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.

- .5 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.3 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

3.4 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 031000 - Concrete Forms and Accessories.
- .2 Section 032000 - Concrete Reinforcement

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment:
 - .1 Cast-in-place concrete will not be measured but will be paid for as fixed price item.
 - .2 Supply and installation of anchor bolts, nuts and washers and bolt grouting will not be measured but considered incidental to work.

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
 - .1 Type GU, GUb and GUL - General use cement.
 - .2 Type MS and MSb - Moderate sulphate-resistant cement.
 - .3 Type MH, MHb and MHL - Moderate heat of hydration cement.
 - .4 Type HE, HEb and HEL - High early-strength cement.
 - .5 Type LH, LHb and LHL - Low heat of hydration cement.
 - .6 Type HS and HSb - High sulphate-resistant cement.
 - .2 Fly ash:
 - .1 Type F - with CaO content less than 15%.
 - .2 Type CI - with CaO content ranging from 15 to 20%.
 - .3 Type CH - with CaO greater than 20%.
 - .3 GGBFS - Ground, granulated blast-furnace slag.
- .2 Reference Standards:
 - .1 ASTM
 - .1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .5 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .6 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

- .7 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .8 ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 CSA International
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide testing or inspection results for review by Engineer and do not proceed without written approval when deviations from mix design or parameters are found.
- .3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .4 Concrete hauling time: provide for review by Engineer deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .5 Provide two copies of WHMIS MSDS.

1.5 QUALITY ASSURANCE

- .1 Provide Engineer, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .2 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Engineer on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.

.7 Joints.

- .3 Quality Control Plan: provide written report to Engineer verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
- .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Engineer and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Engineer.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance : to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Engineer and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU.
- .2 Blended hydraulic cement: Type GUB to CSA A3001.
- .3 Portland-limestone cement: Type GUL to CSA A23.1.
- .4 Water: to CSA A23.1.
- .5 Aggregates: to CSA A23.1/A23.2.
- .6 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C494 or ASTM C1017. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 52 MPa at 28 days.
- .8 Curing compound: to CSA A23.1/A23.2 white.
- .9 Premoulded joint fillers:

- .1 Bituminous impregnated fiber board: to ASTM D1751.

2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet performance criteria to CSA A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure: C-2.
 - .2 Compressive strength at 28 age: 32 Mpa minimum.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Engineer written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Engineer approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
 - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .11 Do not place load upon new concrete until authorized by Engineer.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Engineer.

- .2 Where approved by Engineer, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Engineer.
 - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Engineer before placing of concrete.
 - .5 Confirm locations and sizes of sleeves and openings shown on drawings.
 - .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts:
- .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
 - .2 Cast anchor bolts in the concrete.
- .4 Drainage holes and weep holes:
- .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .6 Finishing and curing:
- .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by Engineer or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete: Broom. Provide written declaration that compounds used are compatible.
 - .4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .7 Joint fillers:
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Engineer.
 - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form joints as indicated.
 - .4 Install joint filler.
 - .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless indicated otherwise.

3.3 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Engineer for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Contractor will pay for costs of tests.
 - .1 Minimum 1 set of cylinders per concrete pour.
- .4 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .6 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.4 CLEANING

- .1 Provide appropriate area on job site where concrete trucks and be safely washed.
- .2 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
- .3 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .4 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .5 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.
 - .6 ASTM A490M, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-85.10, Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).
 - .1 Handbook of the Canadian Institute of Steel Construction.
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CAN/CSA-S16, Limit States Design of Steel Structures.
 - .4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
 - .5 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
 - .6 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
 - .7 CSA W59, Welded Steel Construction (Metal Arc Welding).
 - .8 CSA W178.1, Certification of welding inspection organizations.
 - .9 CSA W178.2, Certification of welding inspectors.
- .5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
 - .1 NACE No. 3/SSPC SP-6, Commercial Blast Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:

- .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Erection drawings:
 - .1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
 - .1 Description of methods.
 - .2 Sequence of erection.
 - .3 Type of equipment used in erection.
 - .4 Temporary bracings.
- .4 Fabrication drawings:
 - .1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Province of Ontario, Canada.
- .5 Fabricator Reports:
 - .1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.
- .6 Qualifications:
 - .1 Company certification is in accordance with CSA W47.1 Division 1 or 2.
 - .2 Welders' CWB Qualifications.
 - .3 Welding procedures are approved by the CWB in accordance with to CSA W47.1 and CSA W59.
 - .4 Splicing details and procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written recommendations.
- .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
 - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
 - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non-standard connections.

2.2 MATERIALS (Note ALL steel to be Hot Dipped Galvanized)

- .1 Structural steel: to CSA-G40.20/G40.21 Grade 300W.
- .2 Anchor bolts: to ASTM A36/A36M.
- .3 Bolts, nuts and washers: zinc coated type 1 to ASTM A325/ASTM A325M .
- .4 Welding materials: to CSA W48 Series or CSA W59 and certified by Canadian Welding Bureau.
- .5 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds. Grind smooth.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S16.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 CONNECTION TO EXISTING WORK

- .1 Verify dimensions and condition of existing work and new works, report discrepancies and potential problem areas to Consultant for direction before commencing fabrication.

3.4 MARKING

- .1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.5 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of.

- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.6 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing agency acceptable to the Consultant. The inspection organization undertaking to inspect welding shall be qualified in accordance with the requirements of CSA W178.1 and certified by the Canadian Welding Bureau. Alternatively, visual weld inspection may be performed by persons certified to Level 2 or 3 of CSA W178.2.
- .2 The inspection agency will submit reports to the Consultants, Contractor, Steel Fabricator and Municipal Authorities covering the Work inspected and provide details of nonconformities or deficiencies observed.
- .3 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Consultant.
- .4 Inspection shall consist of at a minimum:
 - .1 The inspector shall carry out visual inspection of at least 10% of all connections and 100% of butt joints that are loaded in direct tension.
 - .2 Overall dimensions.
 - .3 Fabricated members against specified member sections.
 - .4 Workmanship regarding layout, punching and drilling of holes.
 - .5 Shop and field inspection of bolt installation.
 - .6 Shop and field inspection of welded joints.
 - .7 Galvanizing and field touch-up.
 - .8 Sample checking that tolerances are not exceeded during erection including fit-up of field welded joints.
- .5 Submit test reports to Consultant within 1 weeks of completion of inspection.
- .6 Contractor will pay costs of tests.
- .7 Remove and replace non - conforming materials without delay and without extra cost

3.7 CLEANING

- .1 Remove from the site any excess materials.

END OF SECTION

Part 1 General

1.1 GENERAL ELECTRICAL SCOPE OF WORK

- .1 The contractor is responsible for all civil, structural, mechanical and electrical work required to complete the construction of a new 115kV substation as per the design drawings.
 - .1 The scope of work will include but is not limited to the following tasks:
 - .1 Complete all civil and structural work required to construct concrete bases for the 115kV circuit switcher, 115kV overhead line support, 115kV power transformer and 6.9kV outdoor walk-in enclosure.
 - .2 Supply, install and test new 115kV circuit switcher.
 - .3 Supply, install and test new 115kV power transformer
 - .4 Supply, install and test new 115kV lightning arrestors
 - .5 Supply, install and test new 6.9kV outdoor switchgear installed in a walk-in outdoor enclosure.
 - .6 Supply, install and test new substation ground grid.
 - .7 Supply and install new substation fencing.
 - .8 Supply and install new 115kV overhead line.
 - .9 Supply, install and test all new 6.9kV feeder cables connected to existing loads.

1.2 STAGING AND SCHEDULING OF WORK

- .1 The contractor is responsible for the arrangement and organization of the required work and staging to implement these tender documents. The proper staging of this work is critical to completing all work within acceptable timelines.
- .2 The contractor must maintain operational access to the switchgear during non-shutdown periods of this project.
- .3 All non weekend work may be completed during normal business hours.
- .4 All shutdowns must be scheduled 30days in advance of proposed shutdown date. All shutdowns must be completed during overtime hours. Shutdowns must be scheduled between 8pm Friday night to 8pm Sunday night.
- .5 Contain all work being performed within the physical area of work which is under way, or approved work areas as indicated by the client. Keep the amount of disruption in the existing or associated facility to a minimum.
- .6 The Client has the right to reschedule or cancel any shutdowns as required with 24 hours written notice, without paying additional charges.

- .7 The Client has the right to reschedule or cancel any shutdowns as required with between 0 and 24 hours of verbal or written notice, with the payment of fair and reasonable mobilization costs. These costs to be itemized with detailed documentation to be reviewed by the Client and Engineer.

1.3 CODES AND STANDARDS

- .1 Perform work in accordance with the following codes, standards, and regulations:
 - .1 CSA C22.1-2015 Canadian Electrical Code Part I
 - .2 NETA, ATS-2013, Standard for Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
 - .3 Comply with CSA and Ontario Electrical Safety Bulletins enforced at time of tender submission.

1.4 CARE, OPERATION AND START-UP

- .1 Instruct Engineer and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.5 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 CIRCUIT PHASING

- .1 For any switchgear or distribution components that are being replaced, ensure at least one significant point within the downstream distribution is properly rotation phased with an appropriately rated phase rotation meter, both before and after replacement. Note rotation with coloured tape, letters, or other markings, and provide documentation to the client and engineer before any modification occurs.
 - .1 Note that this must be done at every tie breaker and downstream of every feeder being replaced or modified or having their cables disconnected and reconnected.

- .2 For any systems or circuits that are looped, tied or have multiple feeds that may be closed in parallel, physical confirmation that phases are being maintained is required when switchgear or distribution components are being replaced or modified.
 - .1 After the system is de-energized, perform continuity checks to confirm which incoming A/B/C phases are physically connected to the outgoing phases.
 - .2 Note the physical location of the incoming and outgoing cables if they are fixed and use coloured tape, letters, or other markings, and provide documentation to the client and engineer before any modification occurs.
 - .3 After completion of the system modification, perform phasing across the poles of the open device within the looped or parallel systems with both lines energized.
 - .1 Confirm a-a', b-b', and c-c' voltage is zero
 - .2 Confirm a-b', a-c', b-c' voltage is rated line to line voltage
- .3 For all measurements, use appropriate personnel, work methods, and PPE per CSA Z462 'Electrical Workplace Safety'

1.7 SEISMIC RESTRAINT

- .1 Install electrical system with adequate structural support to withstand seismic forces in accordance with Section 4.1.8 of the Ontario Building Code.
- .2 Retain a Seismic Structural Engineer licensed in the Province of Ontario to perform a review of the proposed electrical installation and prepare installation documents indicating all required seismic supports, bracings, and fastenings. These documents shall be sealed and signed by the engineer and submitted as part of the shop drawing package prior to work proceeding on site.
- .3 Equipment to be included, but not limited to:
 - .1 Suspended Conduit and Cable Tray
 - .2 Free standing distribution equipment such as switchboards, transformers, motor control centers, battery banks, and loadbreaks.
 - .3 Suspended lighting fixtures
- .4 This facility is classified as 'Normal' with an Importance Factor of 1.0 as referenced to in clause 4.1.8.5 (1) of the Ontario Building Code.
- .5 Seismic Engineer to review installation upon completion and provide signed confirmation in writing that the installation is in general compliance with the structural installation instructions.
- .6 The electrical contractor is to be solely responsible for this portion of work. Include all elements of seismic design, materials, and site review in Bid Price.

1.8 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Pay associated fees.

- .2 Engineer will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
- .3 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department authorities having jurisdiction on completion of work to Engineer.

1.9 MATERIALS AND EQUIPMENT

- .1 All materials to be new and unused.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department. Pay associated fees.
- .3 Factory assemble control panels and component assemblies.

1.10 WARRANTY AND TRIAL USAGE

- .1 Provide warranty as per specific Section, or minimum warranty as follows.
- .2 All equipment to carry a minimum of a one year unlimited warranty on all parts, labour, and expenses for the replacement of the defective or non-functional part from the date of energization.
- .3 Warranty of the electrical systems or equipment that is energized and used on temporary or partial basis shall not commence until the entire project has reached Substantial Completion.
- .4 Temporary, or trial use, or any electrical devices or equipment shall not be construed as evidence of acceptance of the same.

1.11 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is specified in Division 16 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 15 and shown on mechanical drawings.

1.12 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment 'equipment green' finish to EEMAC Y1-1-1955.

- .2 Paint indoor switchgear and distribution enclosures 'light grey' to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.13 EQUIPMENT IDENTIFICATION

- .1 Identify with 3mm (1/8") Brother, P-Touch non-smearing tape, or an alternate approved by the NRC Departmental Representative, all electrical outlets shown on drawings and/or mentioned in the specifications. These are the lighting switches, recessed and surface mounted receptacles such as those in offices and service rooms and used to plug in office equipment, telecommunication equipment or small portable tools. Indicate only the source of power (Ex. for a receptacle fed from panel L32 circuit #1: "L32-1").
- .2 Light fixtures are the only exceptions for electrical equipment identification (except as noted in 7.13 below). They are not to be identified.
- .3 Identify with lamicoïd nameplates all electrical equipment shown on the drawings and/or mentioned in the specification such as motor control centers, switchgear, splitters, fused switches, isolation switches, motor starting switches, starters, panelboards, transformers, high voltage cables, industrial type receptacles, junction boxes, control panels, etc., regardless of whether or not the electrical equipment was furnished under this section of the specification.
- .4 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.
- .5 Wording on lamicoïd nameplates to be approved by the NRC Departmental Representative prior to fabrication.
- .6 Provide two sets of lamicoïd nameplates for each piece of equipment; one in English and one in French.
- .7 Lamicoïd nameplates shall identify the equipment, the voltage characteristics and the power source for the equipment. Example: A new 120/240 volt single phase circuit breaker panelboard, L16, is fed from panelboard LD1 circuit 10.

PANEL L16
120/240 V
FED FROM LD1-10"

PANNEAU L16
120/240 V
ALIMENTE PAR LD1-10

- .8 Provide warning labels for equipment fed from two or more sources - "DANGER MULTIPLE POWER FEED" black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.

- .9 Lamicoid nameplates shall be rigid lamicaid, minimum 1.5 mm (1/16") thick with:
 - .1 Black letters engraved on a white background for normal power circuits.
 - .2 Black letters engraved on a yellow background for emergency power circuits.
 - .3 White letters engraved on a red background for fire alarm equipment.
- .10 For all interior lamicaid nameplates, mount nameplates using two-sided tape.
- .11 For all exterior lamicaid nameplates, mount nameplates using self-tapping 2.3 mm (3/32") dia. slot head screws - two per nameplate for nameplates under 75 mm (3") in height and a minimum of 4 for larger nameplates. Holes in lamicaid nameplates to be 3.7 mm (3/16") diameter to allow for expansion of lamicaid due to exterior conditions.
 - .1 No drilling is to be done on live equipment.
 - .2 Metal filings from drilling are to be vacuumed from the enclosure interiors.
- .12 All lamicaid nameplates shall have a minimum border of 3 mm (1/8"). Characters shall be 9 mm (3/8") in size unless otherwise specified.
- .13 Identify lighting fixtures which are connected to emergency power with a label "EMERGENCY LIGHTING/ÉCLAIRAGE D'URGENCE", black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.
- .14 Provide neatly typed updated circuit directories in a plastic holder on the inside door of new panelboards.
- .15 Carefully update panelboard circuit directories whenever adding, deleting, or modifying existing circuitry.

1.14 WIRING IDENTIFICATION

- .1 Identify each conductor, including spares, with a unique alphanumeric designation to match drawings and to facilitate troubleshooting and maintenance.
 - .1 Identify wiring at both ends with heat shrink type, indelible machine printed wire markers. Raychem ShrinkMark, or approved equal.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.15 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 All new conduits to be colour-coded EMT, type as follows:
 - .1 Fire alarm – red conduit

- .2 Emergency power circuits – yellow conduit
- .3 Voice/data – blue conduit
- .4 Gas detection system – purple conduit
- .5 Building Automation system – orange conduit
- .6 Security system – green conduit
- .4 Apply paint to the covers of junction boxes and condulets of existing conduits as follows:
 - .1 Fire alarm – red
 - .2 Emergency power circuits – yellow
 - .3 Voice/data – blue
 - .4 Gas detection system – purple
 - .5 Building Automation system – orange
 - .6 Security system – green
- .5 Power cable colours:

	Prime
Up to 250 V	yellow
Up to 600 V	black
Up to 15 kV	Red

1.16 ACOUSTICAL PERFORMANCE

- .1 In general provide equipment producing minimal sound levels in accordance with the best and latest practices established by the electrical industry.
- .2 Do not install any device or equipment containing a magnetic flux path metallic core, such as gas discharge lamp ballasts, dimmers, solenoids, etc., which are found to produce a noise level exceeding that of comparable available equipment.

1.17 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminium conductors.

1.18 MANUFACTURERS AND CSA LABELS

- .1 Ensure that manufacturer's registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.
- .2 Do not paint over registration plates or approval labels. Leave openings through insulation for viewing the plates. Contractor's or sub-contractor's nameplate not acceptable.

1.19 WARNING SIGNS

- .1 Provide warning signs, as specified or to meet requirements of Authorized Electrical Inspection Department and NRC Departmental Representative.

- .2 Accept the responsibility to protect those working on the project from any physical danger due to exposed live equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts with the appropriate voltage. Caution notices shall be worded in both English and French.

1.20 SINGLE LINE ELECTRICAL DIAGRAMS

- .1 Client will provide the contractor with a copy of the existing electrical single line in AutoCAD. Contractor will update the existing copy of electrical single line to as-built configuration. Provide copy of updated single line drawings in electronic AutoCAD format to client via DVD.
- .2 Provide two single line electrical diagrams under plexiglass as follows:
 - .1 Electrical distribution system: locate in main electrical room and 6.9kV outdoor substation.
- .3 Provide 6 full size, colour, paper copies to client.
- .4 Drawings: 600 x 600 mm minimum size.

1.21 LOCATION OF OUTLETS

- .1 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .2 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

1.22 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Fire alarm stations: 1500 mm.
 - .5 Fire alarm bells: 2100 mm.

1.23 LOAD BALANCE

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

- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.24 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.25 FIELD QUALITY CONTROL

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being constructed.
- .3 Conduct and pay for following tests:
 - .1 Circuits originating from branch distribution panels.
 - .2 Lighting and its control.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Other tests as specified in Section 260510 – Electrical Testing
- .4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .5 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .6 If requested, schedule and carry out tests in presence of Engineer. Provide ten (10) business days written notice of tests.
- .7 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- .8 Submit test results for Engineer's review.

1.26 WORK ON LIVE EQUIPMENT & PANELS

- .1 NRC requires that work be performed on non-energized equipment, installation, conductors and power panels. For purposes of quotation assume that all work is to be done after normal working hours and that equipment, installation, conductors and power panels are to be de-energized when worked upon.

1.27 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Client or engineer will provide copy of the existing coordination study, including recommended settings of protective devices.
- .2 Implement and test protective devices at required settings as per Section 260510 – Electrical Testing.
- .3 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .4 Per Ontario Electrical Safety Code Bulletin 14-1-1, all new or modified circuit breakers, or existing breakers as indicated on drawings, with adjustable Long Delay Pick-Up Settings shall be provided with a Size 7 lamacoid label indicating the maximum allowable over-current setting that the breaker is allowed to be set at.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SCOPE

- .1 The work listed in these specifications involves hazardous voltages, materials, operations, and equipment. These specifications do not claim to address all of the safety problems associated with their use. It is the responsibility of the user to review all applicable regulatory limitations prior to the use of these specifications.
- .2 The contractor shall provide qualified services, or shall engage the services of a specialized, qualified testing firm, for the purpose of performing inspections and tests as herein specified.
- .3 The contractor, or specialized testing firm, shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
- .4 The contractor will arrange and pay for all required ESA maintenance and inspection certificates for their scope of work.
- .5 The contractor will arrange and pay for all switching and isolation services required from Hydro-One.
- .6 The contractor will provide electrical switching and grounding orders as per EUSA and CSA Z462 guidelines to ensure adequate protection and safety for both contractor and the client during the shutdown. These switching orders to cover both de-energization and re-energization for both normal and emergency systems during the shutdown. These shall be provided to the engineer and client at least 20 business days before the shutdown for review.
- .7 The contractor will provide a comprehensive shutdown procedure. It will list all primary contacts with their telephone numbers, and will identify all timelines for the shutdown correlated to the starting and finishing of all tasks during the shutdown, such as generator starts, switching order implementations, safety meetings, re-energizations, and other similar tasks. This must be coordinated with the client, the maintenance contractor, the local supply authority, the specialist testing organization, and other related groups. These shall be provided to the engineer and client at least 20 business days before the shutdown for review.
- .8 The Client has the right to reschedule or cancel the shutdown as required with 24 hours written notice, without paying additional charges.
- .9 The Client has the right to reschedule or cancel the shutdown as required with between 0 and 24 hours of verbal or written notice, with the payment of fair and reasonable mobilization costs. These costs to be itemized with detailed documentation to be reviewed by the Client and Engineer.

1.2 REFERENCES

- .1 NETA, ATS-2013, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
- .2 IEEE – Standard Collection C57 – 1998.
- .3 IEEE – Standards Collection C37 – 1998.
- .4 CSA Z462 ‘Workplace Electrical Safety’
- .5 Infrastructure Health and Safety Association (comprising the former Electrical & Utilities Safety Association of Ontario)

1.3 QUALIFICATIONS OF TESTING FIRM

- .1 The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- .2 All employees of the testing firm shall be qualified as per CSA Z462 requirements.
- .3 The testing firm shall have at least one person on site with one of the following qualifications to provide technical supervision and/or guidance as required for the remainder of the testing personnel:
 - .1 An employee certified by the InterNational Electrical Testing Association (NETA)
 - .2 A Professional Engineer (P. Eng) licensed in the Province of Ontario with specialized training and experience in the testing and inspection of electrical power distribution equipment
 - .3 A member of the Ontario Association of Certified Engineering Technicians and Technologists (OACETT) with specialized training and experience in the testing and inspection of electrical power distribution equipment
 - .4 The contractor is to supply the Client, within 10 business days of awarding of contract, the name and qualifications of the proposed on-site supervisor. Approval, in writing from the Client, is required if the contractor needs to change the on-site supervisor for any reason. The Client will have the right to reject candidates not meeting the above qualifications.
- .4 All work designated ‘Specialist Testing’ shall be performed by employees of the specialist testing firm and all personnel must be qualified to operate, test, and commission high and low voltage electrical equipment.
- .5 All work designated ‘Generalist Testing’ may be completed by qualified electricians, technicians, technologists, or engineers employed or subcontracted by the specialist testing firm or electrical contractor.

- .6 The contractor to supply the Client with a list of people proposed for site work with their qualifications at least 10 business days before the shutdown, or as early as required to receive appropriate clearances. The Client will have the right to reject candidates not meeting the above qualifications.
- .7 The agency must have the necessary wiring, materials, equipment, tools, instruments, measuring devices and all other tools necessary to carry out the work.
- .8 The testing firm shall submit interim proof of all the above qualifications when responding to the Request for Proposals.
- .9 Various specialized testing firm have been pre-qualified to provide the client with the inspections and tests herein specified:
 - .1 Eaton Engineering Services
 - .2 Schneider Engineering Services

1.4 DIVISION OF RESPONSIBILITY

- .1 The testing firm shall supply a suitable and stable source of electrical power to each test site unless notified by the client in writing that sufficient local power will be available for operating test equipment. All portable alternating current (AC) power sources shall operate at 60 Hz +/- 0.1 Hz.
- .2 The testing firm shall supply adequate portable lighting for each test site unless notified by the client in writing that sufficient local lighting will be available for operating test equipment. Ensure adequate lighting is available both with and without normal and/or emergency power.
- .3 The owner, or owner's representative, will supply an up to date short circuit analysis and coordination study, a protective device setting sheet, a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.
- .4 The owner, or owner's representative, shall notify the testing firm when equipment becomes available for maintenance tests. Work shall be coordinated to expedite project scheduling. Note: various pieces of equipment are required to maintain each buildings environmental condition. It is imperative that the communication between each building's operations personnel and the testing firm be established prior to the isolation of any equipment. Sufficient time shall be given for the shutdown and startup of equipment such as chillers, pumps, and other essential equipment.
- .5 The testing firm shall notify the owner, or owner's representative, prior to commencement of any testing.
- .6 Deviation from the planed schedule of work for each stage of the work must be approved by the owner or owner's representative prior to the isolation of any additional equipment.

- .7 Once the 'Station Guarantee' is received from the Utility, the testing firm shall be fully responsible for their own safety, including all switching procedures, equipment isolation, and grounding procedures. At the end of each stage of the work, the testing firm shall ensure that all temporary grounds are removed from the equipment and all equipment is placed into its normal operation position prior to releasing the 'Station Guarantee'. It is the testing firm's responsibility to record the position of all circuit breakers and switches under the scope of the contract and to ensure that the 'As found' position is maintained after the work is completed.

1.5 SAFETY AND PRECAUTIONS

- .1 Safety practices shall include, but are not limited to, the following requirements:
- .1 The current Occupational Health and Safety Act
 - .2 CSA Z462 'Workplace Electrical Safety'
 - .3 Workplace Hazardous Materials Information System (WHMIS). Submit to owner, or owner's representative, pertinent MSDS information.
 - .4 Applicable Provincial, local, and client safety operating procedures
 - .5 National Fire Protection Association – NFPA, and the National Fire Code of Canada
 - .6 OSHA 29 CFR 1910.147. Control of Hazardous Energy Sources (Lockout/Tagout)
- .2 All tests shall be performed with apparatus de-energized except where otherwise specifically required. Lock out and tag procedures shall be in effect. All testing firm representatives shall lock and tag all equipment tested under the scope of work. The testing agency shall provide a 'lock box' for any equipment requiring more than 3 locks. All equipment to be tested under the scope of work shall be isolated from all sources of power, locked and tagged, tested for voltage potential with an approved potential tester rated for the voltage application, and grounded from all sources of power using approved temporary grounds.
- .3 As per CSA Z462, all testing firm representatives shall wear the appropriate Personal Protective Equipment (PPE) including approved safety boots, side impact hard hats, safety glasses and/or safety shields, arc flash coveralls, and rubber gloves with protectors during switching operations. All PPE shall be rated for the appropriate voltage class application.
- .4 The contractor shall review and supervise all operations with respect to safety, and notify any sub-contractors and/or the client of any known or found hazards or information about the client's installation that needs to be transmitted to sub-contractors.

1.6 TEST EQUIPMENT

- .1 All test equipment shall be in good mechanical and electrical condition.
- .2 Metering or monitoring equipment shall be true RMS sensing only. (Peak sensing equipment shall not be permitted).

- .3 Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked. Field Test Equipment shall meet the following criteria:
 - .1 1000 volt DC Insulation Resistance test equipment shall have a meter scale of at least 500 Gig Ohms.
 - .2 5000 volt DC Insulation Resistance test equipment shall have a meter scale of at least 500 Meg Ohms
 - .3 Low Resistance test equipment shall have a minimum of 5 ampere DC output and the ability to measure down to a 5 micro Ohms.
 - .4 Transformer turns ratio test equipment shall have a minimum of 130 to 1 ratio and scaled operate to three (3) significant digits. Test equipment shall have excitation current measurement capability to at least 5 amperes.
 - .5 Winding Resistance test equipment shall have a minimum of 5 ampere DC output and the ability to measure to a 100 milli-Ohms scale.
 - .6 Relay test equipment shall have a minimum of 100 amperes AC output in order to test standard mechanical overcurrent relays.
 - .7 Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of 2% of the scale used.
 - .8 Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment. Test equipment shall not exceed 2.0 percent Total Harmonic Distortion THD output on voltage waveforms and 2.0 percent THD output on current waveforms.
- .4 Test Instrument Calibration
 - .1 The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
 - .2 Calibration shall be done by a calibration agency compliant with International Standards Organization ISO 17025 and Standard Council of Canada CAN-P-4D.
 - .3 Dated calibration labels shall be visible on all test equipment.
 - .4 Records must be available and up to date for the owner, or owner's representative, to inspect calibration of each piece of equipment.

1.7 TEST REPORT

- .1 The testing firm shall maintain a written or typed record of all field tests, and then shall assemble and certify a final completely typed test report.
- .2 The test report shall include the following:
 - .1 Summary of project, complete with a detailed deficiency list, comments, results, analysis, and recommendations.
 - .2 Description of all equipment tested which shall include complete equipment nameplate values and/or installation information (e.g. Manufacturer, Date, Model Number, Serial Number, Voltage, Ampacity, Phases, kW, Power Factor, Horsepower, RPM, Torque, Type, Size, Insulation Type, Insulation Rating (100%, 133%, etc.), Shield if present, Number of conductors, Free air or Raceway rating, Configuration, etc.).

Please note, the above list is not a complete and comprehensive list. Each device test sheet should have enough data to clearly identify the device, its location within the distribution system, a unique identifier, and all parameters which define its ratings and application. As a minimum, each device test sheet should usually include all parameters defined by the device's ruling Industry Standard.

- .3 Include results from all tests above with starting conditions noted.
- .4 Include any items found out of specified tolerances.
- .5 Include any relevant comments about the condition of the switchgear.
- .3 A blank copy of all applicable test sheets on the project shall be submitted to the Client for approval within five (5) business days of the contract issuance. The Client has the right to reject test sheets that do not include all required information or test results.
- .4 Each item within the Specialist's testing listed under item 4.1.2 shall be detailed with all item information, ratings, and test results on one or more pages per unit (unless units are in sets like fuses).
- .5 Group all devices by substation, type, ID number, and area.
- .6 Furnish three (3) paper copies of the complete report to the owner, or owner's representative.
- .7 Furnish three (3) .pdf electronic copies, with high resolution printing allowed, of the complete report to the owner, or owner's representative on DVD.
- .8 Provide copies of report to owner, or owner's representative, with operation and maintenance manuals.
- .9 Any system, material, or workmanship, which is found defective on the basis of maintenance tests, shall be reported verbally during the shutdown, and in writing in the final report.

Part 2 Inspection and Test Procedures

2.1 WORK COMMON TO MOST ELECTRICAL ASSEMBLIES

- .1 Inspection
 - .1 Compare equipment nameplate information with latest single line diagram to ensure agreement.
 - .2 Inspect for evidence of corrosion, the presence of corona or insulation breakdown, and/or for environmental contamination, especially on insulators or insulating surfaces.
 - .3 Verify acceptable anchorage, required area clearances, and proper alignment.
 - .4 Verify presence of required warning signs.
 - .5 Verify that protective devices and settings, instrument transformers and ratios, and all other electrical elements correspond to single line drawings, coordination study, and/or relevant documentation.

- .6 Verify that ventilation filters are present and in good condition, and/or that ventilation openings or vents are clear.
 - .7 Verify that there are no inadvertent connections of the ground bus to the neutral bus on any electrical systems containing a neutral. Ensure that a ground to neutral bond(s) is in the correct location.
- .2 Mechanical/Functional Verification
- .1 For commissioning, verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with manufacture's published data or, if not available, use NETA Table 10.12. For maintenance, verify general tightness of accessible bolted electrical connections.
 - .2 Test operation, alignment, and penetration of instrument and control power transformer withdrawal disconnects, current-carrying and grounding.
 - .3 Exercise all active components, and verify the operation of all mechanical indicating devices.
 - .4 Test all electrical and mechanical interlock systems for proper operation and sequencing:
 - .5 Attempt to close locked-open devices. Attempt to open locked-closed devices.
 - .6 Make Kirk Key exchanges with devices operated in off-normal positions.
 - .7 Verify that Kirk Key numbers match with the single line diagram and record them on the approved test sheet.
- .3 Cleaning
- .1 Thoroughly clean switchgear cells or electrical equipment prior to testing unless as-found and as-left tests are required. Clean equipment using cleaning agents that have high dielectric properties, repel moisture, prevent corona tracking, and are not harmful to the electrical equipment insulation, such as Banwet manufactured by Brodi.
 - .2 Vacuum all loose elements from electrical switchgear, junction boxes, and other areas within or without electrical equipment. Blowers shall not be used unless no other methods to remove contaminants are possible.
- .4 Lubrication
- .1 Verify appropriate contact lubricant on moving current carrying parts. Refer to manufacturer's recommendations on lubrication of components.
 - .2 Verify appropriate lubrication on moving and sliding surfaces. Refer to manufacturer's recommendations on lubrication of components.

2.2 OVERHEAD TOWER ASSEMBLIES, GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning.
 - .1 Clean and then visually inspect all insulators for the absence of any tracking or cracks. Lightly tap all porcelain insulators to check for sound quality and the presence of internal failures compared to similar insulators.
 - .2 Use appropriate overhead lifting devices or manual work methods and protections as required by facility and local authority requirements.

.2 Electrical Tests

- .1 Disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B –Black, Phase C – Blue). After testing re-connect equipment and conductors in the original phasing order.

2.3 SWITCHGEAR ASSEMBLIES, GREATER THAN 750V

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning.

.2 Electrical Tests

- .1 Disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B –Black, Phase C – Blue). After testing re-connect equipment and conductors in the original phasing order. Perform field taping if required in accordance to Section 3.
- .2 Perform tests on all instrument and control power transformers in accordance with relevant Section.
- .3 Perform insulation resistance tests on each bus section. Energize each phase with the correct test voltage ensuring the opposing two phases and neutral (4 wire only) are grounded. Each test shall occur for a duration of one (1) minute. Electrical equipment rated from 600 volts AC to 2,600 volts AC shall be tested at 1,000 volts DC. Electrical equipment rated from 2,601 volts AC to 69,000 volts DC shall be tested at 5,000 volts DC.
- .4 Perform an overpotential (hi-pot) test on each bus section. Energize each phase with the correct DC test voltage ensuring the opposing two phases and neutral (4 wire only) are grounded. Each test shall occur for a duration of one (1) minute. The step voltage method shall be used to achieve the full test voltage, whereby the test voltage is raised to final value in 10 equal steps (increments of 1/10 the final test voltage). There will be a 30 second delay between incremental steps where the micro-Amp leakage current will be recorded for each step. After 6 step intervals a linear rate of change leakage current versus test voltage shall be established. During the final 4 step changes if the predicted rate of change is greater than 5 to 1 leakage current versus test voltage the test shall be terminated and all test results up to that point will be documented. All tests shall be performed as per manufacturers published data. If manufacturer's data is not available this test shall be performed in accordance to the NETA standard Table 10.2.
- .5 Perform a system function test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Energize control circuits with the correct designed tripping and closing circuit voltages.
- .6 Operate all circuit breakers and switches manually and electrically in local and remote modes of operation to ensure correct closing and tripping.
- .7 Verify that all indication and alarm lights and audible devices operate correctly.
- .1 General Industrial/Commercial Application: red signifies device closed and green signifies device open.

- .2 General Utility Application: green signifies device closed and red signifies device open.
- .8 Verify the operation of switchgear cell heaters.
- .3 Test Values
 - .1 Compare bus connection resistances to values of similar connections.
 - .2 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, which deviate from similar bus by more than 25 percent of the lowest value. Microhm value should not exceed the following:
 - .1
$$\frac{0.050\text{volts}}{\text{Equipment Continuous Current Rating}} \times 1,000,000$$
 - .3 Insulation resistance values for bus, control wiring, and instrument & control power transformers shall be in accordance with manufacturers published data. In the absence of manufacturers published data, use NETA Standard Table 10.1. (Note: Do not use test voltage levels in NETA Table 10.1) Values of insulation resistance less than this table or manufacturers minimum should be investigated. Overpotential tests should not proceed until insulation resistance levels are raised above minimum values.
 - .4 The insulation shall withstand the overpotential test voltage applied. Flag any values greater than 10 Micro Amperes.

2.4 115,000V CIRCUIT SWITCHER

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Trip/Close – Verify circuit switcher and associated disconnect trips and removes potential kinetic energy for closing (spring charge type mechanism).
 - .2 Position Indicator – verify charger, open and close indicator.
 - .3 Secondary Contact Blocks - verify alignment, engagement, and correct contact
 - .4 Padlock/Key Lock Operator – ensure circuit switcher’s interrupter and disconnect can be locked open.
 - .5 Circuit Switcher
 - .1 Operation Counter – record number of as found and as left operations
 - .2 Auxiliary Switches – ensure that circuit switcher properly engages and toggles ‘a’, ‘b’, and position contacts
 - .3 Cut Off Switch – ensure electrical motor cutoff operates consistently.
 - .4 Electrical Interlocks – Ensure anti-pumping (Y) relay operates correctly. Ensure (52 X) relay operates correctly (electrical coil close only).
- .2 Electrical Tests
 - .1 Perform a contact resistance test with a low resistance ohmmeter. Test should be performed through the entire circuit switcher from line side of disconnect and load side of interrupter.

- .2 Perform insulation-resistance tests on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or Table 10.1.
- .3 Perform SF6 bottle integrity (overpotential) test across each SF6 bottle with the switch in the open position in strict accordance with manufacturer's published data. Do not exceed maximum voltage stipulated for this test. Do not perform this test unless the contact displacement of each interrupter is within manufacturer's tolerance. (Be aware that some dc high-potential test sets are half wave rectified and may produce peak voltages in excess of the switch manufacturer's recommended maximum.)
- .4 Perform resistance measurements through all bolted connections with a low resistance ohmmeter.
- .5 Perform insulation resistance test at 250 volts DC on all control wiring. Do not perform insulation resistance tests on solid state or electronic control devices.
- .6 Measure the following coil resistances with a DC ohmmeter;
 - .1 Closing Coil
 - .2 Tripping Coil
 - .3 52 X Coil
- .7 With breaker in the test position, make the following tests:
 - .1 Trip and close circuit switcher with the control switch.
 - .2 Trip circuit switcher by operating each of its protective relays.
 - .3 Verify trip free and antipump (Y relay) function.
 - .4 Perform minimum pickup voltage tests on trip coil and record value.
- .3 Test Values
 - .1 Compare bolted connection resistances to values of similar connections.
 - .2 Bolt torque levels shall be in accordance with NETA Standard Table 10.12 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 which deviate from adjacent poles or similar circuit switchers by more than 25 percent of the lowest value. Microhm value should not exceed the following:
 - .1
$$\frac{0.050 \text{volts}}{\text{Equipment Continuous Current Rating}} \times 1,000,000$$
 - .4 If circuit switcher contact resistance exceeds above formula, burnish main contacts and apply lubrication as per manufacturer specification until correct contact resistance is achieved.
 - .5 Control wiring insulation resistance shall be a minimum of two megohms.
 - .6 Critical distances of operating mechanism should be in accordance with manufacturer's published data.
 - .7 The SF6 bottles shall withstand the overpotential voltage applied.
 - .8 Coil resistances should be consistent with previous year's results.

- .9 Minimum pickup for trip coil shall conform to manufacturers published data. If data is not available trip coil should operate at 25 percent below rated voltage.

2.5 FUSES, GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Disassemble fuse units to inspect link conditions and record link nameplate data.
 - .1 Measure fuse resistance before and after this operation to ensure proper re-assembly
 - .2 Fuse Holder – Inspect for cracks, corona and erosion, especially where fuse link seats into holder
 - .3 Fuse Mounting – Record fixed or drawout, verify that each fuse holder has adequate mechanical support.
 - .4 Fuse Alignment – verify latch on drawout mounts
 - .5 Muffler – Verify that expulsion limiting devices are in place on all holders having expulsion type elements, verify arc stop material in good condition
- .2 Electrical Tests
 - .1 Measure fuse resistance with a Low Resistance Test Set. (Ensure that Low Resistance test set current output does not exceed rated fuse current.)
- .3 Test Values
 - .1 Investigate fuse resistance values that deviate from each other by more than 15 percent. Fuse links may have crystallized.

2.6 CIRCUIT BREAKERS, VACUUM, GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Ground Contact – verify breaker moving contact fingers with ground bus
 - .2 Floor Trip/Close Tripper – Verify circuit breaker trips and removes potential kinetic energy for closing (spring charge type mechanism) or inhibits close coil operation (electrical coil type mechanism) while racking in and out of cell.
 - .3 Position Indicator – verify fully connected, test, and fully disconnected indicators.
 - .4 Secondary Contact Blocks - verify alignment, engagement, and correct contact
 - .5 Padlock/Key Lock Operator – ensure breaker can be locked in the fully disconnected position
 - .6 Racking Mechanism - verify unobstructed operation with breaker.
 - .7 Verify that all maintenance devices are available for servicing and operating the breaker. (umbilical cord, racking handle, drawout rails, lifting mechanism)
 - .8 Circuit Breaker
 - .1 Operation Counter – record number of as found and as left operations
 - .2 Auxiliary Switches – ensure that breaker properly engages and toggles ‘a’, ‘b’, and position contacts
 - .3 Cut Off Switch – ensure electrical motor cutoff operates consistently.

- .4 Electrical Interlocks – Ensure anti-pumping (Y) relay operates correctly. Ensure (52 X) relay operates correctly (electrical coil close only).
- .9 Vacuum Bottles
 - .1 Verify that all vacuum bottles are sealed and without dents or other mechanical indications of problems.
 - .2 Verify that vacuum bottle contact wear indicator is not indicating
- .2 Electrical Tests
 - .1 Perform a contact resistance test with a low resistance ohmmeter. Test should be performed through the entire breaker from line side primary drawout contact to load side primary drawout contact.
 - .2 Perform insulation-resistance tests on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or Table 10.1.
 - .3 Perform vacuum bottle integrity (overpotential) test across each vacuum bottle with the switch in the open position in strict accordance with manufacturer's published data. Do not exceed maximum voltage stipulated for this test. Provide adequate barriers and protection against x radiation during this test. Do not perform this test unless the contact displacement of each interrupter is within manufacturer's tolerance. (Be aware that some dc high-potential test sets are half wave rectified and may produce peak voltages in excess of the switch manufacturer's recommended maximum.)
 - .4 Perform resistance measurements through all bolted connections with a low resistance ohmmeter.
 - .5 Perform insulation resistance test at 250 volts DC on all control wiring. Do not perform insulation resistance tests on solid state or electronic control devices.
 - .6 Measure the following coil resistances with a DC ohmmeter;
 - .1 Closing Coil
 - .2 Tripping Coil
 - .3 52 X Coil
 - .7 With breaker in the test position, make the following tests:
 - .1 Trip and close breaker with the control switch.
 - .2 Trip breaker by operating each of its protective relays.
 - .3 Verify trip free and antipump (Y relay) function.
 - .4 Perform minimum pickup voltage tests on trip coil and record value.
- .3 Test Values
 - .1 Compare bolted connection resistances to values of similar connections.
 - .2 Bolt torque levels shall be in accordance with NETA Standard Table 10.12 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 which deviate from adjacent poles or similar breakers by more than 25 percent of the lowest value. Microhm value should not exceed the following:

$$.1 \quad \frac{0.050 \text{volts}}{\text{Equipment Continuous Current Rating}} \times 1,000,000$$

- .4 If breaker contact resistance exceeds above formula, burnish main contacts and apply lubrication as per manufacturer specification until correct contact resistance is achieved.
- .5 Circuit breaker insulation resistance shall be in accordance with NETA Standard Table 10.1. (Note: Do not use DC test voltage levels in NETA Standard Table 10.1)
- .6 Control wiring insulation resistance shall be a minimum of two megohms.
- .7 Insulation resistance values should be in accordance with manufacturer's published data or Table 10.1.
- .8 Critical distances of operating mechanism should be in accordance with manufacturer's published data.
- .9 The vacuum bottles shall withstand the overpotential voltage applied.
- .10 Coil resistances should be consistent with previous year's results.
- .11 Minimum pickup for trip coil shall conform to manufacturers published data. If data is not available trip coil should operate at 25 percent below rated voltage.

2.7 DISCRETE PROTECTIVE RELAYS

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Prior to cleaning the relay, record as-found settings.
 - .2 Tighten case connections. Inspect cover for correct gasket seal. Clean cover glass. Inspect shorting hardware, connection paddles, and/or knife switches. Remove any foreign material from the case. Verify target reset.
 - .3 Inspect relay for foreign material, particularly in disc slots of the damping and electromagnets. Verify disk clearance. Verify contact clearance and spring bias. Inspect spiral spring convolutions. Inspect disk and contacts for freedom of movement and correct travel. Verify tightness of mounting hardware and connections. Burnish contacts. Inspect bearings and/or pivots.
 - .4 Verify that all settings are in accordance with coordination study or setting sheet supplied by owner.
- .2 Electrical Tests
 - .1 Perform insulation resistance test at 250 volts DC on each circuit to frame. Do not perform insulation resistance test on solid state and microprocessor based relays.
 - .2 Inspect targets and indicators.
 - .3 Ensure correct magnitude and polarity of power supply to relay including the verification of any external power supply voltage drop resistors inherent to the relay (solid state and microprocessor based relays only)
 - .4 Determine pickup and dropout of electromechanical targets.
 - .5 Verify operation of all light emitting diode indicators.
 - .6 Set contrast for liquid crystal display readouts.

- .3 Functional Operation
 - .1 87T Transformer Differential Protection
 - .1 Record the relays setting and operating range.
 - .2 Determine pickup current.
 - .3 Determine time delay at rated current.
 - .2 46 Negative Sequence Current Protection
 - .1 Record the relays setting and operating range.
 - .2 Determine pickup current.
 - .3 Determine time delay at rated current.
 - .3 27 Under-Voltage Protection
 - .1 Record the relays setting and operating range.
 - .2 Determine pickup voltage.
 - .3 Determine time delay at rated voltage.
 - .4 81 Under/Over Frequency Protection
 - .1 Record the relays setting and operating range.
 - .2 Determine pickup frequency.
 - .3 Determine time delay at rated frequency.
 - .5 50/50G Instantaneous Overcurrent Relay
 - .1 Record the relays setting and operating range.
 - .2 Determine pickup current.
 - .3 Determine dropout current.
 - .4 Determine time delay at rated current.
 - .6 51/51N/51G Time Overcurrent Relay
 - .1 Record the relays tap setting, time dial setting, tap range, time dial range, seal in coil setting, seal in coil range, and time current curve type.
 - .2 Verify and/or calibrate timed contact zero adjustment.
 - .3 Perform secondary current injection test
 - .4 Determine minimum pickup current value.
 - .5 Determine time delays at two points on the manufacturers published time current curve or published formula. Time values shall be selected at 2 and 5 times the relay tap setting from the published time current curve with respect to the time dial setting.
 - .6 Verify the operation of the seal in target.
 - .7 Control Verification
 - .1 Perform primary injection test:
 - .1 Utilizing a high output relay test set, wrap window type current transformers individually with the appropriate number of turns to functionally operate the corresponding phase and ground overcurrent relay.
 - .2 If the current transformers are bar type remove the CT secondary conductors and perform a secondary injection test at the secondary conductors to functionally operate the corresponding phase and ground overcurrent relays

- .2 Verify that each of the relay contacts performs its intended function in the control scheme including breaker trip tests, close inhibit tests, 86 lockout tests, and alarm functions.
- .3 Verify control wiring from the instrument transformers to each protective relay.
- .8 Test Values
 - .1 When not otherwise specified, use manufacturer's recommended tolerances.
 - .2 When critical test points are specified, the relay should be calibrated to those points even though other test points may be out of tolerance.
 - .3 If the 51-timed overcurrent relay is found to be out of manufacturer's tolerances for the two point test, a combination of dampening magnet and core flux set screw shall be adjusted to properly calibrate the relay at 2 and 5 times the tap setting.

2.8 INSTRUMENT TRANSFORMERS, BOTH CTS AND PTS, APPLIED TO CIRCUITS GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Verify that all required grounding and shorting connections are correct. Ensure that after tests are completed all functioning Current Transformer (CT) shorting connections are not made and that all non-functioning CTs shorting connections are made. Ensure that after tests are completed all CTs have a completed permanent secondary circuit through the correct corresponding device.
 - .2 Ensure that donut type CTs rated for 0.6 kV systems have sufficient insulation and clearance from the primary switchgear bus when being applied to medium voltage systems. Ensure that bar type CTs do not exhibit any signs of corona discharge at the CT mounting base.
 - .3 Verify correct operation of transformer withdrawal mechanism and grounding operation. Ensure that shutters operate properly on Potential Transformer (PT) cabinets. Verify that hinged type, drawout PT cabinets are mechanically interlocked so that entry cannot be gained while the PTs are energized.
 - .4 Ensure that all PTs are correctly installed so that the PT primary circuit is connected through current limiting fuses and not directly connected to the switchgear phase bus.
 - .5 Ensure that all PT primary circuit cable conductors are properly installed and mechanically braced. Verify that all jumper type cable conductor sizes are at least 2 AWG or greater. Verify that all shielded conductors have proper stress cones.
- .2 Electrical Tests, Current Transformers
 - .1 Perform insulation resistance test of the current transformer and wiring to ground at 1000 volts DC. Do not perform insulation resistance test on solid state and microprocessor based relays.
 - .2 Perform a polarity test of each current transformer using the DC injection bumping method, or any automated method within an approved test set.

- .3 Perform a ratio verification test by injecting a large enough amount of current through the primary circuit of the CT to be able get a measurable amount of current from the secondary circuit of the CT, note the amount and calculate the measured ratio.
- .4 Perform an excitation test on transformers used for relaying applications in accordance with ANSI/IEEE C57.13.1.
 - .1 Before the excitation test is made, the current transformer should be demagnetized. To perform the test, an ac test voltage is applied to the secondary winding with the primary open circuited. The voltage applied to the secondary of the current transformer is varied, and the current drawn by the winding at each selected value of voltage is recorded. Readings near the knee of the excitation curve are especially important in plotting a comparison curve. For current transformers with taps, the secondary tap should be selected to assure that the current transformer can be saturated with the test equipment available. The highest tap which can accommodate that requirement should be used. The selection of instruments is especially important for this test. The ammeter should be an RMS instrument.
 - .2 CAUTION: If voltage is applied to a portion of the secondary winding, the voltage across the full winding will be proportionately higher because of autotransformer action. Current transformers should not remain energized at voltages above the knee of the excitation curve any longer than is necessary to take readings. Any substantial deviation of the excitation curve for the current transformer under test from curves of similar transformers or manufacturer's data should be investigated.
- .3 Electrical Tests, Voltage Transformers
 - .1 Perform insulation resistance tests primary winding to ground with the secondary winding grounded. Test voltages shall be applied for one minute at 1000 volts DC. Do not perform this test with solid state devices connected.
 - .2 Perform a polarity test on each transformer to verify the polarity marks or H1 X1 relationship.
 - .3 Perform a turns ratio test on all tap positions.
- .4 Test Values
 - .1 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 which deviate from similar connections by more than 25 percent of the lowest value.
 - .2 Insulation resistance measurement on any instrument transformer shall be not less than that shown in NETA Standard Table 10.1.
 - .3 Polarity results shall agree with transformer markings.
 - .4 Ratio accuracy shall be within 0.5 percent of nameplate or manufacturer's published data.
 - .5 Deviation from the excitation test manufacturers expected results may indicate a turn to turn short circuit, distortion of test supply voltage waveform, or the presence of a completed conducting path around the current transformer core.

2.9 LIGHTNING ARRESTORS, GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
 - .2 Verify that stroke counter, if present, is correctly mounted and electrically connected.
- .2 Electrical Tests
 - .1 Disconnect all conductors prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order. For equipment rated over 750 volts AC ensure that the connections are covered with “air seal” and high voltage rubber tape correctly applied as per the system rated voltage levels. “Duct seal” shall not be permitted.
 - .2 Perform resistance measurements of ground connection with a low resistance ohmmeter.
 - .3 Perform an insulation resistance test at voltage levels in NETA Standard Table 10.1.
- .3 Test Values
 - .1 Compare bolted connection resistances to values of similar connections.
 - .2 Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.
 - .3 Insulation resistance values should be in accordance with NETA Standard Table 10. 1.

2.10 CABLES, GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.
 - .2 Inspect terminations and splices for evidence of overheating and corona.
 - .3 Inspect for proper shield grounding or isolation as required, cable support, and termination.
 - .4 Verify that visible cable bends meet or exceed ICEA and/or manufacturers minimum allowable bending radius.
 - .5 If cables are terminated through window type current transformers, make an inspection to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
- .2 Electrical Tests
 - .1 Disconnect all conductors prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order. Retape as per section 3.

- .2 Perform a shield continuity test on each power cable by ohmmeter method.
 - .3 Perform an insulation resistance test utilizing a megohmmeter with a voltage output of at least 5000 volts DC for cables rated greater than 750 volts AC. Individually test each conductor with all other conductors and shields grounded. Test duration shall be one minute.
 - .4 Provide VLF testing for all shielded power cables containing extruded dielectric insulation to IEEE 400.2 "Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)".
- .3 Test Values
- .1 Shielding must exhibit continuity. Investigate resistance values in excess of ten ohms per 1000 feet of cable.

2.11 TRANSFORMERS, MEDIUM VOLTAGE, LIQUID FILLED

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning
 - .1 Inspect primary and secondary bushings, tank wall, gaskets, and radiators for insulating fluid leaks and cracks.
 - .2 Inspect pressure relief diaphragm for damage.
 - .3 Verify that alarm, control, and trip settings on temperature indicators are as specified.
 - .4 Verify that cooling fans and/or pumps operate correctly.
 - .5 Verify operation of all alarm, control, and trip circuits from temperature and level indicators, pressure relief device, and fault pressure relay.
 - .6 Verify correct liquid level in all tanks and bushings. Ensure temperature correction is applied when reading gauges.
 - .7 Verify "silica gel" or equivalent breathing apparatus is present on all conservator type transformers and that the "silica gel" colour indication is at least 70% blue or orange. (Conservator type only)
 - .8 Verify that the valve between the main tank and conservator tank is in the fully open position and that there are no obstructions in the breathing pipe. (Conservator type only)
- .2 Electrical Tests
 - .1 Disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order. Make field connects as per Section 3.
 - .2 Perform insulation resistance tests (two winding transformers). With all primary side (High) electrical connections shorted together and all secondary side (Low) electrical connections shorted together test the following;
 - .1 High to Low with Low Grounded
 - .2 Low to High with High Grounded
 - .3 High and Low connected together to Ground

- .4 Test voltage shall be 1000 volts DC with resistances tabulated and graphed at 10 seconds, 20 seconds, 30 seconds, one minute, five minutes, and 10 minutes. Test duration shall be for ten minutes. Calculate polarization index and dielectric absorption values. Correct the ten minute value to 20°C in accordance with test equipment manufacturer's published data.
 - .1
$$D.A. = \frac{1 \text{ Min. Re sult}}{30 \text{ Sec. Re sult}}$$
 - .2
$$P.I. = \frac{10 \text{ Min. Re sult}}{1 \text{ Min. Re sult}}$$
- .3 Perform turns ratio tests on all tap positions for all phases to ensure proper exercising of the off load tap changer. Return the tap changer to the designated "as found" tap position, lock tap changer in place, and perform turns-ratio test on all phases after all other electrical tests have been completed.
- .4 On all liquid transformers larger than 1500kVA or if specified in the Contract Documents, perform insulation power factor/dissipation factor test (two winding transformers). With all primary side (High) electrical connections shorted together and all secondary side (Low) electrical connections shorted together perform the following test:
 - .1 Energize High
 - .1 Ground Low (GST), (CH + CHL)
 - .2 Guard Low (GST), (CH)
 - .3 Unground Low (UST), (CHL) (UST)
 - .2 Energize Low
 - .1 Ground High (GST), (CL + CHL)
 - .2 Guard High (GST), (CL)
 - .3 Unground High (UST), (CHL) (UST)
 - .3 AC test voltages shall be equivalent to but not exceed equipment nameplate nominal ratings and never exceed 10 kVAC. Capacitance values for each test shall be recorded. Accepted insulation power factor/dissipation test sets are Doble MH2 or equivalent.
- .5 On all top mounted exposed bushings or if specified in the Contract Documents, perform the following power factor/dissipation factor tests for all bushings rated above 2601 volt AC:
 - .1 Hot collar watts loss tests.
 - .2 C1 capacitance test. (applicable for bushings with C1 tap only)
 - .3 C2 capacitance test. (applicable for bushings with C1 tap only)
 - .4 Hot Collar test shall be performed at 10 kVdc. Capacitance test voltage shall be performed as per bushing manufacturer's published data. Correct for 20°C in accordance with test equipment manufacturer's published data.
- .6 Perform excitation current tests in accordance with test equipment manufacturer's published data.

- .7 Measure the resistance of each winding with an approved winding resistance tester, on all primary windings in each tap changer positions and on each secondary winding.
 - .8 If core ground strap is accessible, measure core insulation resistance at 500 volts DC.
 - .9 Remove a sample of insulating liquid in accordance with ASTM D923. Sample shall be tested in accordance with the referenced standard.
 - .1 Dielectric breakdown voltage: ASTM D877 and/or ASTM D1816
 - .2 Acid neutralization number: ANSI/ASTM D974
 - .3 Interfacial tension: ANSI/ASTM D971 or ANSI/ASTM D2285
 - .4 Color: ANSI/ASTM D1500
 - .5 Visual Condition: ASTM D1 524
 - .6 Parts per million water: ASTM D1 533. Required on 25 kV or higher voltages and on all silicone filled units.
 - .7 Measure dissipation factor or power factor in accordance with ASTM D924.
 - .8 Part per million of PCB (Perform only if values are not known) per ASTM D-4059.
 - .10 Remove a sample of insulating liquid in accordance with ASTM D3613 and perform dissolved gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D3612. (Atmospheric air shall not enter the test sample) Test should include dissolved water and total dissolved gas concentration complete with the following gas concentrations:
 - .1 Hydrogen (H₂)
 - .2 Methane (CH₄)
 - .3 Carbon Monoxide (CO)
 - .4 Acetylene (C₂H₂)
 - .5 Ethylene (C₂H₄)
 - .6 Ethane (C₂H₆)
 - .7 Carbon Dioxide (CO₂)
 - .8 Oxygen (O₂)
 - .9 (N₂)
 - .10 Evaluation of gas concentrations with recommendations shall be submitted within chemical analysis report.
 - .11 Remove a sample of insulating liquid in accordance with ASTM D3613 and perform Furan Analysis in accordance with ASTM D-5837.
- .3 Test Values
- .1 Insulation resistance test values at one minute should not be less than values recommended by the manufacturer. Resistance values to be temperature corrected in accordance with the manufacturer.
 - .2 The polarization index should be compared to previously obtained results. Polarization Index calculations range from 2 to 5. Investigate any values which deviate from range.

- .3 Turns ratio test results shall not deviate more than one half percent from either the adjacent coils or the calculated ratio.
- .4 Maximum power factor of liquid filled transformers corrected to 20°C shall be in accordance with transformer manufacturer's published data. Representative values are indicated in NETA Standard Table 10.3. Compare with test equipment manufacturer's published data. To ensure test results are valid the Grounded Specimen Tests must equal the summation of the Guarded Specimen Test and the Ungrounded Specimen Test. Measured capacitance values have the same relationship.
- .5 Investigate bushing power factors and capacitances that vary from nameplate values by more than ten percent. Investigate any bushing hot collar watts loss results that exceed the test equipment manufacturers published data. Investigate hot collar results, which deviate from similar results by more than 15 percent. In the case of hermetically sealed liquid filled bushings perform the hot collar test on every bushing skirt in order to detect bushing oil levels.
- .6 Typical excitation current test data pattern for three legged core transformer is two similar current readings and one lower current reading.
- .7 Winding resistance measurements should compare within one percent of previously obtained results after factoring in temperature correction. Investigate any values which deviate from similar connections by more than 15 percent of the lowest value.
- .8 Core insulation values should be comparable to previously obtained results but not less than one megohm at 500 volts dc. If the core insulation is breached a circulating current in the transformer core will be established that will tend to cause adverse heating of the unit. Monitor transformer running temperature.
- .9 Insulating liquid shall be in accordance with NETA Standard Table 10.4. Make observations on acceptability.
- .10 Evaluate results of dissolved gas analysis in accordance with ANSI/IEEE Standard C57.104 and make observations on acceptability.

2.12 GROUNDING RESISTORS, AIR COOLED

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning
 - .1 Perform specific inspections and mechanical tests as recommended by manufacturer.
 - .2 Verify if current transformers, or other non-resistor devices are present within the resistor enclosure.
- .2 Electrical Tests
 - .1 Disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order. Make field connections as per Section 3 if required.
 - .2 Perform insulation resistance measurements per NETA
 - .3 Perform resistance measurements through resistor or inductor and bolted connections with a low-resistance ohmmeter, either DC or AC as required.

- .3 Test Values
 - .1 Compare bolted connection resistances to values of similar connections.
 - .2 Bolt-torque levels should be in accordance with NETA Standard Table 10.12 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 which deviate from similar connections by more than 50 percent of the lowest value.
 - .4 Insulation-resistance test values at one minute should be in accordance with NETA Standard Table 10.5.

2.13 CABLES, GREATER THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.
 - .2 Inspect terminations and splices for evidence of overheating and corona.
 - .3 Inspect for proper shield grounding or isolation as required, cable support, and termination.
 - .4 Verify that visible cable bends meet or exceed ICEA and/or manufacturers minimum allowable bending radius.
 - .5 If cables are terminated through window type current transformers, make an inspection to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
- .2 Electrical Tests
 - .1 Disconnect all conductors prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order. Retape as per section 3.
 - .2 Perform a shield continuity test on each power cable by ohmmeter method.
 - .3 Perform an insulation resistance test utilizing a megohmmeter with a voltage output of at least 5000 volts DC for cables rated greater than 750 volts AC. Individually test each conductor with all other conductors and shields grounded. Test duration shall be one minute.
 - .4 Provide VLF testing for all shielded power cables containing extruded dielectric insulation to IEEE 400.2 "Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)".
- .3 Test Values
 - .1 Shielding must exhibit continuity. Investigate resistance values in excess of ten ohms per 1000 feet of cable.

2.14 CABLES, LESS THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.
 - .2 Inspect terminations and splices for evidence of overheating and corona.
 - .3 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with NETA standard Table 10.12.
 - .4 Inspect for shield grounding, cable support, and termination.
 - .5 Verify that visible cable bends meet or exceed ICEA and/or manufacturers minimum allowable bending radius.
 - .6 If cables are terminated through window type current transformers, make an inspection to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
- .2 Electrical Tests
 - .1 If required by electrical tests, disconnect all conductors prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order.
 - .2 Perform an insulation resistance test utilizing a megohmmeter with a voltage output of at least 500 volts DC for cables up to 250 volts, and at 1000 volts DC for cables rated from 250 to 600 volts AC. Individually test each conductor with all other conductors and shields grounded. Test duration shall be one minute.
- .3 Test Values
 - .1 Minimum insulation resistance values should be comparable to previously obtained results, but not less than two megohms. Investigate values that differ from other phases by more than 50%.

2.15 CIRCUIT BREAKER TRIP UNITS, THERMAL MAGNETIC

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Record as-found settings.
- .2 Electrical Tests
 - .1 Verify functionality of trip unit by tripping using the trip button of the trip unit, if present.
 - .2 If requested by contract documents, provide primary injection of the circuit breaker trip unit.
- .3 Test Values
 - .1 When not otherwise specified, use manufacturer's recommended tolerances.
 - .2 When critical test points are specified, the relay should be calibrated to those points.

2.16 PANELBOARDS AND MCCS, EITHER BREAKER OR FUSIBLE DISCONNECT (DISTRIBUTION, LIGHTING, EMERGENCY, ETC.)

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Note the position of all circuit breakers or disconnects. Operate all circuit breakers or disconnects to ensure proper mechanical operation. Ensure that all devices are left in the original position.
 - .2 Inspect all wires for evidence of damage, chafing, or pinching in the panel board covers.
 - .3 Check tightness of all connections.
- .2 Electrical Tests
 - .1 Perform insulation resistance tests on the main bus with all breakers open and control wiring disconnected. Energize each phase with the correct test voltage ensuring the opposing two phases and neutral (4 wire only) are grounded. Each test shall occur for a duration of one (1) minute. Electrical equipment rated from 120 volts AC to 250 volts AC shall be tested at 500 volts DC. Electrical equipment rated above 250 volts AC to 600 volts DC shall be tested at 1000 volts DC.
 - .2 If required for electrical testing, disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B –Black, Phase C – Blue, Neutral – White). After testing re-connect equipment and conductors in the original phasing order.
- .3 Test Values
 - .1 Insulation resistance values for bus shall be in accordance with manufacturers published data. In the absence of manufacturers published data, use NETA Standard Table 10.1. (Note: Do not use test voltage levels in NETA Table 10.1) Values of insulation resistance less than this table or manufacturers minimum should be investigated.

2.17 SPLITTER TROUGHS

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Inspect all wires for evidence of damage, chafing, or pinching in the panel board covers.
 - .2 Check tightness of all connections.
- .2 Electrical Tests
 - .1 Perform insulation resistance tests on the main bus. Energize each phase with the correct test voltage ensuring the opposing two phases and neutral (4 wire only) are grounded. Each test shall occur for a duration of one (1) minute. Electrical equipment rated from 120 volts AC to 250 volts AC shall be tested at 500 volts DC. Electrical equipment rated above 250 volts AC to 600 volts DC shall be tested at 1000 volts DC.

- .2 If required by electrical testing, disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing re-connect equipment and conductors in the original phasing order.
- .3 Test Values
 - .1 Insulation resistance values for bus shall be in accordance with manufacturers published data. In the absence of manufacturers published data, use NETA Standard Table 10.1. (Note: Do not use test voltage levels in NETA Table 10.1) Values of insulation resistance less than this table or manufacturers minimum should be investigated.

2.18 TRANSFORMERS, AIR COOLED, SMALL (LESS THAN 167 KVA SINGLE PHASE OR 500 KVA THREE PHASE)

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Inspect core and coil for evidence of insulation breakdown due to excessive heating.
 - .2 Check tightness of all connections.
- .2 Electrical Tests
 - .1 Verify correct secondary voltage phase to phase and phase to neutral after energization and loading.
 - .2 If testing requires cable disconnection, disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order.

2.19 DISCONNECTS (FUSED AND UNFUSED), LESS THAN 750V

- .1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Inspect physical and mechanical condition, including:
 - .1 Blade and Jaw - verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
 - .2 Operating Arm – free movement, break over
 - .3 Operating Mechanism – sprockets, chain, pushrod arms, lubrication.
 - .4 Door interlock – verify door unable to open when switch closed.
 - .2 Inspect fuses if present.
 - .3 Check tightness of all connections.
 - .4 Note position and exercise switch, returning switch to original position.

2.20 DC BATTERY SYSTEMS

- .1 Ensure adequate protective equipment is used during all following tests, which shall include at least the following:
 - .1 Goggles and face shields
 - .2 Acid-resistant gloves
 - .3 Protective aprons
 - .4 Portable or stationary water facilities for rinsing eyes and skin in case of contact with electrolyte
 - .5 Bicarbonate of soda solution, mixed 100 grams bicarbonate of soda to 1 litre of water, to neutralize acid spillage. NOTE - the removal and/or neutralization of an acid spill may result in production of hazardous waste. The user should comply with appropriate governmental regulations.
 - .6 Class C fire extinguisher
 - .7 Adequately insulated tools
- .2 The following protective procedures shall be observed during maintenance:
 - .1 Use caution when working on batteries since they represent a shock hazard.
 - .2 Prohibit smoking and open flames, and avoid activities that increase the chances of arcing in the immediate vicinity of the battery.
 - .3 Ensure that the load test leads are clean, in good condition, and connected with sufficient length of cable to prevent accidental arcing in the vicinity of the battery.
 - .4 Ensure that all connections to load test equipment include appropriate short-circuit protection.
 - .5 Ensure that battery area ventilation is operating per its design.
 - .6 Ensure unobstructed egress from the battery area.
 - .7 Avoid the wearing of metallic objects such as jewellery.
 - .8 Neutralize static build up just before working on the battery by contacting the nearest effectively grounded surface.
 - .9 If installed, ensure that the battery monitoring system is operational.
- .3 Provide the following visual, mechanical, and electrical inspections, noting that all inspections should be made under normal float conditions.
 - .1 Inspect the battery rack/cabinet and anchors for rusting, corrosion, and other deterioration that could affect the battery rack structural or seismic integrity and strength and inspect approximately 10% of the battery rack fasteners for tightness.
 - .2 Perform the following steps for seismic installations.
 - .1 Inspect the battery to ensure an intercell spacer is present between each battery jar.
 - .2 Inspect the intercell spacers in place for deterioration (broken, warped, crumbling, etc.).

- .3 Verify that the space between each of the end-rails and the end battery jars is less than or equal to 3/16" or a value specified by the manufacturer.
- .3 Verify that the rail insulators are in place and in good condition.
- .4 Verify that the electrolyte level of each cell is between the high- and low-level marks imprinted on the cell case. When any cell electrolyte reaches the low-level line, distilled or other approved-quality water should be added to bring the cells to the manufacturer's recommended full level line. Water quality should be in accordance with the manufacturer's instructions.
- .5 Inspect each battery cell jar, cell jar cover, and seals (jar to cover seal, post to cover seal) for deterioration (acid leakage, cracking, crazing-spider web effect, distortion, etc.).
- .6 Examine the plates in each cell for sulfation. NOTE - sulfation can sometimes be detected on the plate edges by shining a light source on the plates, which will reflect off the yellowish sulfate crystals.
- .7 Examine the plates in each cell for the proper color that indicates a fully charged battery based on the manufacturer's information. NOTE - normally, fully-charged, positive plates are coloured a deep chocolate-brown color. Negative plates are normally a medium grey. A horizontal ring of white deposits around the plates and on the inside of the jar indicates hydration. This is a result of the lead sulfate precipitating out of solution after the recharge of an over discharged cell or the recharge of a discharged cell that has not been promptly recharged. Consult your manufacturer's maintenance instructions for further guidelines in this area. If any negative plates are reddish in color, this indicates copper contamination, and the cell should be replaced as soon as practical.
- .8 Examine through the clear battery jar case, the plates, bus bar connection to each plate, and bus bar connection to the post of each battery cell for corrosion and other abnormalities. Inspect the lower part of the post seals and the underside of the cover for cracking or distortion.
- .9 Examine the cell plates, spacers, and sediment space of each cell to determine if any deterioration (warped plates and spacers, lifted cell posts, pieces of plate material that have fallen off, shorted plates, excessive sediment in the bottom of the cell, plates that have dropped lower than the other plates, etc.) has occurred that could affect a cell relative to the rest of the cells in the battery.
- .10 Examine the cell posts of each cell to determine if any of them have grown or lifted to a larger degree than the rest of the posts of the battery. NOTE - the positive plates of lead-acid batteries normally swell or grow with age and use. Most manufacturers claim that 5% growth is the expected maximum limit during the life of the battery.
- .11 Inspect each electrical cell-to-cell and terminal connection to ensure they are clean (no significant corrosion or foreign matter) and the connection surfaces remain coated with a thin layer of anti-corrosion material. If corrosion is noted, remove the visible corrosion and check the resistance of the connection as per item 2.20.5.3 below. NOTE - unless corrosion is cleaned off of battery terminals periodically, it will spread into the area between the posts and the connectors.
- .12 Verify that all cells of the battery remain properly numbered.

- .13 Verify that each battery cell vent, flame arrestors, and dust caps are present and inspect each for damage.
- .14 Examine the general condition of the battery, battery rack and/or cabinet, and the battery room to determine if they are clean and in good order. When excessive dirt is noted on cells or connectors, remove it with a water-moistened clean wipe. Remove electrolyte spillage on cell covers and containers with a solution of bicarbonate of soda mixed with 100 grams of soda to 1 liter of water. Avoid the use of hydrocarbon-type cleaning agents (oil distillates) and strong alkaline cleaning agents, which may cause containers and covers to crack or craze. Do not allow the cleaning compound to enter the cell.
- .15 Inspect for unintentional battery grounds
- .16 Record float voltage measured at battery terminals. When the float voltage measured at the battery terminals is outside of its recommended operating range, it should be adjusted. Nominal float voltage should be as recommended by manufacturer. Maximum float voltage or Nominal Equalize voltage should be as recommended by manufacturer.
- .17 Record charger output current and voltage. Maximum provided voltage from the charger should be as recommended by manufacturer.
- .18 Record ambient temperature and ventilation
- .4 More detailed testing, should include all items above, plus:
 - .1 Check approximately 10% of the battery rack fasteners for tightness.
 - .2 Measure and record the voltage of each cell
 - .3 Measure and record specific gravity of 10% of the cells of the battery if battery float charging current is not used to monitor state of charge.
 - .4 Measure and record electrolyte temperature of 10% or more of the battery cells. When cell temperatures deviate more than 3°C from each other during a single inspection, determine the cause and correct the problem. If sufficient correction cannot be made, contact the manufacturer for allowances that must be taken. NOTE - when working with large multi-tier installations, the 3°C allowable deviation may not be achievable, especially when relating the bottom to top tier temperature measurements. Typically, the deviation limit should be maintained within tiers.
- .5 Most thorough level of testing, to also include all items above, plus:
 - .1 Measure and record specific gravity and temperature of each cell. Specific Gravity should be maintained at 1.215 for the KCR-7 cell. Please note, specific gravity values are based on a temperature of 25°C, and should be corrected for the actual electrolyte temperature and level. For each 1.67°C above 25°C add 1 point (0.001) to the value. Subtract 1 point for each 1.67°C below 25°C.
 - .2 Check all battery rack connection fasteners for tightness.
 - .3 Cell-to-cell and terminal connection resistance. (NOTE – do not take measurements across the cell. This improper action could cause personal injury, damage to the test equipment, and damage the cell.) If resistance measurements obtained are more than 20% above the installation value, or the greater of 20% or 5 micro-ohms above the average value, or if loose connections are noted, torque and re-test.

If retested resistance value remains unacceptable, the connection should be disassembled, cleaned, reassembled, and retested. Typically, this will involve the following steps:

- .1 Clean posts and connectors and apply a thin coat of heated (between 71 and 85°C) no-oxide grease.
- .2 Re-Install existing inter-cell and inter-tier connectors, and hand tighten nuts in accordance with manufacturer's instructions.
- .3 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.
- .4 Refer to IEEE Std. 484-1996 for detailed procedures and IEEE Std. 450-2002 D.2 and Annex F for further discussions.
- .4 Structural integrity of the battery rack and/or cabinet.
- .6 Equalizing Charge
 - .1 An equalizing charge should be given in any of the following conditions:
 - .1 If the voltages measured under item 2.20.4.1 above are deviating from the average value by an amount greater than that recommended by the manufacturer, typically +/- 0.05V for lead calcium batteries.
 - .2 If the specific gravity, corrected for temperature, of an individual cell falls below the manufacturer's lower limit.
 - .3 If any cell voltage is below the manufacturer's recommended minimum cell voltage.

2.21 GROUND ELECTRODE

- .1 Visual and Mechanical Inspection
 - .1 Inspect expose ground conductor and connections.
 - .2 Inspect ground rod viewport.
 - .3 Dig to expose to underground ground rods and connections, review condition
 - .4 Ensure proper connections are made to all exposed switchgear, structures, transformers, fences, gates, and other items per OESC section 36.
- .2 Electrical Tests
 - .1 Perform fall of potential or alternative test in accordance with IEEE Standard 81 on the main grounding electrode or system.
 - .2 Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- .3 Test Values
 - .1 The resistance between the main grounding electrode and ground should be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner. (Reference ANSI/IEEE Standard 142)
 - .2 Investigate point-to-point resistance values which exceed 0.5 ohm.

Part 3 Field Taping Procedure

3.1 MATERIALS FOR TAPING

- .1 Use acceptable high voltage acceptable filler such as Kearney Air Seal or 3M Scotchfil Electrical Insulation Putty. Standard duct seal is not acceptable.
- .2 Use an acceptable high voltage insulating tape such as Scotch 130C.

3.2 APPLICATION

- .1 Elongate insulating tape 10 to 25 percent during application to ensure a smooth, tight fit. On pads elongate corners only.
- .2 Should a tape roll expire, start the new role by overlapping the previous end by 1/2 turn.
- .3 Apply one layer of insulating tape, lapping as specified in the taping chart; overlap any pre-insulation by 1-1/2 inches.

3.3 APPLICATION ON JOINTS WITH HARDWARE

- .1 Clean area of dirt and foreign matter.
- .2 Apply filler over bare conductor and hardware to cover and smooth out the surface. Blend contour into pre-insulation surfaces. Cover conductors and hardware with at least 1/8 inch of filler.
- .3 Apply pad(s) of insulating tape of sufficient width to overlap pre-insulation by one inch or more.
- .4 Apply one layer of insulating tape, lapping as specified in the chart, overlapping any pre-insulation or pads by 1-1/2 inches.

3.4 TAPING CHART

Rated kV of Equipment	Taping Chart		Insulating Tape		
	Pre-insulation or Pad Overlap Min. Inches	Lap of Tape	Min. Layers	No. of Pads	
Up to 5	1-1/2	1/2	1	1	
Up to 15	1-1/2	2/3	2	2	
Up to 27	1-1/4	2/3	3	3	
Up to 46	1-1/4	2/3	4	4	

3.5 DEFINITIONS

- .1 Joint: Area to be covered with tape which consists of bare conductor and 1-1/2 inches of any pre-insulation next to the bare conductor.

- .2 Pre-Insulation: Any insulating tape applied which is wider than one inch, which includes a band of tape consisting of one or more turns wrapped directly on top of each other.
- .3 Layer: Insulating tape, 1 inch wide, wrapped from one end of the joint to the other (or to a pad) so each succeeding turn laps the previous turn by the amount specified in the chart.
- .4 Overlap: A specified distance measured along the pre-insulation starting from where the pre-insulation ends and the exposed conductor begins.

Part 4 Execution

4.1 GENERAL REQUIREMENTS

- .1 Keep working area clean and safe, all testing and maintenance areas are to be cleaned after usage.
- .2 The contractor is responsible for verifying all types of distribution equipment to be tested, and ensuring they have the proper equipment to test equipment, especially proprietary trip units, relays, controllers, and other similar items.

4.2 EQUIPMENT TO BE TESTED BY SPECIALIST TESTING AGENCY

- .1 Switchgear Assemblies, Greater Than 750v
- .2 115000V Circuit Switcher
- .3 Fuses, Greater Than 750v
- .4 Circuit Breakers, Vacuum, Greater Than 750v
- .5 Circuit Breakers, Low-Voltage Molded-Case Circuit Breakers
- .6 Discrete Protective Relays
- .7 Instrument Transformers, Both Cts And Pts, Applied To Circuits Greater Than 750v
- .8 Lightning Arrestors, Greater Than 750v
- .9 Cables, Greater Than 750v
- .10 Transformers, Medium Voltage, Liquid Filled
- .11 Cables, Less Than 750v
- .12 Circuit Breaker Trip Units, Thermal Magnetic
- .13 Panelboards And Mccs, Either Breaker Or Fusible Disconnect (Distribution, Lighting, Emergency, Etc.)

- .14 Splitter Troughs or Junction Boxes
- .15 Transformers, Air Cooled, Small (Less Than 167 Kva Single Phase Or 500 Kva Three Phase)
- .16 Disconnects (Fused and Unfused), Less than 750v
- .17 Grounding Resistors or Inductors
- .18 Grounding Electrodes
- .19 Battery Chargers and Battery Banks

4.3 EQUIPMENT TO BE TESTED BY ELECTRICAL GENERALISTS

- .1 Overhead Tower Structure, Greater Than 750v

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 337116.01 – Electrical Pole Lines and Hardware.
- .2 Section 260544 - Installation of Cables in Trenches and in Ducts.
- .3 Section 260522 - Connectors and Terminations

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK90 Cable.
 - .2 CAN/CSA-C49.1-M87(R1993), Round Wire, Concentric Lay, Overhead Electrical Conductors.
 - .3 CAN/CSA-C68.3-97 (R2006) - Shielded and Concentric Neutral Power Cables Rated 5-46 kV
- .2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)
 - .1 NEMA WC3-1992/ICEA S-19-81, Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - .2 NEMA WC7-1992/ICEA S-66-524, Cross-Linked Polyethylene Wire and Cable for Transmission and Distribution.
 - .3 ICEA S-96-659 Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy

Part 2 Products

2.1 PRIMARY 115,000V BUS PIPE

- .1 Bus pipe must be aluminum Alloy 6063-T6, schedule 40
- .2 Seamless bus pipe must be used, and minimal joints are permitted based on the use of 40foot piping.
- .3 All pipes must be a minimum 40mm in diameter.
- .4 All bus pipe connectors must be sized to match bus pipe and must be rated for the purpose of supporting and interconnecting the bus pipe.

2.2 PRIMARY OVERHEAD CONDUCTORS 115,000 V

- .1 ACSR Bare overhead conductor to Can/CSA C61089.
- .2 Size: As indicated on drawings.
- .3 Ultimate tensile strength (UTS): 37.4 kN.
- .4 Tension Requirements (Initial Conditions):
 - .1 Minus 20 degrees Celsius: 10.9 kN
- .5 Acceptable manufacturers: General Cable, Pirelli, or approved equivalent

2.3 GUARD WIRE 115,000 V OVERHEAD LINE

- .1 CAN/CSA-G12
- .2 Minimum diameter of 6.35mm
- .3 Ultimate tensile strength (UTS): 12.4 kN.
- .4 Tension Requirements (Initial Conditions):
 - .1 Minus 20 degrees Celsius: 2 kN
- .5 Acceptable manufacturers: General Cable, Pirelli, or approved equivalent

2.4 AIRGUARD POWER CABLE (1001 - 15000 V)

- .1 Cable: to CAN/CSA-C68.10, CSA C22.2 No.230, CSA – C96.1
- .2 Conductor: Class B compact concentric stranded soft drawn annealed copper, sized as indicated on drawings.
- .3 Insulation: Natural high dielectric strength EPR-based insulation, 133% rated.
- .4 Conductor Shield: Extruded thermosetting semi-conducting shield which is free stripping from the conductor and bonded to the insulation.
- .5 Insulation shield: Extruded thermosetting semi-conducting shield with controlled adhesion to the insulation.
- .6 Metallic Shield: Helically applied non-magnetic copper tape over the insulation shield with a minimum overlap of 15%. A Mylar ribbon must be longitudinally applied under the copper tape shield for phase identification.
- .7 Grounding Conductors: Bare stranded copper conductor, one in each interstice.

- .8 Assembly: Phase identified shielded conductors cabled with fillers and grounding conductors, forming a firm and cylindrical cable core. Binder tape to be applied to maintain core symmetry and mechanical stability.
- .9 Mechanical Protection: High strength and high crush resistant Airbag Layer extruded over the core assembly.
- .10 Chemical protection: A layer of Drylam which consists of aluminum tape and a chemical resistant extruded polymer layer must be applied.
- .11 Jacket: Sunlight-resistant, PVC, colored red.
- .12 Acceptable manufacturers: Prysmian, or approved equivalent

2.5 NON-SHIELDED JUMPER CABLE 15,000V

- .1 Cable: to ICEA S-96-659.
- .2 Copper circuit conductors, size and number as indicated.
 - .1 Conductor to be flexible, rope stranded, annealed, uncoated copper.
- .3 Copper Shield: Nylon semi-conducting tape.
- .4 Insulation: Heat, moisture, and ozone resistant ethylene propylene rubber (EPR) 90°C per ICEA S-96-659 (NEMA WC 71), part 4.
- .5 Acceptable manufacturers: BICC, Phillips, Pirelli, or equivalent
- .6 Note: this cable is only to be installed from ceiling IPS through free air down to transformer primary bushings. Cable must not be near any grounded metal or other installations at other than rated voltage.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conductors on pole lines in accordance with Section 337116.01 – Electrical Pole Lines and Hardware.
- .2 Install cables in ducts and manholes in accordance with Section 336573 – Concrete encased duct banks and manholes.
- .3 Install cables per manufacturer’s instructions.
 - .1 Splices are not permitted unless specifically noted in Tender Documents.
 - .2 Bend radius for to the greater or the manufacturer’s recommendations or as allowed by the Ontario Electrical Safety Code.

- .4 Apply Arc Proofing Tape and secure with Glass Cloth Electrical Tape to all cables that are not protected by conduit, cable tray, direct burial, or termination materials.
 - .1 Use manufacturer's recommendations, and in addition;
 - .2 Clean cable sheath and smooth surface contours with electrical insulation putty
 - .3 Apply half lapped arc proofing tape over full length of exposed cable
 - .4 Secure arc flash tape with a 150mm banding of half lapped glass cloth electrical tape at each end to hold the arc flash tape in place.
- .5 Test conductors as per Section 260510 – Electrical Testing

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 65-03, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

- .1 Irreversible Compression type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper or copper alloy sized to fit copper conductors and aluminium allow sized to fit aluminium conductors as required.
 - .1 Use 2 hole NEMA long barrel compression lugs for all cable connections.
- .2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, flexible conduit, as required to: CSA C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of conductive Oxide-Inhibiting joint compound on aluminium conductors prior to installation of connectors. Carefully remove all compound from any insulating surfaces.
- .2 Install Irreversible Compression type connectors with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .3 Cover all splices with shrink insulation rated for minimum 600V similar to Burndy Shrink. Shrink insulation shall not require torches or open flame to activate, just standard industrial heat guns.
- .4 Install fixture type connectors and tighten. Do not over tighten. Replace insulating cap.
- .5 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 260544 - Installation of Cables in Trenches and in Ducts.
- .2 Section 260534 - Conduits
- .3 Section 260536 - Cabletroughs.

1.2 REFERENCES

- .1 CSA C22.2 No. 0.3-2001, Test Methods for Electrical Wires and Cables.
- .2 CSA C22.2 No. 131-2007, Type TECK 90 Cable.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 - Submittal Procedures.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 OPTICAL-FIBER CABLE

- .1 Description: Multimode, 50/125-micrometer, nonconductive, tight-buffer, optical-fiber cable.
 - .1 Comply with ICEA S-83-596 for mechanical properties.
 - .2 Comply with TIA-568-C.3 for performance specifications.
 - .3 Comply with TIA-492AAAA-A for detailed specifications.
 - .4 Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - .1 General Purpose, Nonconductive: Type OFNR or Type OFNP.
 - .5 Conductive cable shall be aluminum-armored type.
 - .6 Maximum Attenuation: 3.5 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 - .7 Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

- .2 Jacket:
 - .1 Jacket Color: Aqua for 50/125-micrometer cable.
 - .2 Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
 - .3 Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 1000 mm.

2.3 OPTICAL-FIBER CABLE HARDWARE

- .1 Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - .1 Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- .2 Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- .3 Cable Connecting Hardware:
 - .1 Comply with Optical-Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA-568-C.3.
 - .2 Quick-connect, simplex and duplex, Type ST connectors. Insertion loss of not more than 0.75 dB.
 - .3 Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.4 SWITCHBOARD CONTROL AND METER WIRING

- .1 Conductors: stranded.
 - .1 Minimum size: 14 AWG for general purpose applications
 - .2 Minimum size: 10 AWG for current transformer secondary applications
- .2 Copper conductors: size as indicated
- .3 Type SIS with 600 V 90°C rated insulation of chemically cross-linked thermosetting polyethylene material XLPE.

Part 3 Execution

3.1 CABLES TO BE USED

- .1 All 120/208/600V power cables to be RWU90 installed in EMT conduit unless indicated otherwise.
- .2 All Battery interconnect cables to be 600V TEW CU.

3.2 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In cabletroughs in accordance with Section 260536.
 - .2 In underground ducts in accordance with Section 260544.
 - .3 In conduits in accordance with Section 260534.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for connectors and terminations.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 41-2007, Grounding and Bonding Equipment.
 - .2 CSA C22.2 No. 65-2003, Wire Connectors
- .2 ANSI/IEEE 386-1985, Separable Insulated Connector Systems for Power Distribution Systems above 600V.
- .3 IEEE Std. 404, Cable Joints and Splices
- .4 ANSI C119.4, Standard for Copper and Aluminum Conductor Connectors

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 – Submittal Procedures

1.4 CERTIFICATES

- .1 Obtain inspection certificate of compliance covering high voltage stress coning from inspection authority and include it with maintenance manuals.

Part 2 Products

2.1 CONNECTORS

- .1 Irreversible compression type wire connectors with current carrying parts of copper or copper alloy sized to fit copper conductors and aluminium alloy sized to fit aluminium conductors as required.
 - .1 Use 2 hole NEMA long barrel compression lugs for all cable connections.

2.2 STRESS CONES

- .1 Provide stress cones for all 15,000V cable terminations. Stress cones are to be installed as close to the compression connection points as possible.
 - .1 Acceptable manufacturers: 3M or approved equivalent

2.3 IPS BUS TERMINATIONS

- .1 All terminations of IPS bus to equipment terminals must be completed using appropriately rated IPS Terminals furnished with a minimum 4 hole bolt pattern.
- .2 Provide expansion fittings as required as per manufactures recommendations, but in no case is bus lengths to exceed 60feet without the installation of expansion fittings.
- .3 End caps are to be installed where open ends of IPS bus are exposed.
- .4 Where two sections of IPS bus is joined together, appropriately rated bus couplers are to be installed.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of conductive Oxide-Inhibiting joint compound on aluminium conductors prior to installation of connectors. Carefully remove all compound from any insulating surfaces.
- .2 Install Irreversible Compression type connectors with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .3 Install stress cones, in accordance with manufacturer's instructions.
- .4 Install IPS connectors and terminations in accordance with manufactures instructions.
- .5 Bond and ground as required to CSA C22.2No.41.
- .6 Compression lugs are to be provided for connections of #8 AWG or larger.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 260500 - Electrical General Requirements.
- .2 Section 323113 – Chain Link Fences and Gates

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.
 - .2 Canadian Standards Association (CSA)
 - .1 CSA C22.2No.0.4-04 (R2013), Bonding and Grounding of Electrical Equipment

Part 2 Products

2.1 MATERIALS

- .1 Rod electrodes: copper clad steel, 19 mm dia by 3 m long.
- .2 Conductors: bare, stranded, soft annealed copper wire, size 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.
- .3 Conductors: pvc insulated coloured green, stranded soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .4 Conductors: pvc insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.
- .5 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates, vault doors.
- .6 Bolted removable test links.
- .7 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings,
 - .2 Protective type clamps,
 - .3 Bolted type conductor connectors,

- .4 Thermit welded type conductor connectors,
 - .5 Bonding jumpers, straps,
 - .6 Pressure wire connectors.
- .8 Wire connectors and terminations: to Section 260522 - Connectors and Terminations.

Part 3 Execution

3.1 GROUNDING INSTALLATION

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.2No.0.4, design drawings and requirements of local authority having jurisdiction.
- .2 Ground fences to station ground grid.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process, or permanent compression connectors to ANSI/IEEE 837.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG bare copper cable for taps on risers from main ground bus to equipment.
- .8 Deep well ground rods must be #4/0AWG, encased in Conducrete, and extending to a depth of 160meters below grade. Each deep well ground rod must be tested following their installation and the test results provided to the engineer immediately following testing. Contractor to carry **a cash allowance of \$172,331.00 plus applicable taxes** to hire the services of SAE to complete the installation of all four deep well ground rods. If all four deep well ground rods are not required a credit for each ground rod not install must be provided.
 - .1 SAE Contact information:
Craig Hughes
19 Churchill Drive
Barrie, Ontario
L4N 8Z5
705-733-3307
- .9 Use tinned copper conductors for aluminum structures.
- .10 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

- .1 Install ground rod electrodes, driven vertically so the top of the rod is level with the grounding grid conductors at a depth of 0.3m. Make grounding connections to station equipment.
- .2 The ground electrode horizontal conductors are to be 2/0 AWG bare copper conductors and should be laid as per the substation electrode drawing. If a grid conductor's path is blocked by a concrete pad or another structure, minor adjustments in routing are acceptable; however, if the whole path is blocked, then circle the obstruction with a conductor, fasten the ends together and connect to rebar within the obstruction, and attach all obstructed grid conductors onto the circled conductor.
- .3 Install ground rod electrodes as indicated in drawings.
- .4 Install at least one Ground Electrode Inspection Box inside the high voltage substation to allow easy access to the actual grid.
- .5 The substation fence perimeter can be any size or shape but all segments, extensions, protrusions, etc. must be at least 1 m within the outside perimeter of the ground grid. The swinging gate should swing outward; therefore, the ground grid should be extended in a loop at least 1 m past the outer extremity of the gate during its travel.

3.3 HIGH VOLTAGE SUBSTATION EQUIPMENT GROUNDING

- .1 Install grounding connections as indicated to typical station equipment including:
 - .1 Sky wire, neutral, gradient control mats.
 - .2 Non current carrying parts of:
 - .1 transformers, motors, circuit breakers, current transformers, frames of gang-operated switches and fuse cutout bases.
 - .2 Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
 - .3 Meter and relay cases.
 - .4 Any exposed building metal, within or forming part of station enclosure.
 - .5 Sub-station fences.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Any gang-operated switch shall be connected to a metallic gradient mat with No. 2/0 AWG by two separate conductors. The gradient control mat shall have a dimension of approx. 1.2m x 1.8m and shall be positioned on top of 0.150 m of clean crushed 3/4" stone.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections from switchgear grounding bus to existing grounding electrode with #2/0 stranded bare copper cable.

- .2 Install grounding connections from switchgear grounding bus to new perimeter grounding bus with #2/0 stranded bare copper cable. Use existing slab conduit if possible, or new overhead conduit, or if permitted by client, across floor slab while mechanically protected with ¼” thick galvanized steel with no-slip tread pattern bent at roughly a 140° angle, mounted as flush with the floor as possible and securely fastened to concrete floor.

3.5 NEUTRAL GROUNDING

- .1 Connect transformer neutral to one side of 3984V resistor, the other side of the resistor being connected directly to main station ground. Use wire colours as per OESC.

3.6 CABLE SHEATH GROUNDING

- .1 Bond single conductor, metallic sheathed cables together at one end only.
- .2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.
- .3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260510 - Electrical Testing.
- .2 The station ground grid resistance must be measured after completion of construction and changes if required shall be made to ensure that the design resistance was achieved. Use the ‘Fall of Potential’ method as per IEEE 81-1983, ‘IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System’ to satisfy OESC Rule 36-304 (4).
- .3 The ‘Fall of Potential’ measurement steps should be from 10 to 90% percent of the full distance at 5% increments. The full distance from C1 to C2 must be at least 12 times the longest dimension across the ground grid, requiring lead lengths typically at least 150m. The ground straps between the building and external substation should be lifted (unless required as part of the design) to remove the influence of the building upon the ground electrode resistance. Ensure and provide documentation that a proper 4 probe measurement device is being used to remove the error introduced by the C1/C2 lead lengths. The resultant readings should be tabulated and graphed to show the point of inflection to determine the actual station resistance.
- .4 Please note that this measurement has the potential to be hazardous during live operation of the substation (in the event of a fault) and should only be performed if safe conditions can be arranged, preferably while the station is de-energized.
- .5 Perform test before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 260527 – Primary Grounding
- .2 Section 262818 – Ground Fault Protection Equipment

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green, type RW90.
- .3 Grounding resistor, and alarming and control system: as per Section 262818 - Ground Fault Equipment Protection.

2.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 2/0 AWG copper conductors for connections to electrodes.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

2.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral secondary system.

2.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list.

- .1 Service equipment, transformers, switchgear, duct systems, frames of motors, starters, control panels, building steel work, distribution panels, outdoor lighting.

2.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of outdoor walking enclosure's electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.

2.6 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, intercommunication systems as indicated.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install high resistance grounding unit in accordance with Section 262818 Ground Fault Protection Equipment.
- .2 Run ground wire in conduit when located outside of protected environment like switchgear enclosure.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.

END OF SECTION

Part 1 General

1.1 NOT USED.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended, and set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 013300 - Submittal Procedures.

1.2 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

1.3 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

1.4 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

Part 2 Execution

2.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

2.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.

- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

2.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 260500 - Electrical General Requirements.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.1-1998, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.3 CONDUIT BOXES

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

2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.5 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.

- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.6 SERVICE FITTINGS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 Provide correct size of openings in boxes for conduit and armored cable connections. Reducing washers are not allowed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-1977(R1999), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R1999), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-M91(R1999), Flexible Nonmetallic Tubing.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Liquid Tight flexible metal conduit to CSA C22.2 No. 56-1977(R1999)
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 EMT: to CSA C22.2 No. 83-M1985(R1999)
- .5 Use EMT conduit for all work except for the following usages:
 - .1 Connections to motors, generators, vibrating equipment, and removable control devices shall be made with Teck cables indoors or outdoors, or flexible conduit indoors, or liquid-tight flexible conduit outdoors.
 - .2 Teck cables shall be used where shown on the drawings, and may be used in other areas, subject to the approval of the engineer.
 - .3 Unless noted otherwise, use rigid PVC for exterior underground, duct banks, or within concrete slabs.
- .6 All conduits to be rigid galvanized conduit to be installed surface throughout the project.

2.2 CONDUIT FASTENINGS

- .1 One hole malleable iron straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1 m oc.

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

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90°, 45° and 22.5° bends are required for 25 mm and larger conduits.
- .3 Factory "ells" are not permitted to be modified.
- .4 Ensure conduit bends other than factory "ells" are made with an approved bender. Making offsets and other bends by cutting and rejoining 90°, 45° and 22.5° bends are not permitted.
- .5 Connectors and couplings for EMT must be steel and of the compression type. Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Surface mount conduits except where otherwise noted.
- .3 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .4 Mechanically bend steel conduit over 19 mm dia.
- .5 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .6 Install fish cord in empty conduits.

- .7 Seal conduits where entering into buildings from underground conduit systems to block entrance of moisture and gases.
- .8 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.4 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage, typically at least a slope of 1:400.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 – Submittal Procedures.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 126-M91 (R1997), Cable Tray Systems
 - .2 CAN/CSA C22.2 No. 126.1-2009, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA) standards
 - .1 NEMA VE 1-2009, Metal Cable Tray Systems.
 - .2 NEMA VE 2-2006, Cable Tray Installation Guidelines

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 013300 – Submittal Procedures.
- .2 Provide cabletrough ratings and actual installation details along with information on the proposed suspension system. Include:
 - .1 Type, depth, width, and unit span length.
 - .2 Fitting types for turns, crossings, and elevation changes.
 - .3 Suspension details, including rod and support sizes and ratings
 - .4 Dimension drawing showing proposed cabletrough layout. Include:
 - .1 Elevations
 - .2 Vertical and horizontal changes in directions
 - .3 Clearances (vertical and horizontal) finished floor.
 - .4 Support types and spacing.
 - .5 Penetration of Floors and Fire rated walls.
 - .6 Location of expansion joints.
 - .5 Certificate data to verify compliance with loading and deflection data.

Part 2 Products

2.1 CABLETROUGH

- .1 Aluminum ladder-type cabletroughs and fittings: to NEMA VE 1.

- .2 Span length up to 6m may be used, however, minimum load rating to be 149kg/m or per the intended load. Note that contractor to confirm the final cable loading intended for each tray is within 75% of the rated load rating of the tray.
- .3 Tray: minimum 1,000 mm wide with depth of 100 mm or as detailed in drawings.
- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
 - .1 Inside Radii on fittings: 1200 mm min for cables 15kV or higher, 300mm min for cables 1kV or lower
- .5 Supply and install barriers of sheet steel with a minimum thickness of 1.34mm in cabletroughs if shown on drawings, or if different voltages installed in the same cable trough and any insulation systems are lower than the highest voltage.
- .6 Each straight section and fitting shall be furnished with pre-punched holes to accept the splice plate fastener.
- .7 Manufacturer:
 - .1 Thomas and Betts H-Style.
 - .2 Eaton B-Line.
 - .3 Approved equal.

2.2 SUPPORTS

- .1 Provide Hot-Dipped Galvanized Steel supports as recommended by manufacturer using either:
 - .1 Cantilever Support brackets,
 - .2 Trapezes,
 - .3 Strut Supports,
 - .4 Individual rod suspensions, or
 - .5 Rigid frames, towers and pedestals.
- .2 Provide supports as required, ensuring final weight of assembly and cables is adequately supported taking into consideration additional seismic loads.
- .3 Provide at least one support per length of span, typically mounted $\frac{1}{4}$ down the length of the span, rather than directly under the splice plates.
- .4 Support cabletrough on both sides with provisions for securing hold-down clamps or fasteners to the cable trough.
- .5 When a dropout fitting is located at the end of a run, the cabletrough shall be supported at that point.
- .6 Provide additional supports for future cabletrough, where indicated on drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide and install complete cabletrough system. Contractor to determine exact cabletrough routing from site conditions and include any turns or elevation changes required to avoid interference with other systems.
- .2 Changes in direction or width shall be mechanically continuous and accomplished by use of fittings.
- .3 Expansion and contraction joints shall be provided in straight runs of cabletroughs where 25mm or greater lateral movement may be expected, or to coincide with building expansion joints.
- .4 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough by means of cable clamps or cable ties.
 - .1 Fasten cables at 450mm spacing on vertical cabletrough runs.
 - .2 Fasten cables at 1.5m centers on horizontal cabletrough runs.
- .4 Identify cables every 30 m with size 2 nameplates in accordance with Section 260500.
- .5 Provide and install a continuous minimum # 6 bare copper bond conductor (contractor to adjust the sizing based on the largest feeder ampacity within the trough) for all cabletroughs, to be bonded to the building system ground.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 312310 - Excavating, Trenching and Backfilling.
- .2 Section 336573 - Concrete Encased Duct Banks and Manholes
- .3 Section 260500 - Electrical General Requirements.
- .4 Section 260514 - Power Cable 1001-115,000 V

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

Part 2 Products

2.1 CABLE PROTECTION

- .1 All duct banks are to be encased in 75mm of concrete on all sides of duct bank as indicated in design drawings.

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

Part 3 Execution

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.2 MARKERS

- .1 Mark cable every 150 m along cable runs and changes in direction.
- .2 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .3 Install concrete type markers.
- .4 Lay concrete markers flat and centered over cable with top flush with finish grade.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260510 - Electrical Testing.
- .2 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
- .3 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials, components, cabinets, instruments and installation for metering and switchboard Instruments.
- .2 Text to complete Section 261318 – Primary Switchgear.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 260500 - Electrical General Requirements.

1.3 REFERENCES

- .1 Canadian Standards Association, (CSA International)
 - .1 CAN3-C17-M84(R1999), Alternating - Current Electricity Metering.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 - Submittal Procedures.
- .2 Indicate meter, outline dimensions, panel drilling dimensions and include cutout template.
- .3 Include complete wiring diagrams for all existing and new wiring from instrument transformers through all terminal blocks, to digital metering system. Ensure all wiring numbers are unique and logically assigned.

1.5 WARRANTY

- .1 The manufacturer to warrant the meters for three (3) years from the acceptance date.

1.6 CASH ALLOWANCE

- .1 Contractor to carry a cash allowance of **\$150,000** for the services of Rodan, to complete commissioning of Independent Electricity System Operator (IESO) utility meters. Switchgear manufacture must carry cost to supply and install all potential transformers and current transformers. Rodan will only complete commissioning of Utility Meters and supply Utility meters and bases.

Part 2 Products

2.1 DIGITAL METERING SYSTEM (DMS)

- .1 Main incoming 6.9kV metering will be provided by Schneider Electric ION8650A supplied by others.
- .2 Each 6.9kV feeder is to be equipped with a polyphase, digital electrical meter, capable of performing the following measurements:
 - .1 Power, Energy, and Demand
 - .1 Voltage and Current per phase/neutral/ground; max, min, average, unbalance
 - .2 Power: real, reactive, apparent, power factor, frequency
 - .3 Energy: bi-directional, total, import, export, net
 - .4 Demand: block, rolling block, thermal, predicted
 - .2 Power Quality
 - .1 Sag/Swell monitoring
 - .2 Harmonics: individual, even, odd, total up to 63rd
 - .3 Sampling rate, maximum samples per cycle, 512
 - .4 Transient detection, 5MHz
 - .5 Flicker
 - .3 Logging and Recording
 - .1 Minimum memory capacity 32MB
 - .2 Min/max logging for any parameter
 - .3 Timestamp resolution in seconds, 1ms
 - .4 Historical trend information via front panel display
 - .5 Adjustable setpoints
 - .4 Communications and I/O
 - .1 IEC61850
 - .2 RS-232 ports, 1, for local programming
 - .3 RS-485 ports, 1, with Modbus RTU slave protocol
 - .4 Ethernet ports, 1, 10/100 Base-T, Ethernet TCP/IP
 - .5 Digital inputs, 8, configurable for various alarms
 - .6 Relay outputs, 3, configurable for various alarms
 - .7 KYZ solid state outputs, 1
 - .8 Analog output, 2, configurable for various parameters
 - .9 Embedded Web Server
 - .5 Revenue Metering & Standards
 - .1 ANSI C12.16 accuracy compliant
 - .2 ANSI C12.20 0.2 compliant, Class 10 & 20
 - .3 Instrument Transformer Correction
- .3 5 Amp, 120 Volt standard input
- .4 Device shall be two part unit, allowing current and voltage input portion to be placed at the back of the cubicle, and readout or faceplate to be mounted on door of cubicle for easy access.
- .5 Acceptable Products:

- .1 Schneider Electric (PML) 7650

2.2 TEST AND SHORTING TERMINAL BLOCKS

- .1 Provide and install Shorting Terminal Blocks in the secondary circuits of all current transformers associated with the meters, if not already present.
 - .1 Standard of acceptance:
 - .1 Bussman KUXSC
 - .2 GE EB-27

Part 3 Execution

3.1 INSTALLATION - GENERAL

- .1 Make connections in accordance with manufacturer's diagrams. Ensure connections across a hinged opening are completely protected by flexible plastic protective spiral wrap and are pre-flexed and arranged to ensure wiring does not get pinched in the door or impinge upon terminal blocks or other devices.
- .2 Connect meter cabinets to ground.
- .3 Locate meters within 9 m of instrument transformers. Use 53 mm conduit for interconnections.
- .4 All voltage sensing connections shall be made with 2A fuses, or sized per manufacturer's recommendations.
- .5 Meters must be powered from an auxiliary power supply, and not powered from the same potential transformers feeding the voltage sensing inputs.

3.2 INSTALLATION IN SHOP

- .1 Install instrument transformers, and accessories in control compartment of switchboard.

3.3 SETUP AND COMMISSIONING

- .1 Select and program meter with correct system and control parameters.
- .2 Select and program meter with typical thresholds for alarms, typical trending values, and other advanced system parameters. Typical parameters values would have to be modified for the specifics of each installation area but would typically include the following:
 - .1 Trend every 15 minutes on typical system parameters such as phase and average amps, volts, kW, kVA, PF, etc.
 - .2 Alarm on surges or sags outside of acceptable CAN/CSA 235 normal voltage limits.
 - .3 Alarm and save waveforms for transients outside of acceptable CAN/CSA 235 extreme voltage limits.

- .4 Alarm on THD's outside of normal limits, typically 20% for current and 5% voltage, but set per the location installed
- .5 All setup parameters for communications and I/O, including scaling for analog I/O and logical mapping for digital I/O
- .6 Memory should be set on a first-in first-out configuration
- .3 Provide complete list of initial programming setup values to the client for review and acceptance.

3.4 FIELD QUALITY CONTROL

- .1 Megger all wiring with meter disconnected.
- .2 Conduct tests in accordance with Section 260500- Electrical General Requirements and in accordance with manufacturer's recommendations.
- .3 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .4 Verify correctness of connections, polarities and calibration of instrument transformers, correct scaling of meters, and acceptable inputs or outputs from transducers, signal sources, and electrical supplies.
- .5 Communication outputs of the relay shall be tested and proved to be working before acceptance by the Owner, even if meters are not connected to networking at time of installation.
- .6 Perform tests to confirm correct calibration.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Section 260500 - Electrical General Provisions.
- .2 Section 013000 – Submittals and Record Drawings
- .3 Section 261318 – Primary Switchgear

1.2 WORK OUTLINE

- .1 The work in this section includes fabrication, assembly, delivery, installation, field assembly, connection, supervision of related trades, on-site testing, commissioning and warranty of the systems components, as outlined in this specification and as indicated on the drawings.
- .2 Installation, assembly, and field connections include all interconnecting power, control and instrumentation wiring to terminals within the system.
- .3 Programming and commissioning of Control Systems, HMI and Power Monitoring System.
- .4 Manufacturer certified service representative to provide start up, commissioning and training for each system.

1.3 OPERATIONS AND MAINTENANCE DATA

- .1 Provide separately bound operation and maintenance manual for the HMI system.
- .2 Include:
 - .1 Complete set of approved shop drawings.
 - .2 Parts list with catalogue numbers for all components.
 - .3 Operation and maintenance instructions for each component and for the complete system.
 - .4 Schematic diagrams, indicating all interconnections between equipment.
 - .5 Detailed wiring diagrams for all wiring within the control system, including power, control, instrumentation, and communications. Ensure all wiring numbers are unique and logically assigned.
 - .6 Narrative overview of the complete systems sequence of operation, including all interrelationships with other systems, devices and controls.
 - .7 Certified copy of set up, testing, and commissioning results.
 - .8 Complete set of as-built drawings in both paper and electronic form (.PDF and .DWG).
 - .9 Complete set of control and programming files for all digital devices in both paper and electronic form (.PDF and the file's native formats).
 - .10 All software and licensing required to develop the HMI programming
- .3 Two copies of the manuals listed above shall be submitted prior to Demonstration and Training.

1.4 INSTRUCTION

- .1 Instructions shall only take place after testing and commissioning of the systems is completed, and all operation and maintenance data is submitted to the satisfaction of the Engineer. The Contractor shall provide the services of qualified service representatives for the following training:
 - .1 A minimum period of one day, to instruct the owner's operating personnel in the correct operation and maintenance of the HMI system.
 - .2 One month after the initial courses, provide the following:
 - .1 A 2 hour refresher review on site to instruct the owner's operating personnel in the correct operation and maintenance of the HMI system, including the use of IEC 61850 programming, and review and correct any issues they were noted with the system.

1.5 SITE TESTING AND COMMISSIONING

- .1 Engineer must be notified two weeks prior to any testing.
- .2 Prepare testing procedure and schedule indicating all tests to be performed. Submit to Engineer for review three weeks before testing.
- .3 Test and commission system components and submit to the Engineer a detailed list of sequence of operation indicating test had been verified. At completion of testing and commissioning, duplicate all procedures in the presence of the Engineer. Correct all noted deficiencies to the satisfaction of the Engineer.
- .4 Test and commission the control and instrumentation equipment and demonstrate the overall performance of the complete system in the presence of the Engineer.
- .5 As a minimum, the following steps are required during the testing and commissioning period.
 - .1 Submit typed testing and commissioning forms customized for every typical type of device applied within the system for review by the Engineer. Forms to be modified to the satisfaction of the Engineer.
 - .2 Testing and commissioning shall not commence until all systems are fully operational.
 - .3 Test and commission the system components and complete all forms noted above, and submit to the Engineer for review. All forms shall be included in the final submission of the operation and maintenance manuals.
 - .4 After all of the systems have been satisfactorily commissioned, repeat all testing and commissioning procedures in the presence of the Engineer.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 013300.
- .2 Shop drawings to include, but not limited to:
 - .1 Control and instrumentation equipment
 - .2 Enclosure type and dimensions
 - .3 Description of alarm functions
 - .4 Description of control functions

- .5 Set-point description
 - .6 System schematic showing interconnection of all components
 - .7 Installation drawings and diagrams indicating all interconnections between equipment. Drawing shall include identification numbers for all terminal blocks in all equipment. This shall also be submitted in electronic form.
 - .8 All electronic files for the relays including ladder logic, annotation files, and any other files required for communication with the HMI system shall be supplied.
- .3 Each shop drawing submission shall include a cover letter identifying all changes and deviations from contract drawings and specifications.
- .1 If shop drawings comply fully with contract documents, Contractor shall state “This shop drawing submission complies fully with contract drawings and specifications”.

1.7 CO-ORDINATION

- .1 Installation of instrumentation and control equipment to be coordinated with the work of other trades to ensure proper installation and wiring.

1.8 TENDER DRAWINGS

- .1 The purpose of the drawings is to show the general requirements for the control system and general overview of the method of implementing the specified sequence of operation. It should be used only as a general guide for the design of the control systems. The contractor may use any other method for implementing the specified sequence of operation, subject to the requirements of this specification and shop drawing review. The Contractor is responsible to provide a control system that will execute the specified sequence of operation.

1.9 VAULT HMI SYSTEM DESCRIPTION

- .1 HMI system must be capable of performing the following monitoring, metering and actions via fiber optic communication with remote modules:
 - .1 The HMI will communicate with the following devices:
 - .1 Utility meters via IEC 61850 protocol .
 - .2 All 6.9kV protection relays via IEC 61850 protocol
 - .2 The HMI will display either a complete single line drawing of all 6.9kV breakers and switches within the 6.9kV substation and the two 115kV Circuit switchers.
 - .3 HMI must show the current status of the 6.9kV substation breakers and/or 115kV circuit switcher on the single line page(s) as either “open”, “closed”, or “tripped”. Status should be conveyed to the reader of the HMI by way of a text description and diagrammatically on the single line by showing an open or closed breaker or switch with an appropriate colour (red for closed, green for open, amber for tripped).
 - .4 HMI must display the real time system voltage, current, real power demand (kW) and apparent power demand (kVA) for each breaker in the 6.9kV breakers substation on the single line page(s). If space on each page is lacking, show just the basic parameters and allow more detail by pressing a ‘DMS’ button on the touch screen beside each metered device to go into a detailed metering page.

- .5 HMI system must be capable of opening and closing the 6.9kV breakers and 115kV circuit switcher within the through the HMI's touch screen display if their Local/Remote switch is set to 'Remote'. The HMI must be programmed such that the operation of the breakers can only be performed after the appropriate password is inputted into the HMI, and after a clear query from the system and confirmation from the user that the specific breaker is to be operated or not. Hide open/close buttons on HMI if breaker switch is set to 'Local'.
- .6 The HMI must be capable of storing 5 years of load data, recorded at 15 minute intervals for all 6.9kV breakers within the vault. The HMI must store voltage, current, real power and apparent power. The HMI must provide a screen providing a line graph for the parameter and time period specified by the user.
- .7 HMI system must maintain a time stamped alarm log of all breaker, switch, and relay operations. HMI system must be capable of identifying the specific IEEE relay function that caused a breaker trip.
- .8 HMI must be capable of transferring all stored data to a USB memory disk.
- .9 HMI system must include all required interfacing and auxiliaries, such as wiring, conduit, I/O interfacing, etc.

Part 2 Products

2.1 HUMAN MACHINE INTERFACE (HMI)

- .1 The HMI interface may either be an integrated 22" touchscreen display with built-in controls or may be a separate 22" touchscreen display with separately DIN-rail mounted micro-form factor computer controls.
- .2 Communication with relays must be completed using IEC 61850 protocol. PLCs are not permitted to allow communication.
- .3 HMI interface must have the following minimum properties:
 - .1 Touchscreen technology
 - .2 1920 x 1080 pixels
 - .3 22" inches nominal, 21.5" visible
 - .4 Minimum 8H scratch resistant surface hardness
 - .5 LCD TFT with extended viewing angle
 - .6 Minimum 65k colours
 - .7 24MB usable memory for application data
 - .8 24MB additional memory for options
 - .9 2 x MMC/SD combination slots for long term data storage
 - .10 2 x USB 2.0 slots
 - .11 Power supply 125VDC preferred, 24VDC acceptable
 - .12 Communication ports – Ethernet minimum 2 x 10/100/1000; 1 x RS 422/485
 - .13 Mounted in a NEMA 1, enclosure minimum 500mm x 500mm x 200mm
- .4 Provide fiber to Ethernet converter to allow HMI communication with the relay network.
- .5 Approved manufacturer:
 - .1 Schneider
 - .2 Rockwell/Allan Bradley

Part 3 Execution

3.1 WIRING AND TERMINATION

- .1 Relay-to-relay communication must be through fiber optic communication.
- .2 Meter-to-HMI communication must be through fiber optic communication.
- .3 Relay-to-HMI communication must be through fiber optic communication.

3.2 INSTALLATION AND VERIFICATION

- .1 Install, calibrate, and connect equipment in accordance with manufacturer's instructions.
- .2 Provide and install all interconnecting wiring.
- .3 All equipment shall be factory assembled and tested prior to shipping.
- .4 Perform on-site system verification and final calibration.
- .5 The contractor shall certify that the installation has been completed in accordance with their instructions.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Duct Banks and Manholes: Section 336573- Concrete Encased Duct Banks and Manholes
- .2 Aggregates: Section 310516 – General Aggregates
- .3 Fences & Gates: Section 323113 - Chain Link Fences and Gates
- .4 Cast-in-Place Concrete: Section 033000 - Cast-in-Place Concrete
- .5 Grounding: Section 260527 - Grounding – Primary

1.2 REFERENCES

- .1 ANSI C29.9-1983, Wet-Process Porcelain Insulators (Apparatus, Post Type).
- .2 CAN/CSA-G40.21-M92, Structural Quality Steels.
- .3 CAN/CSA-S16.1-M89, Limit States Design of Steel Structures.

1.3 SUPPLY SYSTEM DATA

- .1 Supply system data: 115kV, 60Hz, 3 phase, 3 wire, grounded, 1500 MVA symmetrical fault capacity, 450 kV BIL.
- .2 Verify coordination of substation protection with supply authority's protection.

1.4 REQUIREMENTS OF SUPPLY AUTHORITY

- .1 Submit shop drawings to Electrical Safety Authority and obtain certification that equipment meets their requirements, before submission of drawings to Engineer.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 013300 – Submittal Procedures.
- .2 Obtain certification from inspecting authority, for integrated items indicated on plot plan.
- .3 Indicate:
 - .1 Floor anchoring method and dimensioned foundation drawings.
 - .2 Foundation loadings under loaded conditions.
 - .3 Dimensioned position and size of bus bars and connections showing electrical clearances.

- .4 Identified dimensioned layout of components.
- .5 Protection co-ordination time current characteristics.
- .4 Submit structure design criteria for Engineer's review.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for substation for incorporation into manual specified in Section 013300 – Submittal Procedures.
- .2 Submit 5 copies of maintenance data for complete substation including components in combined manual.

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 013300 – Submittal Procedures.

1.8 DELIVERY AND STORAGE

- .1 Ship foundation anchoring devices in advance of substation structure.

Part 2 Products

2.1 MATERIALS

- .1 Steel structural members: to CAN/CSA-G40.21.
- .2 High tensile, hot dipped galvanized, bolts, nuts, washers: to CAN/CSA-S16.1.

2.2 OIL CONTAINMENT SYSTEM

- .1 Include all elements of oil containment system including but not limited to the design, materials and installation in Bid Price.
- .2 The bid price for the oil containment portion must include, but not limited to:
 - .1 Hiring the services of CI Agent to complete the design of the oil containment systems for the new 115kV transformer, T2 and existing 115kV transformer T1.
 - .2 Excavation of substation.
 - .3 Supply all material and labour to complete the oil containment system installation including geotextiles, CI Agent oil containment system, oil absorption material, membranes and civil materials.
 - .4 Complete oil containment system installation as per CI Agent design.

2.3 SUBSTATION GROUNDING

- .1 Provide Substation grounding in accordance with Section 260527 and as shown on tender drawings.

2.4 SUBSTATION FENCE

- .1 Provide substation chain link fence in accordance with Section 323113 and as shown on tender drawings.

2.5 POWER TRANSFORMER

- .1 Provide power transformer in accordance with Section 261214 and as shown on tender drawings.

2.6 15KV SWITCHGEAR AND WALK-IN ENCLOSURE

- .1 Provide power transformer in accordance with Section 261318 and as shown on tender drawings.

2.7 OUTDOOR HIGH VOLTAGE CIRCUIT SWITCHERS

- .1 Provide 115kV Vertical Circuit Switcher with integral double break horizontal disconnect in accordance with Section 262819 and as shown on tender drawings.

2.8 6.9KV NEUTRAL GROUNDING RESISTOR

- .1 Provide 6.9kV neutral grounding resistor in accordance with Section 262818 and as shown on tender drawings.

2.9 HUMAN MACHINE INTERFACE (HMI)

- .1 Provide HMI in accordance with Section 260905 and as shown on tender drawings.

2.10 GRAVEL

- .1 Provide 150mm layer of clear, washed, 19mm limestone in Substation area extending and 2m outside of fence perimeters and gate swing radius, in accordance with Section 310516 and design drawings.

2.11 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 260500- Electrical General Requirements.
- .2 Warning signs to caution against fuse changing.

- .3 Danger signs, warning against high voltage as required by inspection department.

Part 3 Execution

3.1 INSTALLATION

- .1 Set and secure substation structures in place rigid, plumb and square and as indicated.
- .2 Make field connections.
- .3 Connect equipment, lightning arrestors, structure to station ground system.
- .4 Co-ordinate connection to supply, with power supply authority. Identify phases.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260510 – Electrical Testing.
- .2 Arrange for pre-service inspection, oil sample and insulation test.
- .3 Operate interrupter closing and tripping mechanism and verify correct functioning.
- .4 Perform VLF test for 15kV cables.
- .5 Check insulation of substation assembly with 1000V megger with feeder cables and connections disconnected.
- .6 Conduct high potential tests on substation assembly to Engineer's written instructions.
- .7 Verify phase rotation of each feeder.
- .8 Check continuity of each feeder.

END OF SECTION

Part 1 General

1.1 SECTION SCOPE

- .1 Supply, installation, testing, and commissioning of main 115kV-6900/3984V, 15/20MVA, Delta-Wye, oil filled transformer.

1.2 RELATED SECTIONS

- .1 Section 264101 – Primary Lightning Arrestors.

1.3 REFERENCES

- .1 CAN/CSA-C88-M90 (R1999), Power Transformers and Reactors.
- .2 CAN/CSA-C802.3-01, Maximum Losses for Power Transformers
- .3 CAN/CSA-C108.3.1-M84 (R2005), Limits and Measurement Methods of Electromagnetic Noise From AC Power Systems, 0.15-30 MHz
- .4 Factory Mutual Standard 3990

1.4 DEFINITIONS

- .1 ONAN – Oil Natural Air Natural
- .2 ONAF – Oil Natural Air Forced

1.5 SOURCE QUALITY CONTROL

- .1 Submit PDF copies of product data and shop drawings for approval before purchase of transformer.
- .2 Provide test report for the following factory testing:
 - .1 Pressure test to 7 PSI for 1 minute. There shall be no evidence of leakage, permanent distortion, or rupture.
 - .2 The following tests from IEEE C57.19.90 ‘Test Code for Liquid-Immersed Transformers’
 - .1 Winding ratio on all connections
 - .2 Polarity and phase relation
 - .3 Full and reduced wave impulse for verification of BIL
 - .4 Dielectric for insulation strength; coil to core, high to low voltage winding, and terminals to ground, and the voltage levels specified in IEEE C57.10.00

- .5 No-load losses and excitation current at rated voltage and frequency
- .6 Over-excitation for turn-to-turn layer-to-layer insulation strength.
- .3 The engineer and client has the right to witness all factory testing. Inform the engineer of the schedule and location of tests at least 20 business days before testing occurs.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with Section 013300 – Submittal Procedures.

1.7 CLOSEOUT SUBMITTALS

- .1 Provide post installation and commissioning test results for liquid cooled transformers, arrestors, oil, etc. for incorporation into manual specified in Section 017800 – Closeout Instructions.
- .2 Include insulating liquid maintenance data.

1.8 DELIVERY AND STORAGE

- .1 Transformer shipping, unloading, and setting to be arranged and paid for by contractor.
- .2 Contractor shall coordinate shipping date with the client to ensure arrival after curing of concrete is complete.
- .3 Contractor to be on site when unloading and setting is completed by a certified rigger paid for, arranged, and scheduled by the contractor. Contractor to ensure placement of transformer is acceptable and as per plans. Contractor to be responsible for all power, grounding, instrumentation, and control wiring and cabling.

Part 2 Products

2.1 EQUIPMENT

- .1 Transformer will be supplied, installed, tested, and commissioned by the contractor.
 - .1 Oil filled ONAN/ONAF rating pad mounted power transformer, complete with top mounted primary and side mounted enclosed secondary cable bushings and accessories to form a complete factory assembled, self contained unit for mounting on concrete pad.
 - .2 Radiators, complete with fans and control equipment.
 - .3 Off-Load Tap Changer, and associated equipment
 - .4 Transformer mounted secondary neutral grounding resistor, 1200 Amps, 4000V, 10 second rating.

- .2 Contractor responsible for final testing and commissioning of transformer and neutral grounding resistor.

2.2 TRANSFORMER CHARACTERISTICS

- .1 Liquid cooled, outdoor, power transformer type ONAN/ONAF rating.
- .2 Primary voltage: 115,000V, 60Hz, delta connected, 3phase, 3 wire.
- .3 Secondary voltage: 6900V, wye connected, 3phase, 4wire, neutral brought out through bushing for solid or impedance grounding.
- .4 Angular displacement to be DY1
- .5 Capacity: 15MVA ONAN rating, 20MVA ONAF rating.
- .6 Basic impulse level: 650kV primary, 95kV secondary.
- .7 Impedance: to be 7.4%.
- .8 Losses as per CSA C802.3-01.
- .9 Temperature rise 65°C
- .10 Maximum sound rating not to exceed 67 db at ONAN rating
- .11 Equipped with conservator and Silica gel breather.
- .12 Primary lightning arrestors are to be mounted on top of transformer in close proximity to the transformer's primary bushings. Mounting brackets for lightning arrestors are to be welded to the transformer tank and constructed such that the lightning arrestors can be removed in the field without impacting the transformer's insulating fluid or requiring access to the inside of the transformer's tank.

2.3 MOUNTING

- .1 Transformers suitable for pad mounting
- .2 Provide lifting hooks

2.4 ENCLOSURE

- .1 All gauges, valves, tap changer, oil pressure relief valves, etc. to be contained within the transformer enclosure(s).
- .2 All access doors to be hinged and be capable of being locked with a single lock.
- .3 Transformer to have a liquid preservation system.

- .4 Enclosure designed for a minimum withstand pressure of 7 psi without permanent distortion. Rectangular tank shall be designed for a minimum withstand pressure of 15 psi without rupture.

2.5 FANS

- .1 Provide connections for required amount of 120VAC single phase power supply of fans to provide ONAF requirements
- .2 Fans to have totally enclosed fan motors
- .3 Fan blades suitably guarded with openings no larger than 12.7mm wide
- .4 Wiring to the fan motor to be:
 - .1 Installed as teck cable no longer than required to connect the motors, with heat shrink tubing installed over all fittings, and:
 - .2 Stainless steel torx screws used on all junction box covers to prevent access to cable connections, and:
 - .3 Supplied from a circuit or common breaker that when de-energized shall be easily recognized such as a lighting circuit
- .5 The transformer high temp alarm (along with others as per drawings) will be brought back to the respective transformer's protection relays installed in the 6.9kV switchgear.

2.6 RADIATORS

- .1 Provide removable type rads
- .2 Oil supplied to rads must be capable of being shut off by valves interconnection rads to transformer tank

2.7 VOLTAGE TAPS

- .1 Eight - 2.5% taps, 4-FCAN, 4-FCBN and nominal.
- .2 Internally operated off-load tap changer, with provision for padlocking.

2.8 HIGH VOLTAGE BUSHINGS

- .1 Bushings: to EEMAC L9-3.

2.9 INSULATING LIQUID

- .1 Insulating liquid: standard mineral oil

2.10 THROAT CONNECTIONS FOR SIDE MOUNTED TERMINALS

- .1 Extend secondary terminals through throat connections to cable connection boxes.

2.11 CURRENT TRANSFORMERS

- .1 In accordance with Section 262219 – Instrument Transformers
- .2 Two sets of bushing mounted current transformers are to be installed on the transformer primary for implementation of transformer differential protection.

2.12 ACCESSORIES SUPPLIED WITH TRANSFORMER

- .1 Liquid temperature measuring device, maximum indicating type, with alarm contacts.
- .2 Liquid level gauge with alarm contacts.
- .3 Pressure relief device
- .4 Sudden Pressure relay with alarm contacts and shut-off valve.
- .5 Winding Celsius temperature detector relay and sensing elements with fan and alarm contacts.
- .6 Wiring and terminal box for protective devices.
- .7 Top non-flammable insulating liquid sampling device.
- .8 50 mm drain valve with plug.
- .9 Needle sample valve
- .10 Top filter press connection.
- .11 Factory install accessories.
- .12 Nema 4X control box, with all alarms wired to terminal blocks

2.13 EQUIPMENT IDENTIFICATION

- .1 Contractor to provide equipment identification in accordance with Section 260500 - Electrical General Requirements.
- .2 Owner's equipment reference label: size 7.

2.14 ACCEPTABLE MANUFACTURER'S

- .1 ABB Inc.
- .2 Siemens

- .3 Or Approved Equivalent

Part 3 Execution

3.1 INSTALLATION

- .1 Contractor to install transformer(s) only after other work in area is completed and in accordance with manufacturer's instructions.
- .2 Contractor to ensure concrete base is completely cured and backfilled before installation of transformer(s).
- .3 Contractor's certified rigger to use spreader bars on slings when lifting transformers into place.
- .4 Contractor's certified rigger to set and secure transformer in place rigid, plumb, square.
- .5 Contractor to make connections.
- .6 Contractor to connect transformer neutral terminal to neutral grounding resistor.
- .7 Contractor to set taps to produce rated secondary voltage at no-load.
- .8 Contractor to wire one set contacts on liquid temperature measuring device, liquid level gauge, sudden pressure relay, and winding temperature detector relay, to close alarm contacts when unsafe condition reached.

3.2 FIELD QUALITY CONTROL

- .1 Contractor to supply and pay for Specialty Testing Agency to perform tests and commissioning in accordance with Section 260510 - Electrical Testing.
- .2 Specialty Testing Agency to check oil level and temperature indicators.
- .3 Specialty Testing Agency to inspect for oil leaks and excessive rusting.
- .4 Specialty Testing Agency to inspect oil level.
- .5 Specialty Testing Agency to confirm silica gel breather is connected to the conservator and air flow is permitted from the conservator to the silica gel breather.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for primary switchgear assembly.

1.2 RELATED SECTIONS

- .1 Section 013300 – Submittal Procedures.
- .2 Section 260500 – Electrical General Requirements.
- .3 Section 260950 – SCADA Control and Instrumentation.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C57.12-99, Distribution and Power Transformers, Guide for Loading Dry-Type, appendix to ANSI C57.12 standards.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.31-M89(R2000), Switchgear Assemblies.
 - .2 CSA C22.2 No.58-M1989(R2000), High-Voltage Isolating Switches.
 - .3 CSA G40.20/G40.21-98(June 2000), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC G1-1-1958, Indoor and Outdoor Switch and Bus Insulators.
 - .2 EEMAC G8-3.3, Metal-Enclosed Interrupter Switchgear Assemblies.
- .4 National Electrical Manufacturers Association (NEMA)

1.4 DESCRIPTION OF SYSTEM

- .1 Primary switchgear assembly to include:
 - .1 Enclosure (walk in outdoor) and associated lights, heaters, and ancillary equipment.
 - .2 15kV Vacuum Circuit breakers
 - .3 Potential Transformers
 - .4 Current Transformers
 - .5 Protective Relays
 - .6 Digital Metering Systems
 - .7 Mimic Bus Layout
 - .8 Grounding studs with insulated boots
 - .9 Infrared windows
 - .10 Breaker Control and Lockout Switches

- .11 Maintenance switch and light, one for each individual breaker
- .12 Local/Remote switch and light, one for each individual breaker.
- .13 125VDC Battery System and Charger
- .14 HMI Control System
- .15 Portable breaker lifting crane (one total)

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with 013300 – Submittal Procedures
- .2 Indicate:
 - .1 Complete Bill of Material for switchgear and all associated interrupting devices, controls, and relaying
 - .1 Ensure enough additional information (cut sheets or device ordering brochure) is provided to cross reference model numbers with device ordering information, options, auxiliary devices, etc.
 - .2 Floor anchoring method and dimensioned foundation template.
 - .3 Dimensioned cable entry and exit locations.
 - .4 Dimensioned cable termination height.
 - .5 Dimensioned position and size of busbars and details of provision for extension.
 - .6 Dimensioned positions of main connections, including air clearances and support insulators.
 - .7 Layout of internal and front panel components suitably identified.
 - .8 Layout of rear door and infrared windows in relation to cable connection points
 - .9 Arrangement and layout of Mimic Bus
 - .10 Arrangement and sequence of kirk interlock scheme
 - .11 Time current characteristics curves of protection devices.
 - .12 Physical dimensions of interrupting devices, cradle, optional items, finger clusters, bus arrangements, and other relevant items
 - .13 Wiring diagrams of interrupting devices, fuses, relays, trip units, current transformers, potential transformers, trip switches, auxiliary contacts, optional accessories, and other related devices. Clarify which is field, cell, and/or internal device wiring.
 - .14 Include all information on associated fuses, relays, or trip units; including time-current typical protective curves, settings, readouts, sensor and plug sizes, etc.
 - .15 Include protective device and relay or trip unit installation, operation, testing, and maintenance instructions

1.6 QUALITY ASSURANCE

- .1 In accordance with Section 013300 – Submittal Procedures.
 - .1 Provide manufacturer's type test certificates indicating switchgear cubicles and components tested as integrated assembly.
 - .1 Factory test switchgear assembly to IEEE C37.20.2 Production Tests
 - .2 Factory test main components to Section 260510 – Electrical Testing, including:

- .1 Current Transformers
 - .2 Potential Transformers
 - .3 Circuit Breakers
 - .4 Relays – functional test only
 - .5 Control Assemblies – functional test only
 - .6 Digital Metering System – functional test only
 - .7 Local/Remote controls – functional test only
 - .8 Maintenance Switch – functional test only
- .2 The contractor will pay for travel, accommodation, and meal expenses for one client and one engineering representative to witness all factory acceptance tests of the switchgear. Assume travel from Ottawa to the location of the factory where switchgear is being tested. Assume local travel expenses, accommodations, and meals for one full day before tests begin until, and including, one full day after tests complete.
 - .3 Contractor to liaise with factory and be responsible for notifying client and engineer at least 15 business days before switchgear is ready for final testing, providing locations, manufacturer contact information, test times, and other related information.
 - .4 Supplier or manufacturer to have conducted all required tests prior to the witness test by the client and engineer and determined that the system(s) are operating and functioning properly. Test documents shall be provided to the engineer at least 2 business days before FAT testing is scheduled.
 - .5 Subsequent site visits by the client and engineer as a result of the supplier or manufacturer's failure to provide acceptable performance of the equipment shall be at the expense of the contractor, including the engineer's time chargeable at the rate applicable and all travel expenses.
 - .6 Any costs associated with delays or cancellations of the FAT testing causing extra or subsequent visits to the factory by the client and engineer to be borne by the contractor. All costs will be substantiated by receipts and/or invoices.

1.7 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for primary switchgear assembly for incorporation into manual specified in Section 013300 – Submittal Procedures.

1.8 DELIVERY AND STORAGE

- .1 Ship and store switchgear assembly in upright position.
- .2 Store in weather protected, warm, dry enclosure.
- .3 Keep doors locked and protect instruments from damage and dust.
- .4 Ship channel base sills, anchoring devices in advance of switchgear.

1.9 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with 013300 – Submittal Procedures.
- .2 Include:
 - .1 One sets power fuses of each type installed.

Part 2 Products

2.1 MATERIALS

- .1 Switchgear assembly: to CAN/CSA-C22.2 No.31.
- .2 Steel for cubicles: to CSA G40.21.
- .3 Insulators: to ECSA C22.2 No.58.
- .4 Enclosure finish to ANSI C57.12.

2.2 PRIMARY SWITCHGEAR

- .1 Primary switchgear: outdoor walk-in, 15kV, 2000A, 3 phase, 3wire, short circuit capacity 36kA, BIL 95 kV.

2.3 PRIMARY ENCLOSURE

- .1 Primary enclosure: metal clad free standing, floor mounted, dead front, multi cubicle unit. Constructed from rolled flat steel sheets. Size: as required. Factory installed in outdoor walk-in enclosure.
- .2 Ventilating louvres: vermin, rain proof with easily replaceable fiberglass filters.
- .3 Use non-corrosive bolts and hardware.
- .4 Access from front and back.
- .5 Full height outer doors, gasketed, hinges on left side, provision for multiple padlocking. Three point latch, stops, to open at least 135 degrees.
- .6 Hinge doors on same side.
- .7 Gaskets on removable or openable covers.
- .8 Metal pocket c/w weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.
- .9 Space heaters: 120V, 250 W, 60Hz, single phase, low watt density complete with thermostat and disconnect switch in each cubicle. Power from local panelboard fed from auxiliary supply.

2.4 WALK IN ENCLOSURE FOR 15KV SWITCHGEAR

- .1 Complete 15kV switchgear and associated battery bank to be factory installed in a metal enclosed walk-in enclosure. Walk-in enclosure must be factory assembled with the switchgear and battery bank installed inside enclosure prior to delivery to site. Walk-in enclosure must be sized to accommodate all future switchgear cells and access doors must be provided on enclosure to access rear of future switchgear cells.
- .2 Enclosure to be furnished with task lighting operated by a three way switch. Switches to be located at man door entrances to enclosure. Lighting levels to be a minimum of 300 lux.
- .3 Switchgear walk-in enclosure to have two access doors as shown on drawings. Doors to be equipped with Panic bars, lockable from the exterior of the walk-in enclosure.
- .4 Enclosure to be furnished with 4 duplex receptacles inside enclosure, located on all four walls.
- .5 Enclosure to be supplied with a heating and cooling system capable of maintaining a 5 degree C (10 degree F) temperature difference between the interior and exterior of the enclosure.
- .6 Access to cable terminations at rear of switchgear to be provided by double doors that once opened will provide access to the rear of the metal clad switchgear, as indicated on drawings.
- .7 Battery bank must meet specification sections 26 33 16 and 26 33 43.
- .8 Enclosure to be heated such that the internal temperature can be maintained at 15 degrees C when the outside air temperature is minus 30 degrees C. Electric heating is to be implemented.
- .9 Walk-in enclosure to be mounted to cast-in-place concrete base as indicated on drawings.
- .10 Contractor is responsible for the supply and installation of walk-in enclosure, which is to include but is not limited to the purchase, delivery and placement of walk-in enclosure on cast in place concrete pad. Contractor is also responsible for hiring the service of the switchgear manufacturer to complete start-up and commissioning of the switchgear and auxiliary equipment.
- .11 Provide local 100Amp, 120/240V, 3p, 4w panelboard to supply all local ancillary loads. The panel is to be supplied from existing emergency panel, Panel EL3. A dedicated 1 pole, 15amp circuit breaker capable of being locked in the closed position must be supplied to supply the 120VAC receptacles of the metering cabinets.
- .12 Install metering cabinets as shown on drawings. Utility metering cabinets will be supplied by others.
- .13 Install 27mm EMT conduit between utility metering cabinets.
- .14 Install 120VAC, 15amp receptacles in each utility metering cabinet, supplied from walk-in enclosures auxiliary panel.

- .15 Install 53mm EMT conduits from each utility metering cabinet to the new switchgear. Install utility potential transformer wires and utility current transformers wires from terminals of instrument transformers to utility metering cabinets. Maintain 600mm of wire in metering cabinets for termination by others. All wiring must be a minimum of #10AWG, RW90, colour coded to reflect the phase it is metering.

2.5 BUS BARS

- .1 Three phase insulated busbars, continuous current rating 2000A extending full width of cubicle suitably supported on insulators.
- .2 Main connections between busbars, major switching components of continuous current rating to match major switching components.
- .3 High conductivity copper for busbars and main connections.
- .4 Brace busbar system including ground bus to withstand stresses resulting from short circuit currents specified.
- .5 Silver surfaced joints, secured with non-corrosive bolts and washers, tightened with torque wrench in accordance with manufacturer's recommendations.
- .6 Identify phases of busbars by suitable marking.
- .7 Busbar connectors when switchgear shipped in more than one section.

2.6 INFRARED WINDOWS

- .1 Each switchgear compartment containing incoming or outgoing cable connections shall have 4 inch I.R. windows that will support the use of Long Wave and Short Wave I.R. camera systems.
- .2 Provide enough windows on each rear door to view each visible incoming or outgoing feeder cable to bus connection, with an acceptable viewing angle to each connection.
- .3 The windows shall have 100% transmission of visual wavelengths
- .4 The windows shall have 98% of Infrared wavelengths, both short (0.35 to 5.5 μm) and long (8 to 12 μm) wave
- .5 The windows shall have a removable metallic cover plate.
- .6 Use standard Field of View calculations to determine where to install windows. $\text{FOV} = 2 \times (\text{tangent of } \frac{1}{2} \text{ the angle}) \times \text{distance}$, assuming a standard camera FOV of 24° .
- .7 Acceptable Products:
 - .1 IRISS VP100
 - .2 Hawk IR
 - .3 H.VIR Comet
 - .4 Fluke
 - .5 Or approved Equivalent

2.7 GROUNDING

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of cubicle and situated at bottom.
- .2 Lugs at each end for size 2/0 AWG grounding cable.
- .3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus
- .4 Carry bare copper 2/0 AWG grounding cable from each end of ground bus to station ground.

2.8 GROUNDING STUDS

- .1 Provide grounding studs at all cable termination points.
- .2 Studs to be CuAL Bronze, rated for 30,000 amperes for 30 cycles
- .3 Diameter of ball head to be 25mm, overall length to be 78mm.
- .4 Provide each stud with a removable insulating cover boot
- .5 Similar to MacLean Power Systems HC-30029

2.9 CIRCUIT BREAKER

- .1 As per section 262413 – Circuit Breakers Switchboard Type.
- .2 Breaker to be mounted in rack out mounting assembly with automatic primary and auxiliary disconnecting contacts. Racking per the following:
 - .1 Manually from in front of the switchgear with provided racking tool
 - .2 Base price includes one portable racking device powered at 120VAC with remote controls
- .3 Primary contacts to be automatically covered by shutters interlocked with removal mechanism.
- .4 Auxiliary contacts: 8 - N.O., 8 - N.C.
- .5 Auxiliaries:
 - .1 Status light: open-green, close-red.
 - .2 Status flags: open-green, close-red.
- .6 Breaker lock-out switch and Remote-Local operating switches
 - .1 Standard of Acceptance: Electros witch
- .7 Arc flash maintenance switch.

2.10 CONTROL AND LOCKOUT SWITCHES

- .1 Provide one open/close control switch for each breaker with clear protective Plexiglas cover to protect against inadvertent operation.
- .2 Provide one lockout switch for each breaker to prevent inadvertent re-energization in the event of a fault condition.
- .3 Standard of Acceptance: Electroswitch Series 24
- .4 Switch cover's to be STI, type STI-13200NC covers or approved equivalent.

2.11 COMMUNICATION PORT

- .1 Provide and mount Cat 5e Ethernet communication port with metal flip cover on each control cubicle door, similar to Hubbell Panel-Safe Power and Data Access Port P5E to allow communication with each feeder meter.
- .2 Support and protect patch cord within hinge-crossing plastic spiral wrapped wire bundle.

2.12 FIBER OPTIC COMMUNICATION

- .1 Interconnect fiber optic communication of ports of all relays together to allow for peer to peer communication. Relay network to be independent of metering network.
- .2 Interconnect fiber optic communication of ports of all meters together to allow for peer to peer communication. Metering network to be independent of relay network.
- .3 Connect relay and metering networks to independent fiber optic router.

2.13 TRIP RELAYS

- .1 As per section 261826 – Medium Voltage Protection Relays.

2.14 INSTRUMENT TRANSFORMERS

- .1 Switchgear manufactures must supply all instrument transformers including the utility instrument transformers.
- .2 Switchgear manufacture must also supply one set of spare utility current transformers and one set of spare utility potential transformers, which includes three potential transformers and three current transformers.
- .3 As per section 262219 – Instrument Transformers

2.15 BATTERY BANK

- .1 As per section 263316 – Storage batteries and racks
- .2 As per section 263343 – Battery Chargers

2.16 STATUS INDICATOR LIGHTS

- .1 Provide Close and Open Pilot lights for each breaker
 - .1 Status light: open-green, closed-red.
 - .2 Maintenance switch light: Blue when active.
 - .3 All indicator lights to be push-to-test, long lasting LED type.
 - .4 Remote or Auto - amber

2.17 METERING AND SWITCHBOARD INSTRUMENTS

- .1 Utility metering cell door must be gasketed, lockable as well as sealable.
- .2 As per section 260923.01 – Metering and Switchboard Instruments

2.18 FINISHES

- .1 Apply finishes in accordance with Section 260500 - Electrical General Requirements.
- .2 Cubicle exteriors: gray.
- .3 Walk-in enclosure exterior: gray
- .4 Cubicle interiors: white.
- .5 Supply 2 spray cans touch up paint.

2.19 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 260500 - Electrical General Requirements.
- .2 Nameplates:
 - .1 Switchgear designation: label - white plate, black letters, size7, engraved.

2.20 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 260500 - Electrical General Requirements.

2.21 ACCEPTABLE MANUFACTURERS

- .1 Schneider Electric
- .2 Eaton
- .3 Approved equivalent

Part 3 Execution

3.1 INSTALLATION

- .1 Set and secure complete walk-in assembly in place on channel base, rigid, plumb and square.
- .2 Make field connections in accordance with manufacturer's recommendations.
- .3 Connect ground bus to building system ground.
- .4 Render entire assembly rodent and insect proof by means of plates, and screens and grouting.
- .5 Ensure fixed housing into which circuit breaker moving carriage enters, is plumb.
- .6 Check factory made connections for mechanical security and electrical continuity.
- .7 Check relay settings against shop drawings.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260510 - Electrical Testing.
- .2 Operate circuit breaker closing and tripping mechanisms, to verify correct functioning.
- .3 Check insulation of switchgear assembly with 1000V megger. If values not satisfactory, clean, and dry and heat switchgear and repeat tests until readings acceptable to Engineer.
- .4 Check phase rotation of each feeder prior to energizing any loads and results must be verified by engineer prior to energizing loads.
- .5 Check relay settings for correct type and rating.
- .6 Check for grounding and neutral continuity between station ground and system neutral.
- .7 Have factory representative commission final installation and certify proper operation and installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials, components, cabinets, instruments and installation for medium voltage protection relays.

1.2 RELATED SECTIONS

- .1 Section 013300 – Submittal Procedures.
- .2 Section 260500 - Electrical General Requirements.
- .3 Section 260510 – Electrical Testing

1.3 REFERENCES

- .1 IEEE C37.90-2005 – IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 - Submittal Procedures.
- .2 Indicate protection relay, outline dimensions, panel drilling dimensions and include cutout template.
- .3 Include complete wiring diagrams for all existing and new wiring from instrument transformers through all terminal blocks, to medium voltage protection relay. Ensure all wiring numbers are unique and logically assigned.

1.5 WARRANTY

- .1 The manufacturer to warrant the protection relay for one (1) year from the acceptance date.

Part 2 Products

2.1 MEDIUM AND HIGH VOLTAGE PROTECTION RELAYS

- .1 The 6900V feeder protection relays shall incorporate the following features:
 - .1 Trip coil supervision
 - .2 Cold load pickup
 - .3 Phase, Neutral, and Ground overcurrent protection, both timed and instantaneous

- .4 Negative Sequence, both timed and instantaneous
- .5 Over/Under Voltage
- .6 Over/Under Frequency
- .7 Voltage Transformer Fuse failure
- .8 Breaker fail alarm
- .9 SER recorder for the last 512 events, stored in non-volatile memory
- .10 Must communicate IEC 61850 and Modbus RTU Protocols over fiber optic or Ethernet ports.
- .11 Minimum 8 digital inputs and 8 digital outputs standard
- .12 Provide at least 2 group settings capable of being automatically switched using built in control logic, activated based on voltage applied to input of the relay.
- .13 Shall include built in control logic using flexible inputs and outputs
- .14 Provide waveform capture feature, with at least 256 cycles of data. The amount of data to capture and the trigger points shall be user configurable.
- .15 Approved relays:
 - .1 Schneider Micom P143
 - .2 Or approved equivalents
- .2 The 6900V motor protection relays shall incorporate the following features:
 - .1 Trip coil supervision
 - .2 Cold load pickup
 - .3 Phase, Neutral, and Ground overcurrent protection, both timed and instantaneous
 - .4 Motor Differential protection
 - .5 10 RTD inputs
 - .6 Negative Sequence, both timed and instantaneous
 - .7 Over/Under Voltage
 - .8 Over/Under Frequency
 - .9 Voltage Transformer Fuse failure
 - .10 Breaker fail alarm
 - .11 SER recorder for the last 512 events, stored in non-volatile memory
 - .12 Must communicate IEC 61850 and Modbus RTU Protocols over fiber optic or Ethernet ports.
 - .13 Minimum 8 digital inputs and 8 digital outputs standard
 - .14 Provide at least 2 group settings capable of being automatically switched using built in control logic, activated based on voltage applied to input of the relay.
 - .15 Shall include built in control logic using flexible inputs and outputs
 - .16 Provide waveform capture feature, with at least 256 cycles of data. The amount of data to capture and the trigger points shall be user configurable.
 - .17 Approved relays:
 - .1 Schneider Micom P243
 - .2 Or approved equivalents

- .3 The 115000V protection relays shall incorporate the following features:
 - .1 Trip coil supervision
 - .2 Cold load pickup
 - .3 Phase, Neutral, and Ground overcurrent protection, both timed and instantaneous
 - .4 Transformer differential protection
 - .5 Negative Sequence, both timed and instantaneous
 - .6 Over/Under Voltage
 - .7 Over/Under Frequency
 - .8 Voltage Transformer Fuse failure
 - .9 Breaker fail alarm
 - .10 SER recorder for the last 512 events, stored in non-volatile memory
 - .11 Must communicate IEC 61850 and Modbus RTU Protocols over fiber optic or Ethernet ports.
 - .12 Minimum 8 digital inputs and 8 digital outputs standard
 - .13 Provide at least 2 group settings capable of being automatically switched using built in control logic, activated based on voltage applied to input of the relay.
 - .14 Shall include built in control logic using flexible inputs and outputs
 - .15 Provide waveform capture feature, with at least 256 cycles of data. The amount of data to capture and the trigger points shall be user configurable.
 - .16 Approved relays:
 - .1 Schneider Micom P642
 - .2 Or approved equivalents
- .4 The relays shall operate with either wye-connected (four wire) or open-delta connected (three wire) potential transformers, with 5 Amp and 120 Volt standard secondary.
- .5 The relay shall include status and trip target LEDs or a LCD display entry for each function, trip, and alarm.
- .6 Optional and adjustable trip curves including all ANSI and IEC standard curves.
- .7 The relays shall be capable of being set by Windows-based graphical and ASCII terminal interfaces.
- .8 Operating range from -40°C to +85°C.
- .9 Relays shall operate properly from at least 88 to 200 VDC with complete input power interruptions of up to one cycle.
- .10 Provide harsh environment conformal coating over all electronics to resist humidity.
- .11 Provide ABB style Flexitest shorting blocks for all relays voltage and current inputs. Current transformer wires and voltage wires to pass through flexitest switch prior to entry into relay.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide relays, wiring, and associated auxiliaries for all trip elements required in drawings.
- .2 Where indicated on the drawings, provide Test Shorting Blocks for all instrument transformers associated with the meters.
 - .1 Testing Terminal Blocks shall be ABB Flexitest, or equivalent
 - .1 Provide 10 pole units to allow interruption of all voltage and current inputs
 - .2 Ensure Testing switch is designed and wired to allow current and voltage inputs to bypass protection relay and continue to next device on the shared instrument transformer secondary without interruption.
- .3 Install protection relays in location free from vibration and shock.
- .4 Make connections in accordance with manufacturer's diagrams. Ensure connections across a hinged opening are completely protected by flexible plastic protective spiral wrap and are pre-flexed and arranged to ensure wiring does not get pinched in the door or impinge upon terminal blocks or other devices.
- .5 Connect protection relay cabinets to ground.
- .6 Locate protection relays within 9 m of instrument transformers or maximum acceptable distance as calculated by burden and saturation calculations. Use 32 mm conduit for interconnections. Use separate conduit for each set of current transformer connections, exclusive for metering.
- .7 All voltage sensing connections shall be made with 2A fuses unless otherwise specified by relay manufacturer.
- .8 Relays must be powered from an auxiliary power supply, and not powered from the same potential transformers feeding the voltage sensing inputs.

3.2 INSTALLATION IN FACTORY

- .1 Install protection relay, instrument transformers, and accessories in control compartment of switchboard.
- .2 Install protection relay faceplate on switchboard door in punched hole on door.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260501 - Electrical Testing.
- .2 Operate circuit breaker closing and tripping mechanisms, to verify correct functioning.
- .3 Check phase rotation of each feeder.
- .4 Check relay settings for correct type and rating.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for interlock systems.
- .2 Text to complete Section 261318 - Primary Switchgear Assembly to 15 kV.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 013300 - Submittal Procedures.

Part 2 Products

2.1 INTERLOCK SYSTEMS

- .1 Kirk Key interlock scheme is required as follows:
 - .1 Main – tie – Main Kirk Key interlock between the main breakers of the 6.9kV switchgear and the new tie breaker.

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for potential and current transformers.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN3-C13-M83(R1998), Instrument Transformers.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 - Submittal Procedures.
- .2 Indicate dimensions and connection details.

Part 2 Products

2.1 POTENTIAL TRANSFORMERS

- .1 Utility Metering
 - .1 6900V Potential transformers: to CAN3-C13, dry type for indoor use, with following characteristics:
 - .1 Measurement Canada Approval
 - .2 Primary fused
 - .3 Nominal voltage class: 4.2kV.
 - .4 Rated frequency: 60Hz.
 - .5 Basic Impulse Level: 75kV
 - .6 Voltage ratio: 4200:120V
 - .7 Accuracy rating: 0.3 WXY
 - .8 Overload rated at 1.9x for 30 seconds
 - .2 Potential transformers equipped with fuse holder and fuses.
 - .3 One potential transformer required per phase, all three potential transformers to be installed in a draw-out drawer.
- .2 Customer Metering
 - .1 6900V Potential transformers: to CAN3-C13, dry type for indoor use, with following characteristics:
 - .1 Nominal voltage class: 4.2kV.

- .2 Rated frequency: 60Hz.
- .3 Basic Impulse Level: 60kV
- .4 Voltage ratio: 4200:120V.
- .5 Accuracy rating: 0.3 WXM.
- .2 Potential transformers equipped with fuse holder and fuses.
- .3 One potential transformer required per phase, all three potential transformers to be installed in a draw-out drawer.
- .3 Wiring on voltage transformer secondaries to be #10 AWG minimum.
- .4 Approved potential transformer suppliers:
 - .1 Sadtem
 - .2 ABB
 - .3 GE Digital Energy/ITI

2.2 CURRENT TRANSFORMERS

- .1 6900V Current transformers: to CAN3-C13, dry type for indoor use with the following characteristics:
 - .1 Nominal voltage class 15kV for bar type CT's. If placed around insulated 15kV cable, and properly shielded and spaced to eliminate corona, 600V class CT's may be used.
 - .2 Rated frequency: 60Hz.
 - .3 Basic impulse level: 110 kV.
 - .4 Rated primary and secondary current: as indicated on drawings.
 - .5 Utility metering Current Transformers
 - .1 Bar Type Current Transformers
 - .2 Measurement Canada approved
 - .3 Metering accuracy rating: 0.15SB0.9/1.8.
 - .4 Continuous current rating factor 3
 - .5 Thermal withstand to exceed available short-circuit level and fault clearing time.
 - .6 600:5A ratio
 - .7 Acceptable manufacture
 - .1 Sadtem –SW85R series (up to 3000A)
 - .6 Protective Relay Current Transformers
 - .1 Protective relaying accuracy ratings (high accuracy):
 - .1 50:5 C10
 - .2 75 to 250:5 C50
 - .3 300 to 500:5 C100
 - .4 600 to 1000:5 C200
 - .5 1200 to 4000:5 C400
- .2 Wiring on current transformer secondaries to be #10 AWG minimum.
- .3 Provide positive action automatic short-circuiting device in secondary terminals.

2.3 MOUNTING BRACKETS

- .1 Instrument transformers mounted and/or supported by channel type mounting brackets.
- .2 Fabricate brackets and channels from electrogalvanized code gauge painted steel or GPO Glastic material, sized appropriately for mechanical stresses.

Part 3 Execution

3.1 INSTALLATION

- .1 All instrument transformers must be factory installed prior to equipment being shipped to site.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 – Submittal Procedures.
- .2 Section 261318 – Primary Switchgear Assembly to 15kV

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 – Submittal Procedures.
- .2 Provide all electrical and mechanical details on breakers including:
 - .1 Physical dimensions of breaker, cradle, optional items, finger clusters, bus arrangements, and other relevant items
 - .2 Wiring diagrams of breakers, trip units, current transformers, potential transformers, trip switches, auxiliary contacts, optional accessories, and other related devices. Clarify which is field, cell, and/or internal breaker wiring.
 - .3 Include all information on associated trip units, including time-current typical protective curves, settings, readouts, sensor and plug sizes, etc.
 - .4 Breaker and trip unit installation, operation, testing, and maintenance instructions
- .3 Provide factory test results for circuit breakers and associated trip units

1.3 QUALITY ASSURANCE

- .1 Circuit breakers must be new, cannot be re-used or re-manufactured units.
- .2 Circuit breakers must be purchased from authorized distributors and be able to be traced back to the manufacturers assembly plant.

Part 2 Products

2.1 CIRCUIT BREAKERS

- .1 Vacuum circuit breaker, 3 pole, single break, electrically operated, draw out breaker element, sized as indicated, for installation in 6.9kV switchgear.
- .2 Breaker operating mechanism:
 - .1 Stored energy opening and closing either electrically or mechanically charged.
 - .1 Electrically charged, opened, and closed at 125VDC via local battery bank

- .2 Mechanically charged, opened, and closed at breaker faceplate
- .3 Provide charging, opening, and closing device for remote operation by facility personnel through the use of the HMI system.
- .3 Breaker interrupting capacity: 36kA at 6.9 kV.
- .4 Breakers are re-moveable with rack-in assembly
- .5 Breakers to be wired such that the relay is capable of operating the breaker's trip coil directly or the breaker's trip coil can be operated via a lock-out switch
 - .1 Standard of Acceptance: Electroswitch
- .6 Breaker tripping devices, solid state relays as specified in section 261826.
- .7 Trip setting done by digital menu system or via relay's front Ethernet communication port
- .8 Breaker to be mounted in rack out mounting assembly with automatic primary and auxiliary disconnecting contacts. Primary contacts to be automatically covered by shutters interlocked with removal mechanism.
- .9 Auxiliary contacts: 8 - N.O., 8 - N.C.
- .10 Auxiliaries:
 - .1 Status light: open-green, close-red.
- .11 Provide spare parts as recommended by the manufacturer for a maintenance period of at least 2 years.
- .12 Acceptable manufacturers:
 - .1 Schneider
 - .2 Eaton
 - .3 Or approved equivalent

Part 3 Execution

3.1 INSTALLATION

- .1 Mount in draw out assembly.
- .2 Ensure trip free switch works properly when removing breaker with breaker closed.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 260500 - Electrical General Provisions.

1.2 REFERENCES

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 013300 - Submittal Procedures.
- .2 Submit fuse performance data characteristics for each fuse type and size above 200 A. Performance data to include: average melting time-current characteristics.

1.4 DELIVERY AND STORAGE

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in moisture free location.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 017800 - Closeout Submittals.
- .2 Six spare fuses of each type and size installed up to and including 600 A.

Part 2 Products

2.1 FUSES GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

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

- .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type L2, fast acting.
- .2 Class J fuses (formerly HRCI- J).
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.
- .3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its' peak let-through values not to exceed limits of UL 198E-1982, table 10.2.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class -C fuses (formerly HRCII- C).

2.3 FINGER-SAFE FUSE HOLDERS

- .1 Fuse holders to be finger safe, rated for 600V, sized for the required fuse size and type, with a minimum withstand rating of 100kA.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install Class R rejection clips for HRCI-R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Equipment, fabrication and installation for a complete medium voltage low resistance grounding system.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No. 144-M91(R2001), Ground Fault Circuit Interrupters.
 - .2 CSA C22.2 No. 47-M90 Air Cooled Transformers (Dry Type)
 - .3 CSA C22.2 No. 0 - General Requirements – Canadian Electrical Code, Part 11
 - .4 CSA C22.2 No. 0.4 - Bonding and Grounding of Electrical Equipment (Protective Grounding)”
 - .5 CSA C22.2 No. 14 - Industrial Control Equipment
 - .6 CSA C22.2 No. 94 - Special Purpose Enclosures
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2-1999, Application Guide for Ground Fault Protection Devices for Equipment.
- .3 IEEE 32 ‘IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices’

1.3 SUBMITTALS

- .1 Submit 6 copies of product data and shop drawings for approval before installation.
- .2 Submit test report for field testing of ground fault equipment to Engineer and written certification that system as installed meets criteria specified.
- .3 Provide 6 copies of operational and maintenance manuals upon completion of the job.

Part 2 Products

2.1 EQUIPMENT – MV NEUTRAL GROUNDING RESISTOR

- .1 Manufactured to IEEE 32 and CSA C22.2 No. 47
- .2 Outdoor, 1200A rating, 4000V, 10 second duty, with two current transformers within enclosure for measurement of ground fault current.
- .3 The resistive elements shall be low temperature coefficient, resistor grade stainless steel or nickel chromium rigidly supported at each end to allow for expansion due to heating.

- .4 The resistors shall be mounted in corrosion resistant support frames, using stainless-steel hardware.
- .5 The entire resistor frame shall be mounted on insulators rated for the system voltage.
- .6 All resistor terminals and interconnections between units shall be stainless-steel, using stainless-steel hardware including lock washers. High current connections shall be spot or TIG welded as appropriate.
- .7 Connections between resistors and bushings or current transformers shall be solid copper or stainless steel bus or copper cables.
- .8 The bottom of the enclosure shall be screened with expanded or perforated metal with openings of 1/2" or less. This screening shall be welded or bolted in and is not removable. It shall be elevated 4 to 6 inches above the base of the unit.
- .9 Bolt-on side covers on all four sides shall be used. Screened covers may be furnished for certain applications. Louvered or screened openings shall not exceed 1/2".
- .10 Access shall be provided to all components from one side of the enclosure for maintenance or repair.
- .11 Provide Resistor Continuity Monitor

Part 3 Execution

3.1 INSTALLATION

- .1 Install ground fault protection system as per manufacturer's recommendations.
- .2 Make connections as indicated and in accordance with manufacturer's recommendations.
- .3 Ensure neutral grounding device warnings signs are provided and placed at the incoming transformer as per Ontario Electrical Safety Code rule 10-1106 (4).
- .4 Ensure the conductor connecting the neutral grounding device to the neutral point of the transformer, generator, or grounding transformer shall be:
 - .1 Insulated for the nominal system voltage
 - .2 Identified white or grey
 - .3 Sized to conduct the rated current of the neutral grounding device, as per the design drawings.
 - .4 Shall not be grounded
- .5 Ensure the conductor connecting the neutral grounding device to the grounding electrode shall be:
 - .1 A copper conductor, either insulated or bare
 - .2 Identified green if insulated
 - .3 Sized to conduct the rated current of the neutral grounding device, as per the design drawings.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260510 –Electrical Testing.
- .2 Contractor shall pay for and provide field testing and commissioning of ground fault equipment before putting into service.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for outdoor load break switches and fuses.

1.2 RELATED SECTIONS

- .1 Section 013300 – Submittal Procedures.
- .2 Section 260500 - Electrical General Requirements.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C37.46-1981(R1992), Specifications for High Voltage Explosion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches.
- .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC)
 - .1 EEMACG1-1-1958, Indoor and Outdoor Switch and Bus Insulators.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA SG2-1993, High-Voltage Fuses.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 013300 – Submittal Procedures.
- .2 Indicate:
 - .1 Load break mechanism.
 - .2 Switching type.
 - .3 Mounting design.
 - .4 Fuse holder mechanism.
 - .5 Gang operating mechanism.
 - .6 Load rating.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 013300 – Submittal Procedures.

1.6 WARRANTY

- .1 Manufacture must provide a five year warranty from date of equipment shipment to site.

Part 2 Products

2.1 MATERIALS

- .1 Insulators: to EEMAC G1-1.

2.2 OUTDOOR HIGH VOLTAGE VERTICAL CIRCUIT SWITCHER

- .1 Vertical mounted interrupters and dual break power operated disconnect
- .2 Side break power operated disconnect to be gang operated, single throw, 3 pole.
- .3 Rating
 - .1 Outdoor rated
 - .2 3phase, 60HZ, 1200A, 138kV nominal, 145kV maximum, 650kV BIL,
 - .3 40kA, 1-sec short time rating.
 - .4 64kA, Momentary rating
 - .5 40kA, fault closing duty cycle
 - .6 Rated Duty Cycle O-0.3CO-CO-30sec- CO or better
- .4 Construction
 - .1 The circuit switcher assembly shall be made up of a vertical interrupter plus an integral side break disconnect.
 - .2 It shall be supplied complete with specified auxiliary components, including all operating rods, universals gears, interlocks, etc. and be ready for installation at the Customer's substation with minimum assembly.
 - .1 Interrupter
 - .1 The circuit switcher shall be an outdoor, 3- pole, group operated, re-settable device, and electrically linked vertical interrupters with SF6 gas filled single-gap puffer interrupters.
 - .2 Disconnect
 - .1 The integral disconnect shall be a dual break motor operated visible break type such as Switch Blades.
 - .2 The disconnect shall have a motion upon opening to release contact pressure and upon closing to engage contact pressure such as to wipe the stationary jaw contacts clean of any contaminants, and to break any accumulated ice build-up. The interrupter shall open before the disconnect opens and interrupter shall close after the disconnect closes, thus making and breaking the circuit in an SF6 environment.
 - .3 Support Structure
 - .1 The Circuit switcher shall be provided with its own support structure so the minimum clearance of live parts is 5.1m (200 in) above ground.
 - .4 Operating Mechanism & Control Cabinet

- .1 A rotational output motor operating mechanism shall be provided to reset the opening and closing springs and to open and close the disconnect.
- .2 A control cabinet, in a NEMA 4 enclosure, shall be provided to control the circuit switchers and shall have as a minimum the following accessories:
 - .1 Open-close push buttons
 - .2 Manual Trip lever in the event control power is lost.
 - .3 Manual crank handle for open disconnect after interrupters have been manually opened in the event control voltage is lost.
 - .4 Charged and discharged indicators for stored energy mechanism.
 - .5 Operation counter
 - .6 Eight nonadjustable single pole double throw auxiliary-switch contacts which follow the status of the interrupters.
 - .7 Required motor and contactors, fusing etc.
 - .8 Local-remote selector switch
 - .9 Position indication (open or close)
 - .10 All the necessary piping for coupling with movable parts. Decoupling mechanism of disconnect blade.
 - .11 Heater with thermostat control
- .3 Operator Control and Auxiliary Voltage ratings must be 125VDC.
- .5 Ground Pads
 - .1 Four, 2 hole ground pads shall be supplied for grounding the structure to the station ground grid.
- .5 Acceptable Manufacturers:
 - .1 S & C Electric
 - .2 Southern States
 - .3 Or approved equivalent

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Connect switch terminals to primary fuse terminals.
- .3 Locate, mount and connect fuses.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 260510 – Electrical Testing.
- .2 Open and close load break switches at least ten times over period of 8 hours to ensure proper mechanical and electrical performance of installation.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Battery chargers: Section 263343 - Battery Chargers.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 017800 - Closeout Submittals.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/Underwriters Laboratories (UL).
 - .1 ANSI/UL 94-96, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (ANSI Approved November 21, 2003).
 - .2 Canadian Standards Association (CSA International).
 - .1 CAN3-Z299.3-85(R2002), Quality Assurance Program - Category 3.
 - .2 CAN/CSA-G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
 - .5 Institute of Electrical and Electronic Engineers (IEEE).
 - .1 IEEE 484-2002, IEEE Recommended Practices for Installation, Design, and Implementation of Vented Lead-Acid Batteries for Stationary Applications.
 - .2 IEEE 485-1997(R2003), IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.
 - .3 IEEE 450-2002, Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
 - .6 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 013300 - Submittal Procedures.

- .2 Dimensioned sketch showing battery rack, enclosure assembly, individual battery cells, recommended aisle space, headroom, assembly and anchoring of both rack and enclosure assembly.
- .3 Shipping weights.
- .4 Individual battery cells, type, size, A.h capacity at 8 h discharge rate, electrolyte, materials for container, cover, separators, retainers, posts and inter-cell connectors.
- .5 Specific gravity at full charge and 25 deg C.
- .6 Cell charge and discharge curves of voltage, current, time and capacity.
- .7 Maximum short circuit current.
- .8 Maximum charging current recommended for fully discharged condition.
- .9 Full charge voltage per cell.
- .10 Fully discharged voltage per cell.
- .11 Hydrogen generation and ventilation requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for storage batteries and racks for incorporation into manual specified in Section 017800 - Closeout Submittals.
- .2 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.
- .3 Installation details of battery rack, individual cells and inter-cell connectors.
- .4 Replacement instructions for individual cells.
- .5 Electrolyte handling.
- .6 Parts lists with catalogue numbers, and names and addresses of suppliers.
- .7 Factory test records.

1.6 SOURCE QUALITY CONTROL

- .1 To CAN3-Z299.3.
- .2 Complete battery factory tested.

- .3 Connect load designed to fully discharge battery to rated end voltage in 60 min.
- .4 Install dc indicating voltmeter and ammeter.
- .5 Charge battery to ensure cells fully charged. When voltage reaches steady state, record: ambient temperature, temperature of each cell, voltage of each cell, voltage of battery, specific gravity of each cell (lead acid battery only).
- .6 At completion of discharge test, recharge battery at maximum specified rate, and record at 15 min intervals: battery voltage, charging current.
- .7 At start and finish of charging cycle record ambient and battery temperatures, and specific gravity of each cell (lead acid only).
- .8 Submit copy of test results to Engineer.

1.7 WARRANTY

- .1 Contractor hereby warrants the battery against defects in material and workmanship in accordance with GC24, but for 15 years.
 - .1 This warranty is for 100% replacement for the first year and a prorated replacement value in equal yearly decreasing amounts for the remaining 14 years until the expiration of the warranty at the end of 15 years after delivery of the battery.
 - .2 Cells to be warranted for 100% replacement for 60 months against electrolyte leakage and corrosion at post seals.

Part 2 Products

2.1 MATERIALS

- .1 Steel for battery racks: to CAN/CSA-G40.20.

2.2 BATTERY CHARACTERISTICS – 125VDC Bank

- .1 Nominal battery voltage, full charge, 125 VDC.
- .2 Batteries shall be of an adequate capacity to operate closing and tripping mechanisms of breakers, indicating lamps, relays, digital meters, alarms, and annunciators. At a minimum, this should allow two full operations of each breaker (trip open and close) and continuous operation of the remainder of the loads for 8 hours, and one final operation of one breaker. The battery capacity shall be at least 200 Ah.
- .3 Minimum end voltage: 1.75 V per cell after discharge at rated load for period specified.
- .4 Capable of being recharged in period of 8 h to not less than 95% full charge after supplying rated load for period specified, with no harmful effects on battery, including leaking or foaming of electrolyte.
- .5 Battery to deliver specified output at 25 deg C, in ambient temperature from 20 deg C to 40 deg C.

2.3 VALVE REGULATED LEAD-CALCIUM (VRLA) - BATTERIES

- .1 System float voltage: 2.25-2.27 volts per cell.
- .2 Type: Sealed with low pressure release valve with flash arrester
- .3 Immobilized electrolyte using an absorbent glass mat design with non-spillable designation
- .4 Electrolyte: solution of sulphuric acid, specific gravity 1.300 at 25 deg C.
- .5 Battery container and cover: high impact, flame retardant PVC to UL 94-V0, ASTM D-635, self-extinguishing, oxygen index > 32.
- .6 Cells: of identical construction and from same production run.
- .7 Posts: threaded insert with bolt, use stainless steel bolts and nuts with NO-OX-ID grease to coat the contact area of all electrical connections.
- .8 Batteries: in clean state with no evidence of electrolyte on outside of cell containers.
- .9 Acceptable manufacturers
 - .1 C&D technologies
 - .2 Hawker-Siddley
 - .3 Sab-Nife

2.4 ACCESSORIES

- .1 Accessories: self- adhesive numbers for cell identification.
- .2 2 spare intercell connectors, nuts and bolts.
- .3 2 spare inter-tier connectors, nuts and bolts.

2.5 BATTERY RACK

- .1 Multi tier, size as indicated. Bottom tier minimum 120 mm above floor, top of battery cells on highest tier not more than 2 m above floor.
- .2 Frames: angle iron with welded joints ground smooth.
- .3 Rails: steel channels, bolted to frames
- .4 Rubber strips to insulate rails from cells.
- .5 Insulated from ground and floor.
- .6 Free standing - not bolted to floor.
- .7 Primed and epoxy painted to prevent corrosion.

- .8 Corrosion resistant bolts and hardware.
- .9 Configuration permitting any one cell to be removed without removing any other cell.
- .10 Dimensions of space available as indicated.

2.6 BATTERY RACK ENCLOSURE

- .1 Sized to enclose battery rack and all batteries.
- .2 Provide either hinged or bolted panels to allow each access to work on or replace batteries
- .3 Ensure enclosure allows adequate ventilation
- .4 Powder coated white or gray painted finish on inside of enclosure, gray painted finish on exterior.

2.7 INSTALLATION

- .1 Ensure adequate protective equipment is used during the following procedures, which shall include at least the following:
 - .1 Goggles and face shields
 - .2 Acid-resistant gloves
 - .3 Protective aprons
 - .4 Portable or stationary water facilities for rinsing eyes and skin in case of contact with electrolyte
 - .5 Bicarbonate of soda solution, mixed 100 grams bicarbonate of soda to 1 litre of water, to neutralize acid spillage. NOTE - the removal and/or neutralization of an acid spill may result in production of hazardous waste. The user should comply with appropriate governmental regulations.
 - .6 Class C fire extinguisher
 - .7 Adequately insulated tools
- .2 The following protective procedures shall be observed during the tests:
 - .1 Use caution when working on batteries since they represent a shock hazard.
 - .2 Prohibit smoking and open flames, and avoid activities that increase the chances of arcing in the immediate vicinity of the battery.
 - .3 Ensure that the load test leads are clean, in good condition, and connected with sufficient length of cable to prevent accidental arcing in the vicinity of the battery.
 - .4 Ensure that all connections to load test equipment include appropriate short-circuit protection.
 - .5 Ensure that battery area ventilation is operating per its design.
 - .6 Ensure unobstructed egress from the battery area.
 - .7 Avoid the wearing of metallic objects such as jewellery.

- .8 Neutralize static build up just before working on the battery by contacting the nearest effectively grounded surface.
- .3 Locate and erect battery rack as per manufacturer's recommendations.
- .4 Perform pre-installation cell checks as per clause 2.8 below.
- .5 Install battery cells on rack.
 - .1 Ensure seismic racks have spacers between each cell.
 - .2 Do not use lubrication on racks, other than those expressly authorized by the manufacturer in writing, since the plastic rail covering provides a low friction surface for sliding the cells. If a lubricant is deemed necessary, an approved lubricant is unscented talcum powder used sparingly. Remove talcum powder with a cloth dampened in water.
 - .3 Remove orange coloured vent plugs which must be removed and discarded before installing the flame arrestors.
- .6 Provide unique identification for each battery in ascending sequential order as they would be connected in series. The battery at the negative output of the system should be the highest battery number. For individual strings connected in parallel, uniquely identify each string (e.g. A, B, and C).
- .7 Ensure proper orientation of each cell, insuring correct polarity and terminal locations (i.e. positive to negative to positive, etc.)
- .8 Ensure all electrical contacting surfaces have a clean, electrolyte-free finish. Remove any tarnish, discoloration, or oxidation with a platers brass brush.
- .9 Apply a thin coat of heated (between 71 and 85°C) no-oxide grease. Use a hot plate using a thermostatic control, do not overheat grease and cause a fire.
- .10 Install inter-cell and inter-tier connectors, and hand tighten nuts in accordance with manufacturer's instructions.
- .11 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.
- .12 Perform Post Installation testing as per clause 2.9 below.
- .13 Connect battery to load circuit.

2.8 PRE-INSTALLATION CELL CHECKS

- .1 Verify the general appearance and cleanliness each battery cell.
- .2 Inspect each battery cell jar, cell jar cover, and seals (jar to cover seal, post to cover seal) for deterioration (acid leakage, cracking, crazing-spider web effect, distortion, etc.).
- .3 Examine the, bus bar connection to each plate, and bus bar connection to the post of each battery cell for corrosion and other abnormalities. Inspect the lower part of the post seals and the underside of the cover for cracking or distortion.

- .4 Examine the cell posts of each cell to determine if any of them have grown or lifted to a larger degree than the rest of the posts of the battery.

2.9 POST INSTALLATION TESTING

- .1 Check voltage of each cell and overall battery voltage to ensure no batteries are installed in reverse polarity. Correct any incorrect cell orientations where batteries are installed in reverse polarity.
- .2 Confirm that cell-to-cell and terminal connection resistances are appropriate. (NOTE – do not take measurements across the cell. This improper action could cause personal injury, damage to the test equipment, and damage the cell.) If resistance measurements are the greater of 10% above the average value, or 5 micro-ohms, or if loose connections are noted, torque and re-test. If retested resistance value remains unacceptable, the connection should be disassembled, cleaned, reassembled, and retested.
- .3 With the charging source de-energized, connect the positive terminal of the battery to the positive terminal of the charger, and the negative terminal of the battery to the negative terminal of the charger. Check polarities with a voltmeter to be sure that connections are correct. Energize the system by following the manufacturer's procedures.
- .4 Provide an initial equalization charge to the batteries to 2.33VDC. Do not charge to more than 2.38VDC (note – check exact voltages with manufacturer). Review batteries as the equalization charge proceeds, confirm the current acceptance gradually declines, the batteries are not overheating (within +/- 5 degrees F of each other and the ambient). Typical time required can be up to 100 hours, but if batteries are placed in service within 2 weeks of receipt from manufacturer's factory, charging time can be reduced to 24 hours or less. The charge can be terminated when the lowest voltage cell in the battery is no less than 0.05VDC from the average cell voltage. This typically determined by starting detailed cell measurements after 8 hours on equalization charge voltage, when three successive measurements are the same, adequate charge has been provided and charge may be set to float.
- .5 Float charge battery for at 2.22VDC (note – check exact voltages with manufacturer) for 24 h to ensure battery fully charged and in stable condition.
- .6 Verify electrolyte levels are between low and high level marks. If levels are low, add sulfuric acid at the same specific gravity to the cell. This should be done by the manufacturer, or the manufacturer's agent.
- .7 Measure and record individual cell impedances.
- .8 Provide a final record of all each individual cell voltage, electrolyte temperature, specific gravity, and level, along with all other measurements gathered during commissioning, including open circuit voltages, initial charge readings, float charge readings, intercell connection resistances, and individual cell impedances.
- .9 Leave battery in fully charged state.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Battery charger performance, accessories, installation and tests.
- .2 Text to complete Section 261318 – Primary switchgear assembly to 15 kV.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 017800 - Closeout Submittals.
- .3 Section 260500 - Electrical General Requirements.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.107.1-01, General Use Power Supplies.
 - .2 CSA C22.2 No.107.2-01, Battery Chargers.

1.4 PERFORMANCE REQUIREMENTS

- .1 Automatically maintain battery in fully charged state with available supply power. Maintain dc float voltage within plus or minus 1% of setting, no load to full load, during mains voltage variations of plus 10% to minus 15% and frequency variations of plus or minus 5%.
- .2 Equalize charging rate such that after battery has provided full power output for specified duration, charger returns battery to 95% of fully charged state in 8 hours.
- .3 Automatic equalize charging circuit to initiate equalize charging of battery for 24 hours after discharge of 5% of ampere-hour battery rating.
- .4 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours, to return unit to float charge.
- .5 Manual adjustment of float charge voltage with range plus or minus 5%.
- .6 Manual adjustment of equalizing charge voltage.
- .7 Automatic current limiting adjustable between 80 and 120% of normal voltage rating.
- .8 Audible noise level not to exceed 65 dBA at 1.5 m.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 013300 - Submittal Procedures.

- .2 Outline sketch with dimensions showing arrangement of cubicle, components, meters and controls.
- .3 Shipping weight.
- .4 Schematic diagram showing components.
- .5 Charger data: type and capacity, battery charging sequence, current-time data for Silicon Controlled Rectifier (SCR) protective devices, estimated noise level, metering, alarms, controls and efficiency.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for battery charger for incorporation into manual specified in Section 017800 - Closeout Submittals.
- .2 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.
- .3 Copy of approved shop drawings.
- .4 Technical description of components.
- .5 Parts lists with catalogue numbers and names and addresses of suppliers.

Part 2 Products

2.1 CHARGER CHARACTERISTICS

- .1 Battery charger: to CSA C22.2 No. 107.1.
- .2 Input: 208 Vac, 3 phase, 4 wire, grounded neutral, 60Hz.
- .3 Output: 60A_{dc} at 125 V_{dc}, ripple voltage less than 2%.
- .4 Acceptable Manufacturers:
 - .1 C-Can
 - .2 Sab-Nife
 - .3 GNB
 - .4 Ametek
 - .5 Or approved equivalent

2.2 ACCESSORIES

- .1 dc voltmeter: switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output voltage.

- .2 dc ammeter: switchboard type, accuracy plus or minus 2% of full scale, to measure rectifier output current.
- .3 Relay and alarm for ac power failure with time delay to prevent alarm during short power outages.
- .4 Low dc voltage alarm to indicate over discharge, 4 hours emergency time available.
- .5 High dc voltage alarm and high dc voltage automatic shutdown.
- .6 No-charge alarm to indicate charger has no dc output.
- .7 Ground detector relay and alarm.
- .8 Equalizing timer: automatic reset type for unattended stations, 28 day period.
- .9 Filter to reduce ripple voltage in rectifier output from 2% to 100 mV.
- .10 LEDs mounted on front to indicate: failure ac power, low dc voltage, high dc voltage, no rectifier output.
- .11 Alarms: audible alarm when any LED indicates trouble. Silence pushbutton not to extinguish trouble light.
- .12 Common LED test switch and one common Form C alarm contact.
- .13 Cables and clips.

2.3 ENCLOSURE

- .1 Dead front free standing sheet steel, minimum 2.5mm thick CSA Enclosure 1.
- .2 Access from front.
- .3 Convection ventilated.
- .4 Meters, indicating lamps and controls group mounted on front panel.
- .5 Provision for handling by forklift or sling.
- .6 Apply finish in accordance with Section 260500- Electrical - General Requirements.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 260500- Electrical - General Provisions.
- .2 For major components such as input breakers, output breaker: size 4 nameplates.
- .3 For mode lights alarms, meters: size 2 nameplates.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install battery charger.
- .2 Connect input terminals to ac mains.
- .3 Connect output terminals to battery.

3.2 TESTS

- .1 Energize battery charger and operate until battery shows full charge.
- .2 Discharge battery to full discharge condition.
- .3 Recharge battery, recording dc voltage and current once per hour for 8 hours. Test battery to ensure it has reached at least 95% full charge.
- .4 Continue charging to ensure charger changes from equalize rate to float charge rate.
- .5 Demonstrate that automatic timer controls charging and correctly transfers from equalize to float charge after selected period.
- .6 Simulate faults to demonstrate that alarm lights and audible alarms are performing as designed.
- .7 At end of tests, with battery in fully charged condition, operate charger on "float" for minimum period of 24 hours to ensure stable condition is reached and held.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.
- .3 Submit certified test results to Consultant.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: submit manufacturer's installation instructions.
 - .1 Consultant will make available 1 copy of systems supplier's installation instructions.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 SNUBBERS

- .1 Nominal Voltage: 13.8kV
- .2 Frequency: 60Hz
- .3 Rated Capacitance per phase: 0.2 μ F
- .4 Capacitance tolerance: -5%/+10%
- .5 Resistance per phase: 30 Ω
- .6 Insulator BIL: 95KV Minimum
- .7 Working ambient temperature: -20°C to +50°C
- .8 Maximum system THD voltage present: 8%
- .9 Dielectric type: Oil (Non-PCB)
- .10 Bushings: Ceramic
- .11 Bushings, AC Withstand Dry: 38kV (1Min)
- .12 Bushings, AC Withstand Wet: 28kV (10Sec)
- .13 Bushings, Impulse Voltage: 95KV
- .14 Bushings, Creepage to earth/ground: 305mm
- .15 Dimensions: Maximum 450mm W x 495mm H x 135mm D
- .16 Enclosure: Stainless Steel Welded Enclosure with epoxy primer and finish
- .17 Warranty: 12 months
- .18 Manufacturing Compliance: IEC 60871-1:2005, ANSI/IEEE 18, NEMA CP-1, VDE 0560 Part 410
- .19 Quality Management System: ISO 9001-2008

- .2 Acceptable Manufactures
 - .1 Powertech Zorc
 - .2 NTSA
 - .3 Or approved equivalent

2.2 FINISH

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Use flexible leads to connect from the snubber to bus bar as indicated on drawings.
- .2 Cable lead lengths to be maintained to a minimum and have the following characteristics:
 - .1 Non-shielded jumper cable 15,000V
 - .2 Cable: To ICEA S-96-659
 - .3 Copper Circuit Conductors, single conductor minimum #4AWG
 - .4 Conductor to be flexible, rope stranded, annealed, uncoated copper.
 - .5 Copper shield: Nylon semi-conducting tape
 - .6 Insulation: Heat, moisture and ozone resistant ethylene propylene rubber (EPR) 90°C per ICEA S-96-659 (NEMA WC 71), Part 4
 - .7 Terminate cables using compression connections.
 - .8 Cable must be installed from snubber bushing through free air to bus bar indicated. Must be routed such that is not located in proximity to any grounded metal to avoid insulation failure.

3.3 FIELD QUALITY CONTROL

- .1 Inspect and test snubber prior to installation.
 - .1 Ensure all testing is only done by qualified personnel per NFPA 70E with appropriate safety precautions
 - .2 Check for obvious physical damage (Broken bushings, leaking impregnate, bulging tank, tracking on bushings, etc.)
 - .3 With the snubber line connections bonded together and using a DC cable test set, test between line and earth for 10 seconds. Confirm there are no dielectric breakdowns or audible discharges. Use manufacturer approved testing voltages.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for primary lighting arresters.

1.2 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE C62.36-2000, Standard Test Methods for Surge Protectors Used in Low Voltage Data Communications and Signaling Circuits, Standard Test Methods.
 - .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C233.1-87(R1999), Gapless Metal Oxide Surge Arresters for Alternating Current Systems.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 013300 - Submittal Procedures.

Part 2 Products

2.1 MATERIALS

- .1 Arrester component parts: to CAN/CSA-C233.1.
- .2 6900V Arrester characteristics:
 - .1 Station class arrester.
 - .2 System nominal voltage line to line 6900V. Note, 6900V system is medium resistance grounded with 1200Amp resistor.
 - .3 MCOV (maximum continuous operating voltage): 7.65 kV. If manufacturer's recommendation for MCOV level is different from 7.65 kV notify Engineer in writing for final selection.
 - .4 Indoor type.
 - .5 Housing: polymer.

- .6 Acceptable manufacturers:
 - .1 Hubbell
 - .2 G.E.
 - .3 Joslyn
 - .4 Or Approved Equivalent
- .3 115000V Arrester characteristics:
 - .1 Station class arrester.
 - .2 System nominal voltage line to line 115,000V.
 - .3 MCOV (maximum continuous operating voltage): 98 kV.
 - .4 Outdoor type.
 - .5 Housing: Silicone Rubber
 - .6 Acceptable manufacturers:
 - .1 Siemens
 - .2 Or Approved Equivalent

Part 3 Execution

3.1 INSTALLATION

- .1 Mount 6900V arresters on line side of main 6900V breaker, within the main 6900V switchgear, and connect line terminals to phase conductors. Connect ground terminals to ground bus with #2/0 AWG copper ground wire.
- .2 Mount 115,000V arresters to be mounted adjacent to primary transformer bushings such that the lead length from the transformer primary to the lightning arresters terminal is maintained as short as possible.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-1989, Standard for Qualifying Permanent Connections Used in Substation Grounding.
 - .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-B72-M87(R1998), Installation Code for Lightning Protection Systems.

1.3 DESCRIPTION OF SYSTEM

- .1 System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables.
- .2 Sky wire cone, where sky line elevated at height to protected structure beneath, but having no direct connection to sky line which is connected to system of ground electrodes.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 013300 - Submittal Procedures.
- .2 Indicate materials and methods of attachment of conductors to air terminals and electrodes.

1.5 REGULATORY REQUIREMENTS

- .1 System subject to: approval by authority having jurisdiction.

Part 2 Products

2.1 MATERIALS

- .1 Air terminals: copper solid rod.
- .2 #2/0 gauge, copper stranded conductor.

- .3 Fastenings and attachment straps: copper.
- .4 Electrodes: 3 m x 19 mm diameter copper coated steel.
- .5 Use aluminum conductors, terminals, connectors and fastenings for aluminum sheathed buildings or structures. Use copper conductors, terminals, connectors and fastenings for buildings sheathed in other than aluminum.
- .6 Connections: connections formed by thermite process or permanent mechanical compression connectors.

Part 3 Execution

3.1 INSTALLATION

- .1 Plasma structure, as per drawings, to be protected by inter-connected lightning protection system, containing air terminals, ring conductors, down cable, and grounding rods.
- .2 Install lightning protection to CAN/CSA-B72.
- .3 Bond discharge conductors to service mast or other non-current-carrying electrical parts.
- .4 Submit certificate of installation to Engineer.

3.2 INSPECTION

- .1 Obtain inspection certificate from Engineer for discharge conductor passing through any fire supporting membrane.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 - Submittal Procedures.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 013300 – Submittal Procedures.
- .2 Allow continual sampling by Engineer during production.
- .3 Provide Engineer with access to source and processed material for sampling.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand.
 - .2 Manufactured sand.
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate, including slag and expanded shale.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.
- .2 If, in opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .3 Advise Engineer 4 weeks in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 PREPARATION

- .1 Topsoil stripping
 - .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas as directed by Engineer after area has been cleared of weeds and grasses and removed from site.
 - .3 Strip topsoil to depths as directed by Engineer. Avoid mixing topsoil with subsoil.
 - .4 Stockpile in locations as directed by Engineer. Stockpile height not to exceed 2 m.
 - .5 Dispose of topsoil off site.
- .2 Aggregate source preparation
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed by Engineer.
 - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
 - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
 - .4 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
 - .5 Trim off and dress slopes of waste material piles and leave site in neat condition.

- .3 Processing
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Engineer.
 - .3 Wash aggregates, if required to meet specifications. Use only equipment approved by Engineer.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
- .4 Handling
 - .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .5 Stockpiling
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Engineer. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet Project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
 - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Engineer within 48 h of rejection.
 - .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Max 1.5 m for coarse aggregate and base course materials.
 - .2 Max 1.5 m for fine aggregate and sub-base materials.
 - .3 Max 1.5 m for other materials.
 - .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .9 Do not cone piles or spill material over edges of piles.
 - .10 Do not use conveying stackers.
 - .11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.2 CLEANING

- .1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .2 Leave any unused aggregates in neat compact stockpiles as directed by Engineer.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 310516 - Aggregates: General.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C117-95, Standard Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-98, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D4318-00, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A3000-98-A5-98, Portland Cement.
 - .2 CAN/CSA-A23.1-00, Concrete Materials and Methods of Concrete Construction.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: any solid material in excess of 0.25 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

- .3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
 - .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
 - .6 Unsuitable materials:
 - .1 Weak and compressible materials under excavated areas.
 - .2 Frost susceptible materials under excavated areas.
 - .3 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
 - .2 Table

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 – 100
0.02 mm	10 – 80
0.005 mm	0 – 45
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .7 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 PROTECTION OF EXISTING FEATURES

- .1 Protect existing features in accordance with applicable local regulations.
- .2 Existing buried utilities and structures:
 - .1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .2 Prior to commencing excavation Work, notify applicable Owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
 - .3 Confirm locations of buried utilities by careful test excavations.
 - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.

- .5 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before removing, re-routing.
- .6 Record location of maintained, re-routed and abandoned underground lines.
- .7 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
 - .1 Conduct, with Engineer, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair to approval of Engineer.
 - .3 Where required for excavation, cut roots or branches as approved by Engineer in accordance with Section 02901 - Tree and Shrub Preservation.

Part 2 Products

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties to Section 310516 - Aggregates: General and the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1, CAN/CGSB-8.2.
 - .3 Table

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

- .2 Type 3 fill: selected material from excavation or other sources, approved by Engineer for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

- .3 Unshrinkable fill: proportioned and mixed to provide:
 - .1 Maximum compressive strength of 0.4 MPa at 28 days.
 - .2 Maximum Portland cement content of 25 kg/m³ with 40% fly ash replacement: to CAN/CSA-A3000-A5, Type 10.
 - .3 Minimum strength of 0.07 MPa at 24 h.
 - .4 Concrete aggregates: to CAN/CSA-A23.1.
 - .5 Portland cement: Type 10.
 - .6 Slump: 160 to 200 mm.
- .4 Shearmat: honeycomb type bio-degradable cardboard 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete cured.

Part 3 Execution

3.1 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 All excavations around existing underground services are to be completed using hydro vac to prevent damage to existing services.

3.2 STRIPPING OF TOPSOIL

- .1 Commence topsoil stripping of areas as directed by Engineer after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as directed by Engineer. Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by departmental representative. Stockpile height not to exceed 2 m.
- .4 Dispose of unused topsoil to location off site.

3.3 STOCKPILING

- .1 Stockpile fill materials in areas designated by Engineer. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

3.4 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.

- .2 Submit for Engineer's review details of proposed dewatering or heave prevention methods, such as dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in manner not detrimental to public and private property, or any portion of Work completed or under construction.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas.

3.5 EXCAVATION

- .1 Advise Engineer at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Excavate to lines, grades, elevations and dimensions as directed by Engineer.
- .3 Remove concrete and other obstructions encountered during excavation to appropriate waste disposal sites.
- .4 Excavation must not interfere with bearing capacity of adjacent foundations.
- .5 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .6 For trench excavation, unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .7 Keep excavated and stockpiled materials a safe distance away from edge of trench as directed by Engineer.
- .8 Restrict vehicle operations directly adjacent to open trenches.
- .9 Dispose of surplus and unsuitable excavated material off site.
- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .12 Notify Engineer when bottom of excavation is reached.

- .13 Obtain Engineer approval of completed excavation.
- .14 Remove unsuitable material from trench bottom to extent and depth as directed by Engineer.
- .15 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings fill concrete.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected maximum dry density.
- .16 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Engineer.

3.6 FILL TYPES AND COMPACTION

- .1 Use fill of types as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698, ASTM.
 - .1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95 %.
 - .2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 98 %.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill topped with shearmat filler as indicated to underside of slab. Compact base course to 100 %.
 - .4 Place unshrinkable fill in areas as indicated.

3.7 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated. Place bedding and surround material in unfrozen condition.

3.8 BACKFILLING

- .1 Do not proceed with backfilling operations until Engineer has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

- .5 Backfilling around installations.
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 1 m.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Engineer or:
 - .2 If approved by Engineer, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Engineer.
- .6 Place unshrinkable fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.
- .8 Install drainage system in backfill as indicated as directed by Engineer.

3.9 RESTORATION

- .1 Upon completion of Work, remove waste materials and, trim slopes, and correct defects as directed by Engineer.
- .2 Replace topsoil as directed by Engineer.
- .3 Reinstall lawns to elevation which existed before excavation.
- .4 Reinstall pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstall areas affected by Work as directed by Engineer.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 013300 – Submittal Procedures.
- .2 Section 033000 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A53/A53M-01, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-01, Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 ASTM A121-99, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - .4 A653/A653M-01, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM A585-97, Specification for Aluminum-Coated Steel Barbed Wire.
 - .6 ASTM C618-00, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2-00(June 2001), Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CAN/CSA-A3000-98(April 2001), Cementitious Materials Compendium.
Includes:
 - .1 CAN/CSA-A23.5-98, Supplementary Cementing Materials

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 013300 – Submittal Procedures.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 033000- Cast-in-Place Concrete CSA-A23.1.
 - .1 Nominal coarse aggregate size: 20-5.
 - .2 Compressive strength: 20 MPa minimum at 28 days.
 - .3 Additives: fly ash to CAN/CSA-A23.5.
- .2 Chain-link fence fabric: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, #9 gauge steel wire, 4.8 mm in diameter, woven in 50.8 mm mesh.
 - .2 Height of fabric: 1.8 m.
 - .3 Acceptable material: galvanized steel.
- .3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.
- .4 Bottom tension wire: to CAN/CGSB-138.1, Table 2, single strand, galvanized steel wire, 5 mm diameter.
- .5 Tie wire fasteners: to CAN/CGSB-138.1, Table 2 (steel wire) 4, aluminum alloy wire single strand.
- .6 Tension bar: to ASTM A653/A653M, 5 x 25 mm minimum galvanized steel.
- .7 Gates: to CAN/CGSB-138.4.
- .8 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing.
 - .1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized painted with zinc pigmented paint after welding.
 - .2 Fasten fence fabric to gate with twisted selvage at top.
 - .3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.
 - .4 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.

- .9 Fittings and hardware: to CAN/CGSB-138.2, cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum. Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail. Overhang tops to provide waterproof fit, to hold top rails and an outward projection to hold barbed wire overhang. Provide projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart. Projection of approximately 300 mm long to project from fence at 45 deg above horizontal. Turnbuckles to be drop forged.
- .10 Organic zinc rich coating: to CAN/CGSB-1.181.
- .11 Barbed wire: 2 mm diameter galvanized steel wire to ASTM A121 4 point barbs 125 mm spacing.
- .12 Grounding rod: 16 mm diameter copperwell rod, 3 m long to Section 16061 – Grounding Primary.

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1 Grade2.
 - .2 For pipe: 550 g/m² minimum to ASTM A90.
 - .3 For barbed wire: to ASTM A121, Class 2 CAN/CGSB-138.2.
 - .4 For other fittings: to CAN/CSA-G164.

Part 3 Execution

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.2 ERECTION OF FENCE

- .1 Erect fence along lines as indicated as directed by Engineer and to CAN/CGSB-138.3.
- .2 Excavate post holes to 900 mm depth x 300 mm diameter.
- .3 Space line posts 3m apart, measured parallel to ground surface.
- .4 Space straining posts at equal intervals not exceeding 150m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150m.

- .5 Install additional straining posts at sharp changes in grade and where directed by Engineer.
- .6 Install corner post where change in alignment exceeds 10 deg .
- .7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.
- .8 Place concrete in post holes then embed posts into concrete to 900 mm depth x 300 mm diameter. Extend concrete 50 mm above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 Do not install fence fabric until concrete has cured minimum of 5 days.
- .10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface at inclination as indicated. Install braces on both sides of corner and straining posts in similar manner.
- .11 Install overhang tops and caps.
- .12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals. Knuckled selvedge at bottom. Twisted selvedge at top.
- .15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals. Give tie wires minimum two twists.
- .16 Install barbed wire strands and clip securely to lugs of each projection. Barb wire to extend as per distance indicated in drawings.
- .17 Install grounding rods as indicated.

3.3 INSTALLATION OF GATES

- .1 Install gates in locations as indicated.
- .2 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface.
- .3 Determine position of centre gate rest for double gate. Cast gate rest in concrete as directed. Dome concrete above ground level to shed water.

- .4 Install gate stops where indicated.

3.4 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations. Dispose of surplus material and replace damaged turf with sod as directed by Engineer.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 260527 - Grounding - Primary.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D1056-00, Standard Specification for Flexible Cellular Materials -
 Sponge or Expanded Rubber.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A3000-03(R2004), Cementitious Materials Compendium
 - .2 CAN/CSA-A5-03, Portland Cement
 - .3 CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete
 Construction/Methods of Test for Concrete.
 - .4 CSA G30.3-M1983(R1998), Cold-Drawn Steel Wire for Concrete
 Reinforcement.
 - .5 CSA G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete
 Reinforcement.
 - .6 CAN/CSA-G30.18-92(R1998), Billet-Steel Bars for Concrete Reinforcement.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings for precast manholes in accordance with Section 013300 – General
 Instructions.

Part 2 Products

2.1 PVC DUCTS

- .1 PVC ducts, type DB2, encased in 75mm reinforced concrete.
- .2 Concrete: 25 MPa, Class C-4

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded translucent pushfit type couplings, bell end fittings,
 plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

2.3 CABLE PULLING EQUIPMENT

- .1 Pulling iron: galvanized steel rods, size and shape as indicated.
- .2 Pull rope: 6 mm stranded polypropylene, tensile strength 15 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.4 MANHOLES

- .1 Provide type indicated.
- .2 Top, walls, and bottom: reinforced concrete.
- .3 Walls and bottom: monolithic concrete construction.
- .4 Locate duct entrances and windows near corners of structures to facilitate cable racking.
- .5 Covers: fit frames without play.
- .6 Form steel and iron to shape and size with sharp lines and angles.
- .7 Castings: warp and blow hole free.
- .8 Exposed metal: smooth finish without sharp lines and arises.
- .9 Provide lugs, rabbets, and brackets.
- .10 Set pulling-in irons and other built-in items in place before depositing concrete.
- .11 Install pulling-in iron in wall opposite each duct line entrance.
- .12 Cable racks, including rack arms and insulators: sized to accommodate cable.
- .13 Concrete manhole neck to bring cover flush with finished grade in proposed and future paved areas and 100 mm above grade in unpaved or landscaped areas.
- .14 Floor of manholes sloped 1:120 to sump (sump pit: 300x300x150 mm). When shown on drawings, provide drainage pipe outlet to existing storm drainage structure or drainage pits. Ensure drainage is sufficient for installation shown.
- .15 Ground rods: Install copper clad steel, 19 mm dia by 3 m long in sump pit of manholes. Connect ground rod to all exposed metal within manhole and to exposed ground conductors run through manhole
- .16 #6 TWU (insulated) green for manhole frame/cover grounding.

2.5 PRECAST MANHOLES

- .1 Placement of structures to be done in presence of engineer and/or client.
- .2 Precast concrete manholes, collars, and auxiliary sections fabricated in steel forms. Concrete compressive strength not less than 35 MPa and F1 exposure.

- .3 Aggregates: to CSA A23.1/A23.2.
- .4 Top, walls, and bottom: reinforced concrete.
- .5 Cement: CAN/CSA-A3001, Type 10.
- .6 Steel welded wire fabric mesh reinforcing: to CAN/CSA G30.18.
- .7 Pulling inserts and bolts for racks integrally cast in concrete: to ANSI/ACI-347-04.
- .8 Neoprene gasket seals between manhole sections: to ASTM D 1056.
- .9 Lid size: 762 mm clear diameter.
- .10 Precast Concrete Manholes: to ASTM C 478/C 478M

2.6 MANHOLE CABLE RACKS

- .1 Hot dipped galvanized cable racks and supports.
- .2 100 mm preset inserts for rack mounting.
- .3 Six (6) steel hooks are required on each cable rack.

2.7 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm, with words: "Cable", "Joint", "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install underground duct banks and manholes including formwork.
- .2 Build duct bank and manholes on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.
- .3 Open trench completely between manholes to be connected before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .5 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
- .6 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase duct bank with 75 mm thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.

- .7 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
- .8 Use bell ends at duct terminations in manholes or buildings.
- .9 Use conduit to duct adapters when connecting to conduits.
- .10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
- .11 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .12 Allow concrete to attain 50% of its specified strength before backfilling.
- .13 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .14 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .15 Immediately after placing of concrete, pull through each duct steel mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .16 Install four 3 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 10M dowels at manhole or building and support from duct spacers. Protect existing cables and equipment when breaking into existing manholes. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.
- .17 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MANHOLES

- .1 Install precast manholes to location and configuration as indicated on Contract Drawings.
- .2 Install ground rod before placing base slab.
- .3 Provide 125 mm deep window to facilitate cable bends in wall at each duct connection. Terminate ducts in bell- end fitting flush with window face. Provide four (4) 15M steel dowels at each duct run connection to anchor duct run.
- .4 Alternately connect large duct runs by leaving a square opening in wall, later pouring duct run and wall opening in one pour.
- .5 Install manhole collars/necks to bring cover to finished grade. Do not use final cover elevations on Contract Drawings, set manhole cover elevation only after field confirming the finished grade.

- .6 Install manhole frames and covers for each manhole. Set frames in concrete grout onto the manhole neck.
- .7 Drain floor towards sump with 1 to 120 slope minimum.
- .8 Install cable racks, anchor bolts, and pulling irons as indicated on Contract Drawings.
- .9 Grout frames of manholes. Cement grout to consist of two parts sand and one part cement and sufficient water to form plastic slurry.
- .10 Ensure filling of voids in joint being sealed.
- .11 Plaster voids in walls, ceiling, and neck with cement grout.
- .12 Spray paint an "X" on ceiling of manhole above floor drain and sump pit.
- .13 Install fiberglass ladders only in communication manholes as indicated.

3.3 MANHOLE DRAIN

- .1 Provide drainage pipe from the lowest power and communication manholes to a drainage pit situated beyond the manhole structure.
- .2 Use minimum 75 mm diameter PVC drainage pipe of suitable strength. Grout connection to manhole sump and purge and shape around pipe end.

Drainage pipe shall extend a minimum of 3.0 m from the outside of the manhole wall at a minimum slope of 1:50.

- .3 Provide a 1.0 m square by 2.0 m deep drainage pit comprised of 25 mm crushed stone wrapped in filter cloth. Situate drainage pit location such that drainage pipe terminates in center of pit 150 mm from top. Wrap drainage pipe end with piece of filter cloth and secure to pipe with stainless steel clamp.

3.4 CONNECTION TO STRUCTURES

- .1 Install four (4) - 850 mm lengths of 15M dowels, one in each corner of duct bank when connecting duct to manholes or buildings.
- .2 Protect existing cables and equipment when breaking into manholes.
- .3 When placing concrete adjacent to manholes or other structures, ensure placement down sides of duct bank filling space under and around all ducts. Ensure all voids are filled by rodding concrete with a flat bar between all vertical rows.

3.5 MANDREL TESTING

- .1 Supply minimum two (2) wood mandrels for use in confirming that installed ducts are of consistent clear diameter for cable installation. Mandrels to be not less than 300 mm long and of diameter 6 mm less than internal diameter of duct. Do not commence testing until Engineer has inspected and measured mandrels and has approved their use.

- .2 Provide Engineer with two (2) days' notice of proposed testing. Allow Engineer opportunity to view field testing.
- .3 After concrete encasement has obtained minimum 50% of specified strength, pull approved mandrel through each installed duct for each new duct bank, followed by stiff bristle brush to remove any sand, earth or other foreign matter.
- .4 Notify Engineer immediately if mandrel becomes trapped within run. Correct out of tolerance sections of duct bank by excavating, removing, and replacing deformed sections of duct, repouring concrete encasement and retesting all duct runs for specific duct bank.

3.6 MANHOLE ADJUSTMENT

- .1 Adjust top of existing manholes as directed by Engineer. Do not use final cover elevations on Contract Drawings without confirming elevation in field prior to adjustment. Complete localized grading at manholes so that finished grade slopes away from manhole covers at a minimum of 1.5% and manholes are not in a localized depression or on a drainage route.

3.7 PROTECTION OF EXISTING DUCT BANKS AND MANHOLES

- .1 Carefully expose and locate existing duct bank structures and manholes as indicated including hand digging as required. Any damage caused to existing duct bank system as a result of the exposing operation or any other Contractor operation shall be rectified immediately by the Contractor and at no additional cost to Owner, regardless of whether the exist duct bank location differs from that of the Contract Drawings.

3.8 MARKERS

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run. Place concrete duct marker at ends of such duct runs. Construct markers and install flush with grade.
- .2 Mark ducts every 150 m along straight runs and changes in direction.
- .3 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.
- .5 Provide drawings showing locations of markers.

3.9 INSPECTIONS

- .1 Inspection of duct will be carried out by Engineer prior to placing. Placement of concrete and duct cleanout to be done when Engineer present.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/National Electrical Manufacturers (NEMA)
 - .1 ANSI/NEMA C29.17-2002, Composite-Line Post Type Insulators.
 - .2 ANSI/NEMA C29.18-2003, Composite-Distribution Line Post Type Insulators.
 - .3 ANSI/NEMA C29.3-1986(R2002), Wet-Processed Porcelain Insulators-(Spool Type).
 - .4 ANSI/NEMA C29.4-1989(R2002), Wet-Processed Porcelain Insulators (Strain Type).
 - .5 ANSI/NEMA C29.5-1984(R2002), Wet-Process Porcelain Insulators (Low- and Medium-Voltage Pin Type).
- .2 Canadian Electrical Association Purchasing Specification (CEA)
 - .1 CEA LWIWG-02-96, Line Post Composite Insulator for Overhead Distribution Lines.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G12-92(R2007), Zinc-Coated Steel Wire Strand.
 - .2 CAN/CSA-C83-96(R2005), Communication and Power Line Hardware.
 - .3 CAN/CSA-O80 Series-08, Wood Preservation.
 - .4 CAN/CSA-O15-05, Wood Utility Poles and Reinforcing Stubs.
 - .5 CSA O116-1969(R2008), Power and Communication Sawn Wood Crossarms.
- .4 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1B-1, 1957, Standard for Wet Process Porcelain Insulators (Strain Type).
 - .2 EEMAC 2B-1, 1957, Standard for Wet Process Porcelain Insulators (Spool Type).
- .5 Local Utility Standards

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 013300 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada indicating:
 - .1 Materials.

- .2 Method of anchorage.
- .3 Number of anchors.
- .4 Supports.
- .5 Reinforcement.
- .6 Assembly details.
- .7 Accessories.

1.3 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 013300 – Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .2 Health and Safety Requirements: worker protection:
 - .1 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection, protective clothing when applying preservative materials.
 - .2 Workers must not eat, drink or smoke while applying preservative material.
 - .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to sanitary landfill.
 - .4 Workers must wear personal protective wear: hardhat and safety shoes.
- .3 Perform work to comply with applicable Provincial/Territorial regulations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding and packaging materials.

Part 2 Products

2.1 MATERIALS

- .1 Wood preservation: to CAN/CSA O80 Series.
- .2 Power line hardware: to CAN/CSA-C83.
- .3 Wood utility poles: to CAN/CSA-O15, wood species Western Red Cedar, Class H3, preservative treated.
 - .1 24.4 m long poles for primary circuits only.
 - .2 25.9 m long poles for support of Skywire.

2.2 INSULATORS

- .1 Guy strain insulators:
 - .1 Strain type: to ANSI/NEMA C29.4, nominal rating 115 kV, one per guy wire.
- .2 Suspension/dead end insulators nominal rating 115kV.

2.3 GUYS AND ANCHORS

- .1 Guy wire: to CAN/CSA-G12, 9 mm nominal diameter, stranded, galvanized steel for dead ends and guys.
- .2 Guy clamps: three-bolt heavy duty or preform grip type.
- .3 Eye bolt: 19 mm thimble, length to suit, four hole guy straps and 16 mm machine bolt with square washer to attach guy wire to pole.
- .4 Anchor rod: 19 mm diameter x 2.7 m long, galvanized steel with thimble eye.
- .5 Anchor: manufacturer's standard, approved by Departmental Representative.
 - .1 Power installed screw anchor (PISA), double helix.
 - .2 Log anchor in earth or swamp.
 - .3 Rock anchor.
- .6 Guy guard: half-round, galvanized steel 2.7 m long.
- .7 Guy guard: plastic, colored yellow, 2.7 m long.

2.4 PRIMARY CONDUCTORS

- .1 In accordance with Section 26 05 14 - Power Cable and Overhead Conductors (1001 to 115,000V).

2.5 TRANSFORMERS

- .1 In accordance with Section 26 12 14 – Power Transformers.

2.6 LIGHTNING ARRESTERS

- .1 In accordance with Section 26 41 01 - Primary Lightning Arrestors.

2.7 EQUIPMENT IDENTIFICATION

- .1 Rustproof number nails with 50 mm high designated number.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Install electrical pole lines and hardware in accordance with manufacturer's written recommendations and specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION OF POLES

- .1 Where poles require shortening, cut piece from top only.

- .2 Roof top of poles with single slope bevelled top.
- .3 Treat roof top, gains, bored holes with preservative before assembly.
- .4 Cut parallel plane crossarm gains in face of pole for single and double arming, spacing as indicated.
- .5 Bore hole in center of each gain for crossarm bolt.
- .6 Drill crossarms for pins, through bolts, double arm bolts and brace bolts.
 - .1 Pre-drill treated crossarms to standard spacing.
- .7 Install crossarms and braces.
- .8 Attach stand-off insulators and eye-bolts.

3.3 INSTALLATION

- .1 Locate and dig pole holes.
 - .1 Make holes large enough to allow space for tamping backfill.
- .2 Set poles.
- .3 Align poles with crossarms at right angles to pole line on straight runs.
- .4 At change in direction of line, set crossarms to bisect angle formed by change.
- .5 Set poles to maintain even grade.
 - .1 Allow for contour of terrain and do not exceed grading of 1.5 m per pole.
- .6 Replace backfill in 150 mm layers.
 - .1 Tamp each layer, and apply final layer to drain water away from pole.
- .7 Locate and install guy wires and anchors at dead-ends, at non-tangent poles, corner poles, and start of branch feeders.
- .8 Insert anchor at least 1.8 m into ground. Backfill and tamp in 150 mm layers.
- .9 Install insulators.
- .10 Install number nails on each pole.
- .11 Identify primary circuit on pole showing phasing of each conductor, every 1000 m and including origin of primary pole.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests and field inspection for pole lines and hardware prior to energization.
- .2 Use qualified tradespersons for installation, termination and testing of high voltage power lines and hardware.
- .3 Engage an independent testing agent to perform test and inspection on high voltage power lines and equipment.
- .4 Submit test result and inspection certificate for review.

3.5 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION



TP1 Amount Payable – General

1.1 Subject to any other provisions of the contract, Her Majesty shall pay the Contractor, at the times and in the manner hereinafter set out, the amount by which

1.1.1 the aggregate of the amounts described in TP2 exceeds

1.1.2 the aggregate of the amounts described in TP3

and the Contractor shall accept that amount as payment in full satisfaction for everything furnished and done by him in respect of the work to which the payment relates.

TP2 Amounts Payable to the Contractor

2.1 The amounts referred to in TP1.1.1 are the aggregate of

2.1.1 the amounts referred to in the Articles of Agreement, and

2.1.2 the amounts, if any, that are payable to the Contractor pursuant to the General Conditions.

TP3 Amounts Payable to Her Majesty

3.1 The amounts referred to in TP1.1.2 are the aggregate of the amounts, in any, that the Contractor is liable to pay Her Majesty pursuant to the contract.

3.2 When making any payments to the Contractor, the failure of Her Majesty to deduct an amount referred to in TP3.1 from an amount referred to in TP2 shall not constitute a waiver of the right to do so, or an admission of lack of entitlement to do so in any subsequent payment to the Contractor.

TP4 Time of Payment

4.1 In these Terms of Payment

4.1.1 The “payment period” means a period of 30 consecutive days or such other longer period as is agreed between the Contractor and the Departmental Representative.

4.1.2 An amount is “due and payable” when it is due and payable by Her Majesty to the Contractor according to TP4.4, TP4.7 or TP4.10.

4.1.3 An amount is overdue when it is unpaid on the first day following the day upon which it is due and payable.

4.1.4 The “date of payment” means the date of the negotiable instrument of an amount due and payable by the Receiver General for Canada and given for payment.

4.1.5 The “Bank Rate” means the discount rate of interest set by the Bank of Canada in effect at the opening of business on the date of payment.



- 4.2 The Contractor shall, on the expiration of a payment period, deliver to the Departmental Representative in respect of that payment period a written progress claim that fully describes any part of the work that has been completed, and any material that was delivered to the work site but not incorporated into the work during that payment period.
- 4.3 The Departmental Representative shall, not later than ten days after receipt by him of a progress claim referred to in TP4.2,
- 4.3.1 inspect the part of the work and the material described in the progress claim; and
- 4.3.2 issue a progress report, a copy of which the Departmental Representative will give to the Contractor, that indicates the value of the part of the work and the material described in the progress claim that, in the opinion of the Departmental Representative,
- 4.3.2.1 is in accordance with the contract, and
- 4.3.2.2 was not included in any other progress report relating to the contract.
- 4.4 Subject to TP1 and TP4.5 Her Majesty shall, not later than 30 days after receipt by the Departmental Representative of a progress claim referred to in TP4.2, pay the Contractor
- 4.4.1 an amount that is equal to 95% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has been furnished by the Contractor, or
- 4.4.2 an amount that is equal to 90% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has not been furnished by the Contractor.
- 4.5 It is a condition precedent to Her Majesty's obligation under TP4.4 that the Contractor has made and delivered to the Departmental Representative,
- 4.5.1 a statutory declaration described in TP4.6 in respect of a progress claim referred to in TP4.2,
- 4.5.2 in the case of the Contractor's first progress claim, a construction schedule in accordance with the relevant sections of the Specifications, and
- 4.5.3 if the requirement for a schedule is specified, an update of the said schedule at the times identified in the relevant sections of the Specifications.
- 4.6 A statutory declaration referred to in TP4.5 shall contain a deposition by the Contractor that
- 4.6.1 up to the date of the Contractor's progress claim, the Contractor has complied with all his lawful obligations with respect to the Labour Conditions; and
- 4.6.2 up to the date of the Contractor's immediately preceding progress claim, all lawful obligations of the Contractor to subcontractors and suppliers of material in respect of the



work under the contract have been fully discharged.

- 4.7 Subject to TP1 and TP4.8, Her Majesty shall, not later than 30 days after the date of issue of an Interim Certificate of Completion referred to in GC44.2, pay the Contractor the amount referred to in TP1 less the aggregate of
- 4.7.1 the sum of all payments that were made pursuant to TP4.4;
 - 4.7.2 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty or rectifying defects described in the Interim Certificate of Completion; and
 - 4.7.3 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty of completing the parts of the work described in the Interim Certificate of Completion other than the defects referred to in TP4.7.2.
- 4.8 It is a condition precedent to Her Majesty's obligation under TP4.7 that the Contractor has made and delivered to the Departmental Representative,
- 4.8.1 a statutory declaration described in TP4.9 in respect of an Interim Certificate of Completion referred to in GC44.2, and
 - 4.8.2 if so specified in the relevant sections of the Specifications, and update of the construction schedule referred to in TP4.5.2 and the updated schedule shall, in addition to the specified requirements, clearly show a detailed timetable that is acceptable to the Departmental Representative for the completion of any unfinished work and the correction of all defects.
- 4.9 A statutory declaration referred to in TP4.8 shall contain a deposition by the contractor that up to the date of the Interim Certificate of Completion the Contractor has
- 4.9.1 complied with all of the Contractor's lawful obligations with respect to the Labour Conditions;
 - 4.9.2 discharged all of the Contractor's lawful obligations to the subcontractors and suppliers of material in respect of the work under the contract; and
 - 4.9.3 discharged the Contractor's lawful obligations referred to in GC14.6.
- 4.10 Subject to TP1 and TP4.11, Her Majesty shall, not later than 60 days after the date of issue of a Final Certificate of Completion referred to in GC44.1, pay the Contractor the amount referred to in TP1 less the aggregate of
- 4.10.1 the sum of all payments that were made pursuant to TP4.4; and
 - 4.10.2 the sum of all payments that were made pursuant to TP4.7.
- 4.11 It is a condition precedent to Her Majesty's obligation under TP4.10 that the Contractor has made and delivered a statutory declaration described in TP4.12 to the Departmental Representative.



- 4.12 A statutory declaration referred to in TP4.11 shall, in addition to the depositions described in TP4.9, contain a deposition by the Contractor that all of the Contractor's lawful obligations and any lawful claims against the Contractor that arose out of the performance of the contract have been discharged and satisfied.

TP5 Progress Report and Payment Thereunder Not Binding on Her Majesty

- 5.1 Neither a progress report referred to in TP4.3 nor any payment made by Her Majesty pursuant to these Terms of Payment shall be construed as an admission by Her Majesty that the work, material or any part thereof is complete, is satisfactory or is in accordance with the contract.

TP6 Delay in Making Payment

- 6.1 Notwithstanding GC7 any delay by Her Majesty in making any payment when it is due pursuant to these Terms of Payment shall not be a breach of the contract by Her Majesty.

- 6.2 Her Majesty shall pay, without demand from the Contractor, simple interest at the Bank Rate plus 1 -1/4 per centum on any amount which is overdue pursuant to TP4.1.3, and the interest shall apply from and include the day such amount became overdue until the day prior to the date of payment except that

- 6.2.1 interest shall not be payable or paid unless the amount referred to in TP6.2 has been overdue for more that 15 days following

6.2.1.1 the date the said amount became due and payable, or

6.2.1.2 the receipt by the Departmental Representative of the Statutory Declaration referred to in TP4.5, TP4.8 or TP4.11,

whichever is the later, and

- 6.6.2 interest shall not be payable or paid on overdue advance payments if any.

TP7 Right of Set-off

- 7.1 Without limiting any right of set-off or deduction given or implied by law or elsewhere in the contract, Her Majesty may set off any amount payable to Her Majesty by the Contractor under this contract or under any current contract against any amount payable to the Contractor under this contract.

- 7.2 For the purposes of TP7.1, "current contract" means a contract between Her Majesty and the Contractor

7.2.1 under which the Contractor has an undischarged obligation to perform or supply work, labour or material, or

7.2.2 in respect of which Her Majesty has, since the date of which the Articles of Agreement were made, exercised any right to take the work that is the subject of the contract out of the Contractor's hands.



TP8 Payment in Event of Termination

- 8.1 If the contract is terminated pursuant to GC41, Her Majesty shall pay the Contractor any amount that is lawfully due and payable to the Contractor as soon as is practicable under the circumstances.

TP9 Interest on Settled Claims

- 9.1 Her Majesty shall pay to the Contractor simple interest on the amount of a settled claim at an average Bank Rate plus 1 ¼ per centum from the date the settled claim was outstanding until the day prior to the date of payment.
- 9.2 For the purposes of TP9.1,
- 9.2.1 a claim is deemed to have been settled when an agreement in writing is signed by the Departmental Representative and the Contractor setting out the amount of the claim to be paid by Her Majesty and the items or work for which the said amount is to be paid.
- 9.2.2 an "average Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the end of each calendar month averaged over the period the settled claim was outstanding.
- 9.2.3 a settled claim is deemed to be outstanding from the day immediately following the date the said claim would have been due and payable under the contract had it not been disputed.
- 9.3 For the purposes of TP9 a claim means a disputed amount subject to negotiation between Her Majesty and the Contractor under the contract.



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GC1 Interpretation

1.1 In the contract

- 1.1.1 where reference is made to a part of the contract by means of numbers preceded by letters, the reference shall be construed to be a reference to the particular part of the contract that is identified by that combination of letters and numbers and to any other part of the contract referred to therein;
- 1.1.2 “contract” means the contract document referred to in the Articles of Agreement;
- 1.1.3 “contract security” means any security given by the Contractor to Her Majesty in accordance with the contract;
- 1.1.4 “Departmental Representative” means the officer or employee of Her Majesty who is designated pursuant to the Articles of Agreement and includes a person specially authorized by him to perform, on his behalf, any of his functions under the contract and is so designated in writing to the Contractor;
- 1.1.5 “material” includes all commodities, articles and things required to be furnished by or for the Contractor under the contract for incorporation into the work;
- 1.1.6 “Minister” includes a person acting for, or if the office is vacant, in place of the Minister and his successors in the office, and his or their lawful deputy and any of his or their representatives appointed for the purposes of the contract;
- 1.1.7 “person” includes, unless the context otherwise requires, a partnership, proprietorship, firm, joint venture, consortium and a corporation;
- 1.1.8 “plant” includes all animals, tools, implements, machinery, vehicles, buildings, structures, equipment and commodities, articles and things other than material, that are necessary for the due performance of the contract;
- 1.1.9 “subcontractor” means a person to whom the Contractor has, subject to GC4, subcontracted the whole or any part of the work;
- 1.1.10 “superintendent” means the employee of the Contractor who is designated by the Contractor to act pursuant to GC19;
- 1.1.11 “work includes, subject only to any express stipulation in the contract to the contrary, everything that is necessary to be done, furnished or delivered by the Contractor to perform the contract.

1.2 The headings in the contract documents, other than in the Plans and Specifications, form no part of the contract but are inserted for convenience of reference only.

1.3 In interpreting the contract, in the event of discrepancies or conflicts between anything in the Plans and Specifications and the General Conditions, the General Conditions govern.



- 1.4 In interpreting the Plans and Specifications, in the event of discrepancies or conflicts between
- 1.4.1 the Plans and Specifications, the Specifications govern;
 - 1.4.2 the Plans, the Plans drawn with the largest scale govern; and
 - 1.4.3 figured dimensions and scaled dimensions, the figured dimensions govern.

GC2 Successors and Assigns

- 2.1 The contract shall inure to the benefit of and be binding upon the parties hereto and their lawful heirs, executors, administrators, successors and assigns.

GC3 Assignment of Contract

- 3.1 The contract may not be assigned by the Contractor, either in whole or in part, without the written consent of the Minister.

GC4 Subcontracting by Contractor

- 4.1 Subject to this General Condition, the Contractor may subcontract any part of the work.
- 4.2 The Contractor shall notify the Departmental Representative in writing of his intention to subcontract.
- 4.3 A notification referred to in GC4.2 shall identify the part of the work, and the subcontractor with whom it is intended to subcontract.
- 4.4 The Departmental Representative may object to the intended subcontracting by notifying the Contractor in writing within six days of receipt by the Departmental Representative of a notification referred to in GC4.2.
- 4.5 If the Departmental Representative objects to a subcontracting pursuant to GC4.4, the Contractor shall not enter into the intended subcontract.
- 4.6 The contractor shall not, without the written consent of the Departmental Representative, change a subcontractor who has been engaged by him in accordance with this General Condition.
- 4.7 Every subcontract entered into by the Contractor shall adopt all of the terms and conditions of this contract that are of general application.
- 4.8 Neither a subcontracting nor the Departmental Representative's consent to a subcontracting by the Contractor shall be construed to relieve the Contractor from any obligation under the contract or to impose any liability upon Her Majesty.

GC5 Amendments



- 5.1 No amendment or change in any of the provisions of the contract shall have any force or effect until it is reduced to writing.

GC6 No Implied Obligations

- 6.1 No implied terms or obligations of any kind by or on behalf of Her Majesty shall arise from anything in the contract and the express covenants and agreements therein contained and made by Her Majesty are the only covenants and agreements upon which any rights against Her Majesty are to be founded.
- 6.2 The contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work that were made prior to the date of the contract.

GC7 Time of Essence

- 7.1 Time is of the essence of the contract.

GC8 Indemnification by Contractor

- 8.1 The Contractor shall indemnify and save Her Majesty harmless from and against all claims, demand, losses, costs, damages, actions, suits, or proceedings by whomever made, brought or prosecuted and in any manner based upon, arising out of, related to, occasioned by or attributable to the activities of the Contractor, his servants, agents, subcontractors and sub-subcontractors in performing the work including an infringement or an alleged infringement of a patent of invention or any other kind of intellectual property.
- 8.2 For the purpose of GC8.1, "activities" includes any act improperly carried out, any omission to carry out an act and any delay in carrying out an act.

GC9 Indemnification by Her Majesty

- 9.1 Her Majesty shall, subject to the Crown Liability Act, the Patent Act, and any other law that affects Her Majesty's rights, powers, privileges or obligations, indemnify and save the Contractor harmless from and against all claims, demands, losses, costs, damage, actions, suits or proceedings arising out of his activities under the contract that are directly attributable to
- 9.1.1 lack of or a defect in Her Majesty's title to the work site whether real or alleged; or
- 9.1.2 an infringement or an alleged infringement by the Contractor of any patent of invention or any other kind of intellectual property occurring while the Contractor was performing any act for the purposes of the contract employing a model, plan or design or any other thing related to the work that was supplied by Her Majesty to the Contractor.

GC10 Members of House of Commons Not to Benefit



- 10.1 As required by the Parliament of Canada Act, it is an express condition of the contract that no member of the House of Commons shall be admitted to any share of part of the contract or to any benefit arising therefrom.

GC11 Notices

- 11.1 Any notice, consent, order, decision, direction or other communication, other than a notice referred to in GC11.4, that may be given to the Contractor pursuant to the contract may be given in any manner.
- 11.2 Any notice, consent, order, decision, direction or other communication required to be given in writing, to any party pursuant to the contract shall, subject to GC11.4, be deemed to have been effectively given
- 11.2.1 to the Contractor, if delivered personally to the Contractor or the Contractor's superintendent, or forwarded by mail, telex or facsimile to the Contractor at the address set out in A4.1, or
- 11.2.2 to Her Majesty, if delivered personally to the Departmental Representative, or forwarded by mail, telex or facsimile to the Departmental Representative at the address set out in A1.2.1.
- 11.3 Any such notice, consent, order, decision, direction or other communication given in accordance with GC11.2 shall be deemed to have been received by either party
- 11.3.1 if delivered personally, on the day that it was delivered,
- 11.3.2 if forwarded by mail, on the earlier of the day it was received and the sixth day after it was mailed, and
- 11.3.3 if forwarded by telex or facsimile, 24 hours after it was transmitted.
- 11.4 A notice given under GC38.1.1, GC40 and GC41, if delivered personally, shall be delivered to the Contractor if the Contractor is doing business as sole proprietor or, if the Contractor is a partnership or corporation, to an officer thereof.

GC12 Material, Plant and Real Property Supplied by Her Majesty

- 12.1 Subject to GC12.2, the Contractor is liable to Her Majesty for any loss of or damage to material, plant or real property that is supplied or placed in the care, custody and control of the Contractor by Her Majesty for use in connection with the contract, whether or not that loss or damage is attributable to causes beyond the Contractor's control.
- 12.2 The Contractor is not liable to Her Majesty for any loss or damage to material, plant or real property referred to in GC12.1 if that loss or damage results from and is directly attributable to reasonable wear and tear.
- 12.3 The Contractor shall not use any material, plant or real property referred to in GC12.1 except for



the purpose of performing this contract.

- 12.4 When the Contractor fails to make good any loss or damage for which he is liable under GC12.1 within a reasonable time after being required to do so by the Departmental Representative, the Departmental Representative may cause the loss or damage to be made good at the Contractor's expense, and the Contractor shall thereupon be liable to Her Majesty for the cost thereof and shall, on demand, pay to Her Majesty an amount equal to that cost.
- 12.5 The Contractor shall keep such records of all material, plant and real property referred to in GC12.1 as the Departmental Representative from time to time requires and shall satisfy the Departmental Representative, when requested, that such material, plant and real property are at the place and in the condition which they ought to be.

GC13 Material, Plant and Real Property Become Property of Her Majesty

- 13.1 Subject to GC14.7 all material and plant and the interest of the Contractor in all real property, licenses, powers and privileges purchased, used or consumed by the Contractor for the contract shall, after the time of their purchase, use or consumption be the property of Her Majesty for the purposes of the work and they shall continue to be the property of Her Majesty.
- 13.1.1 in the case of material, until the Departmental Representative indicates that he is satisfied that it will not be required for the work, and
- 13.1.2 in the case of plant, real property, licenses, powers and privileges, until the Departmental Representative indicates that he is satisfied that the interest vested in Her Majesty therein is no longer required for the purposes of the work.
- 13.2 Material or plant that is the property of Her Majesty by virtue of GC13.1 shall not be taken away from the work site or used or disposed of except for the purposes of the work without the written consent of the Departmental Representative.
- 13.3 Her Majesty is not liable for loss of or damage from any cause to the material or plant referred to in GC13.1 and the Contractor is liable for such loss or damage notwithstanding that the material or plant is the property of Her Majesty.

GC14 Permits and Taxes Payable

- 14.1 The Contractor shall, within 30 days after the date of the contract, tender to a municipal authority an amount equal to all fees and charges that would be lawfully payable to that municipal authority in respect of building permits as if the work were being performed for a person other than Her Majesty.
- 14.2 Within 10 days of making a tender pursuant to GC14.1, the Contractor shall notify the Departmental Representative of his action and of the amount tendered and whether or not the municipal authority has accepted that amount.
- 14.3 If the municipal authority does not accept the amount tendered pursuant to GC14.1 the Contractor shall pay that amount to Her Majesty within 6 days after the time stipulated in GC14.2.



- 14.4 For the purposes of GC14.1 to GC14.3 “municipal authority” means any authority that would have jurisdiction respecting permission to perform the work if the owner were not Her Majesty.
- 14.5 Notwithstanding the residency of the Contractor, the Contractor shall pay any applicable tax arising from or related to the performance of the work under the contract.
- 14.6 In accordance with the Statutory Declaration referred to in TP4.9, a Contractor who has neither residence nor place of business in the province in which work under the contract is being performed shall provide Her Majesty with proof of registration with the provincial sales tax authorities in the said province.
- 14.7 For the purpose of the payment of any applicable tax or the furnishing of security for the payment of any applicable tax arising from or related to the performance of the work under the contract, the Contractor shall, notwithstanding the fact that all material, plant and interest of the Contractor in all real property, licenses, powers and privileges, have become the property of Her Majesty after the time of purchase, be liable, as a user or consumer, for the payment or for the furnishing of security for the payment of any applicable tax payable, at the time of the use or consumption of that material, plant or interest of the Contractor in accordance with the relevant legislation.

GC15 Performance of Work under Direction of Departmental Representative

- 15.1 The Contractor shall
- 15.1.1 permit the Departmental Representative to have access to the work and its site at all times during the performance of the contract;
 - 15.1.2 furnish the Departmental Representative with such information respecting the performance of the contract as he may require; and
 - 15.1.3 give the Departmental Representative every possible assistance to enable the Departmental Representative to carry out his duty to see that the work is performed in accordance with the contract and to carry out any other duties and exercise any powers specially imposed or conferred on the Departmental Representative under the contract.

CG16 Cooperation with Other Contractors

- 16.1 Where, in the opinion of the Departmental Representative, it is necessary that other contractors or workers with or without plant and material, be sent onto the work or its site, the Contractor shall, to the satisfaction of the Departmental Representative, allow them access and cooperate with them in the carrying out of their duties and obligation.
- 16.2 If
- 16.2.1 the sending onto the work or its site of other contractors or workers pursuant to GC16.1 could not have been reasonably foreseen or anticipated by the Contractor when entering into the contract, and



16.2.2 the Contractor incurs, in the opinion of the Departmental Representative, extra expense in complying with GC16.1, and

16.2.3 The Contractor has given the Departmental Representative written notice of his claim for the extra expense referred to in GC16.2.2 within 30 days of the date that the other contractors or workers were sent onto the work or its site,

Her Majesty shall pay the Contractor the cost, calculated in accordance with GC48 to GC50, of the extra labour, plant and material that was necessarily incurred.

GC17 Examination of Work

17.1 If, at any time after the commencement of the work but prior to the expiry of the warranty or guarantee period, the Departmental Representative has reason to believe that the work or any part thereof has not been performed in accordance with the contract, the Departmental Representative may have that work examined by an expert of his choice.

17.2 If, as a result of an examination of the work referred to in GC17.1, it is established that the work was not performed in accordance with the contract, then, in addition to and without limiting or otherwise affecting any of Her Majesty's rights and remedies under the contract either at law or in equity, the Contractor shall pay Her Majesty, on demand, all reasonable costs and expenses that were incurred by Her Majesty in having that examination performed.

GC18 Clearing of Site

18.1 The Contractor shall maintain the work and its site in a tidy condition and free from the accumulation of waste material and debris, in accordance with any directions of the Departmental Representative.

18.2 Before the issue of an interim certificate referred to in GC44.2, the Contractor shall remove all the plant and material not required for the performance of the remaining work, and all waste material and other debris, and shall cause the work and its site to be clean and suitable for occupancy by Her Majesty's servants, unless otherwise stipulated in the contract.

18.3 Before the issue of a final certificate referred to in GC44.1, the Contractor, shall remove from the work and its site all of the surplus plant and material and any waste material and other debris.

18.4 The Contractor's obligations described in GC18.1 to GC18.3 do not extend to waste material and other debris caused by Her Majesty's servants or contractors and workers referred to in GC16.1.

GC19 Contractor's Superintendent

19.1 The Contractor shall, forthwith upon the award of the contract, designate a superintendent.

19.2 The Contractor shall forthwith notify the Departmental Representative of the name, address and telephone number of a superintendent designate pursuant to GC19.1.



- 19.3 A superintendent designated pursuant to GC19.1 shall be in full charge of the operations of the Contractor in the performance of the work and is authorized to accept any notice, consent, order, direction, decision or other communication on behalf of the Contractor that may be given to the superintendent under the contract.
- 19.4 The Contractor shall, until the work has been completed, keep a competent superintendent at the work site during working hours.
- 19.5 The Contractor shall, upon the request of the Departmental Representative, remove any superintendent who, in the opinion of the Departmental Representative, is incompetent or has been conducting himself improperly and shall forthwith designate another superintendent who is acceptable to the Departmental Representative.
- 19.6 Subject to GC19.5, the Contractor shall not substitute a superintendent without the written consent of the Departmental Representative.
- 19.7 A breach by the Contractor of GC19.6 entitles the Departmental Representative to refuse to issue any certificate referred to in GC44 until the superintendent has returned to the work site or another superintendent who is acceptable to the Departmental Representative has been substituted.

GC20 National Security

- 20.1 If the Minister is of the opinion that the work is of a class or kind that involves the national security, he may order the Contractor
- 20.1.1 to provide him with any information concerning persons employed or to be employed by him for purposes of the contract; and
 - 20.1.2 to remove any person from the work and its site if, in the opinion of the Minister, that person may be a risk to the national security.
- 20.2 The Contractor shall, in all contracts with persons who are to be employed in the performance of the contract, make provision for his performance of any obligation that may be imposed upon him under GC19 to GC21.
- 20.3 The Contractor shall comply with an order of the Minister under GC20.1

GC21 Unsuitable Workers

- 21.1 The Contractor shall, upon the request of the Departmental Representative, remove any person employed by him for purposes of the contract who, in the opinion of the Departmental Representative, is incompetent or has conducted himself improperly, and the Contractor shall not permit a person who has been removed to return to the work site.

GC22 Increased or Decreased Costs



- 22.1 The amount set out in the Articles of Agreement shall not be increased or decreased by reason of any increase or decrease in the cost of the work that is brought about by an increase or decrease in the cost of labour, plant or material or any wage adjustment arising pursuant to the Labour Conditions.
- 22.2 Notwithstanding GC22.1 and GC35, an amount set out in the Articles of Agreement shall be adjusted in the manner provided in GC22.3, if any change in a tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property
- 22.2.1 occurs after the date of the submission by the Contractor of his tender for the contract,
- 22.2.2 applies to material, and
- 22.2.3 affects the cost to the Contractor of that material.
- 22.3 If a change referred to in GC22.2 occurs, the appropriate amount set out in the Articles of Agreement shall be increased or decreased by an amount equal to the amount that is established by an examination of the relevant records of the Contractor referred to in GC51 to be the increase or decrease in the cost incurred that is directly attributable to that change.
- 22.4 For the purpose of GC22.2, where a tax is changed after the date of submission of the tender but public notice of the change has been given by the Minister of Finance before that date, the change shall be deemed to have occurred before the date of submission of the tender.

GC23 Canadian Labour and Material

- 23.1 The Contractor shall use Canadian labour and material in the performance of the work to the full extent to which they are procurable, consistent with proper economy and expeditious carrying out of the work.
- 23.2 Subject to GC23.1, the Contractor shall, in the performance of the work, employ labour from the locality where the work is being performed to the extent to which it is available, and shall use the offices of the Canada Employment Centres for the recruitment of workers wherever practicable.
- 23.3 Subject to GC23.1 and GC23.2, the Contractor shall, in the performance of the work, employ a reasonable proportion of persons who have been on active service with the armed forces of Canada and have been honourably discharged therefrom.

GC24 Protection of Work and Documents

- 24.1 The Contractor shall guard or otherwise protect the work and its site, and protect the contract, specifications, plans, drawings, information, material, plant and real property, whether or not they are supplied by Her Majesty to the Contractor, against loss or damage from any cause, and he shall not use, issue, disclose or dispose of them without the written consent of the Minister, except as may be essential for the performance of the work.



- 24.2 If any document or information given or disclosed to the Contractor is assigned a security rating by the person who gave or disclosed it, the Contractor shall take all measures directed by the Departmental Representative to be taken to ensure the maintenance of the degree of security that is ascribed to that rating.
- 24.3 The Contractor shall provide all facilities necessary for the purpose of maintaining security, and shall assist any person authorized by the Minister to inspect or to take security measures in respect of the work and its site.
- 24.4 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure compliance with or to remedy a breach of GC24.1 to GC24.3.

GC25 Public Ceremonies and Signs

- 25.1 The Contractor shall not permit any public ceremony in connection with the work without the prior consent of the Minister.
- 25.2 The Contractor shall not erect or permit the erection of any sign or advertising on the work or its site without the prior consent of the Departmental Representative.

GC26 Precautions against Damage, Infringement of Rights, Fire, and Other Hazards

- 26.1 The Contractor shall, at his own expense, do whatever is necessary to ensure that
- 26.1.1 no person, property, right, easement or privilege is injured, damaged or infringed by reasons of the Contractor's activities in performing the contract;
 - 26.1.2 pedestrian and other traffic on any public or private road or waterway is not unduly impeded, interrupted or endangered by the performance or existence of the work or plant;
 - 26.1.3 fire hazards in or about the work or its site are eliminated and, subject to any direction that may be given by the Departmental Representative, any fire is promptly extinguished;
 - 26.1.4 the health and safety of all persons employed in the performance of the work is not endangered by the method or means of its performance;
 - 26.1.5 adequate medical services are available to all persons employed on the work or its site at all times during the performance of the work;
 - 26.1.6 adequate sanitation measures are taken in respect of the work and its site; and
 - 26.1.7 all stakes, buoys and marks placed on the work or its site by or under the authority of the Departmental Representative are protected and are not removed, defaced, altered or destroyed.
- 26.2 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure



compliance with or to remedy a breach of GC26.1.

- 26.3 The Contractor shall, at his own expense, comply with a direction of the Departmental Representative made under GC26.2.

GC27 Insurance

- 27.1 The Contractor shall, at his own expense, obtain and maintain insurance contracts in respect of the work and shall provide evidence thereof to the Departmental Representative in accordance with the requirements of the Insurance Conditions "E".

- 27.2 The insurance contracts referred to in GC27.1 shall

27.2.1 be in a form, of the nature, in the amounts, for the periods and containing the terms and conditions specified in Insurance Conditions "E", and

27.2.2 provide for the payment of claims under such insurance contracts in accordance with GC28.

GC28 Insurance Proceeds

- 28.1 In the case of a claim payable under a Builders Risk/Installation (All Risks) insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid directly to Her Majesty, and

28.1.1 the monies so paid shall be held by Her Majesty for the purposes of the contract, or

28.1.2 if Her Majesty elects, shall be retained by Her Majesty, in which event they vest in Her Majesty absolutely.

- 28.2 In the case of a claim payable under a General Liability insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid by the insurer directly to the claimant.

- 28.3 If an election is made pursuant to GC28.1, the Minister may cause an audit to be made of the accounts of the Contractor and of Her Majesty in respect of the part of the work that was lost, damaged or destroyed for the purpose of establishing the difference, if any, between

28.3.1 the aggregate of the amount of the loss or damage suffered or sustained by Her Majesty, including any cost incurred in respect of the clearing and cleaning of the work and its site and any other amount that is payable by the Contractor to Her Majesty under the contract, minus any monies retained pursuant to GC28.12, and

28.3.2 the aggregate of the amounts payable by Her Majesty to the Contractor pursuant to the contract up to the date of the loss or damage.

- 28.4 A difference that is established pursuant to GC28.3 shall be paid forthwith by the party who is determined by the audit to be the debtor to the party who is determined by the audit to be the



creditor.

- 28.5 When payment of a deficiency has been made pursuant to GC28.4, all rights and obligations of Her Majesty and the Contractor under the contract shall, with respect only to the part of the work that was the subject of the audit referred to in GC28.3, be deemed to have been expended and discharged.
- 28.6 If an election is not made pursuant to GC28.1.2 the Contractor shall, subject to GC28.7, clear and clean the work and its site and restore and replace the part of the work that was lost, damaged or destroyed at his own expense as if that part of the work had not yet been performed.
- 28.7 When the Contractor clears and cleans the work and its site and restores and replaces the work referred to in GC 28.6, Her Majesty shall pay him out of the monies referred to in GC28.1 so far as they will thereunto extend.
- 28.8 Subject to GC28.7, payment by Her Majesty pursuant to GC28.7 shall be made in accordance with the contract but the amount of each payment shall be 100% of the amount claimed notwithstanding TP4.4.1 and TP4.4.2.

GC29 Contract Security

- 29.1 The Contractor shall obtain and deliver contract security to the Departmental Representative in accordance with the provisions of the Contract Security Conditions.
- 29.2 If the whole or a part of the contract security referred to in GC29.1 is in the form of a security deposit, it shall be held and disposed of in accordance with GC43 and GC45.
- 29.3 If a part of the contract security referred to in GC29.1 is in the form of a labour and material payment bond, the Contractor shall post a copy of that bond on the work site.

GC30 Changes in the Work

- 30.1 Subject to GC5, the Departmental Representative may, at any time before he issues his Final Certificate of Completion,
- 30.1.1 order work or material in addition to that provided for in the Plans and Specifications;
and
- 30.1.2 delete or change the dimensions, character, quantity, quality, description, location or position of the whole or any part of the work or material provided for in the Plans and Specifications or in any order made pursuant to GC30.1.1,
- if that additional work or material, deletion, or change is, in his opinion, consistent with the general intent of the original contract.
- 30.2 The Contractor shall perform the work in accordance with such orders, deletions and changes that are made by the Departmental Representative pursuant to GC30.1 from time to time as if they had appeared in and been part of the Plans and Specifications.



- 30.3 The Departmental Representative shall determine whether or not anything done or omitted by the Contractor pursuant to an order, deletion or change referred to in GC30.1 increased or decreased the cost of the work to the Contractor.
- 30.4 If the Departmental Representative determines pursuant to GC30.3 that the cost of the work to the Contractor has been increased, Her Majesty shall pay the Contractor the increased cost that the Contractor necessarily incurred for the additional work calculated in accordance with GC49 or GC50.
- 30.5 If the Departmental Representative determines pursuant to GC30.3 that the cost of the work to the Contractor has been decreased, Her Majesty shall reduce the amount payable to the Contractor under the contract by an amount equal to the decrease in the cost caused by the deletion or change referred to in GC30.1.2 and calculated in accordance with GC49.
- 30.6 GC30.3 to GC30.5 are applicable only to a contract or a portion of a contract for which a Fixed Price Arrangement is stipulated in the contract.
- 30.7 An order, deletion or change referred to in GC30.1 shall be in writing, signed by the Departmental Representative and given to the Contractor in accordance with GC11.

GC31 Interpretation of Contract by Departmental Representative

- 31.1 If, at any time before the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, any question arises between the parties about whether anything has been done as required by the contract or about what the Contractor is required by the contract to do, and, in particular but without limiting the generality of the foregoing, about
- 31.1.1 the meaning of anything in the Plans and Specification,
 - 31.1.2 the meaning to be given to the Plans and Specifications in case of any error therein, omission therefrom, or obscurity or discrepancy in their working or intention,
 - 31.1.3 whether or not the quality or quantity of any material or workmanship supplied or proposed to be supplied by the Contractor meets the requirements of the contract,
 - 31.1.4 whether or not the labour, plant or material provided by the Contractor for performing the work and carrying out the contract are adequate to ensure that the work will be performed in accordance with the contract and that the contract will be carried out in accordance with its terms,
 - 31.1.5 what quantity of any kind of work has been completed by the Contractor, or
 - 31.1.6 the timing and scheduling of the various phases of the performance of the work,
- the question shall be decided by the Departmental Representative whose decision shall be final and conclusive in respect of the work.
- 31.2 The Contractor shall perform the work in accordance with any decisions of the Departmental



Representative that are made under GC31.1 and in accordance with any consequential directions given by the Departmental Representative.

GC32 Warranty and Rectification of Defects in Work

32.1 Without restricting any warranty or guarantee implied or imposed by law or contained in the contract documents, the Contractor shall, at his own expense,

32.1.1 rectify and make good any defect or fault that appears in the work or comes to the attention of the Minister with respect to those parts of the work accepted in connection with the Interim Certificate of Completion referred to GC44.2 within 12 months from the date of the Interim Certificate of Completion;

32.1.2 rectify and make good any defect or fault that appears in or comes to the attention of the Minister in connection with those parts of the work described in the Interim Certificate of Completion referred to in GC44.2 within 12 months from the date of the Final Certificate of Completion referred to in GC44.1.

32.2 The Departmental Representative may direct the Contractor to rectify and make good any defect or fault referred to in GC32.1 or covered by any other expressed or implied warranty or guarantee.

32.3 A direction referred to in GC32.2 shall be in writing, may include a stipulation in respect of the time within which a defect or fault is required to be rectified and made good by the Contractor, and shall be given to the Contractor in accordance with GC11.

32.4 The Contractor shall rectify and make good any defect or fault described in a direction given pursuant to GC32.2 within the time stipulated therein.

GC33 Non-Compliance by Contractor

33.1 If the Contractor fails to comply with any decision or direction given by the Departmental Representative pursuant to GC18, GC24, GC26, GC31 or GC32, the Departmental Representative may employ such methods as he deems advisable to do that which the Contractor failed to do.

33.2 The Contractor shall, on demand, pay Her Majesty an amount that is equal to the aggregate of all cost, expenses and damage incurred or sustained by Her Majesty by reason of the Contractor's failure to comply with any decision or direction referred to in GC33.1, including the cost of any methods employed by the Departmental Representative pursuant to GC33.1.

GC34 Protesting Departmental Representative's Decisions

34.1 The Contractor may, within ten days after the communication to him of any decision or direction referred to in GC30.3 or GC33.1, protest that decision or direction.

34.2 A protest referred to in GC34.1 shall be in writing, contain full reasons for the protest, be signed



by the Contractor and be given to Her Majesty by delivery to the Departmental Representative.

- 34.3 If the Contractor gives a protest pursuant to GC34.2, any compliance by the Contractor with the decision or direction that was protested shall not be construed as an admission by the Contractor of the correctness of that decision or direction, or prevent the Contractor from taking whatever action he considers appropriate in the circumstances.
- 34.4 The giving of a protest by the Contractor pursuant to GC34.2 shall not relieve him from complying with the decision or direction that is the subject of the protest.
- 34.5 Subject to GC34.6, the Contractor shall take any action referred to in GC34.3 within three months after the date that a Final Certificate of Completion is issued under GC44.1 and not afterwards.
- 34.6 The Contractor shall take any action referred to in GC34.3 resulting from a direction under GC32 within three months after the expiry of a warranty or guarantee period and not afterwards.
- 34.7 Subject to GC34.8, if Her Majesty determines that the Contractor's protest is justified, Her Majesty shall pay the Contractor the cost of the additional labour, plant and material necessarily incurred by the Contractor in carrying out the protested decision or direction.
- 34.8 Costs referred to in GC34.7 shall be calculated in accordance with GC48 to GC50.

GC35 Changes in Soil Conditions and Neglect or Delay by Her Majesty

35.1 Subject to GC35.2 no payment, other than a payment that is expressly stipulated in the contract, shall be made by Her Majesty to the Contractor for any extra expense or any loss or damage incurred or sustained by the Contractor.

35.2 If the Contractor incurs or sustains any extra expense or any loss or damage that is directly attributable to

35.2.1 a substantial difference between the information relating to soil conditions at the work site that is contained in the Plans and Specifications or other documents supplied to the Contractor for his use in preparing his tender or a reasonable assumption of fact based thereon made by the Contractor, and the actual soil conditions encountered by the Contractor at the work site during the performance of the contract, or

35.2.2 any neglect or delay that occurs after the date of the contract on the part of Her Majesty in providing any information or in doing any act that the contract either expressly requires Her Majesty to do or that would ordinarily be done by an owner in accordance with the usage of the trade,

he shall, within ten days of the date the actual soil conditions described in GC35.2.1 were encountered or the neglect or delay described in GC35.2.2 occurred, give the Departmental Representative written notice of his intention to claim for that extra expense or that loss or damage.

35.3 When the Contractor has given a notice referred to in GC35.2, he shall give the Departmental Representative a written claim for extra expense or loss or damage within 30 days of the date that



a Final Certificate of Completion referred to in GC44.1 is issued and not afterwards.

- 35.4 A written claim referred to in GC35.3 shall contain a sufficient description of the facts and circumstances of the occurrence that is the subject of the claim to enable the Departmental Representative to determine whether or not the claim is justified and the Contractor shall supply such further and other information for that purpose as the Departmental Representative requires from time to time.
- 35.5 If the Departmental Representative determines that a claim referred to in GC35.3 is justified, Her Majesty shall make an extra payment to the Contractor in an amount that is calculated in accordance with GC47 to GC50.
- 35.6 If, in the opinion of the Departmental Representative, an occurrence described in GC35.2.1 results in a savings of expenditure by the Contractor in performing the contract, the amount set out in the Articles of Agreement shall, subject to GC35.7, be reduced by an amount that is equal to the saving.
- 35.7 The amount of the saving referred to in GC35.6 shall be determined in accordance with GC47 to GC49.
- 35.8 If the Contractor fails to give a notice referred to in GC35.2 and a claim referred to in GC35.3 within the times stipulated, an extra payment shall not be made to him in respect of the occurrence.

GC36 Extension of Time

- 36.1 Subject to GC36.2, the Departmental Representative may, on the application of the Contractor made before the day fixed by the Articles of Agreement for completion of the work or before any other date previously fixed under this General Condition, extend the time for its completion by fixing a new date if, in the opinion of the Departmental Representative, causes beyond the control of the Contractor have delayed its completion.
- 36.2 An application referred to in GC36.1 shall be accompanied by the written consent of the bonding company whose bond forms part of the contract security.

GC37 Assessments and Damages for Late Completion

- 37.1 For the purposes of this General Condition
- 37.1.1 the work shall be deemed to be completed on the date that an Interim Certificate of Completion referred to in GC44.2 is issued, and
- 37.1.2 "period of delay" means the number of days commencing on the day fixed by the Articles of Agreement for completion of the work and ending on the day immediately preceding the day on which the work is completed but does not include any day within a period of extension granted pursuant to GC36.1, and any other day on which, in the opinion of the Departmental Representative, completion of the work was delayed for reasons beyond the control of the Contractor.



- 37.2 If the Contractor does not complete the work by the day fixed for its completion by the Articles of Agreement but completes it thereafter, the Contractor shall pay Her Majesty an amount equal to the aggregate of
- 37.2.1 all salaries, wages and travelling expenses incurred by Her Majesty in respect of persons overseeing the performance of the work during the period of delay;
 - 37.2.2 the cost incurred by Her Majesty as a result of the inability to use the completed work for the period of delay; and
 - 37.2.3 all other expenses and damages incurred or sustained by Her Majesty during the period of delay as a result of the work not being completed by the day fixed for its completion.
- 37.3 The Minister may waive the right of Her Majesty to the whole or any part of the amount payable by the Contractor pursuant to GC37.2 I, in the opinion of the Minister, it is in the public interest to do so.

GC38 Taking the Work Out of the Contractor's Hands

- 38.1 The Minister may, at his sole discretion, by giving a notice in writing to the Contractor in accordance with GC11, take all or any part of the work out of the Contractor's hands, and may employ such means as he sees fit to have the work completed if the Contractor
- 38.1.1 Has not, within six days of the Minister or the Departmental Representative giving notice to the Contractor in writing in accordance with GC11, remedied any delay in the commencement or any default in the diligent performance of the work to the satisfaction of the Departmental Representative;
 - 38.1.2 has defaulted in the completion of any part of the work within the time fixed for its completion by the contract;
 - 38.1.3 has become insolvent;
 - 38.1.4 has committed an act of bankruptcy;
 - 38.1.5 has abandoned the work;
 - 38.1.6 has made an assignment of the contract without the consent required by GC3.1; or
 - 38.1.7 has otherwise failed to observe or perform any of the provisions of the contract.
- 38.2 If the whole or any part of the work is taken out of the Contractor's hands pursuant to GC38.1,
- 38.2.1 the Contractor's right to any further payment that is due or accruing due under the contract is, subject only to GC38.4, extinguished, and
 - 38.2.2 the Contractor is liable to pay Her Majesty, upon demand, an amount that is equal to the amount of all loss and damage incurred or sustained by Her Majesty in respect of the



Contractor's failure to complete the work.

- 38.3 If the whole or any part of the work that is taken out of the Contractor's hands pursuant to GC38.1 is completed by Her Majesty, the Departmental Representative shall determine the amount, if any, of the holdback or a progress claim that had accrued and was due prior to the date on which the work was taken out of the Contractor's hands and that is not required for the purposes of having the work performed or of compensating Her Majesty for any other loss or damage incurred or sustained by reason of the Contractor's default.
- 38.4 Her Majesty may pay the Contractor the amount determined not to be required pursuant to GC38.3.

GC39 Effect of Taking the Work Out of the Contractor's Hands

- 39.1 The taking of the work or any part thereof out of the Contractor's hands pursuant to GC38 does not operate so as to relieve or discharge him from any obligation under the contract or imposed upon him by law except the obligation to complete the performance of that part of the work that was taken out of his hands.
- 39.2 If the work or any part thereof is taken out of the Contractor's hands pursuant to GC38, all plant and material and the interest of the Contractor is all real property, licenses, powers and privileges acquired, used or provided by the Contractor under the contract shall continue to be the property of Her Majesty without compensation to the Contractor.
- 39.3 When the Departmental Representative certifies that any plant, material, or any interest of the Contractor referred to in GC39.2 is no longer required for the purposes of the work, or that it is not in the interest of Her Majesty to retain that plant, material or interest, it shall revert to the Contractor.

G40 Suspension of Work by Minister

- 40.1 The Minister may, when in his opinion it is in the public interest to do so, require the Contractor to suspend performance of the work either for a specified or an unspecified period by giving a notice of suspension in writing to the Contractor in accordance with GC11.
- 40.2 When a notice referred to in GC40.1 is received by the Contractor in accordance with GC11, he shall suspend all operations in respect of the work except those that, in the opinion of the Departmental Representative, are necessary for the care and preservation of the work, plant and material.
- 40.3 The Contractor shall not, during a period of suspension, remove any part of the work, plant or material from its site without the consent of the Departmental Representative.
- 40.4 If a period of suspension is 30 days or less, the Contractor shall, upon the expiration of that period, resume the performance of the work and he is entitled to be paid the extra cost, calculated in accordance with GC48 to GC50, of any labour, plant and material necessarily incurred by him as a result of the suspension.



- 40.5 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor agree that the performance of the work will be continued by the Contractor, the Contractor shall resume performance of the work subject to any terms and conditions agreed upon by the Minister and the Contractor.
- 40.6 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor do not agree that performance of the work will be continued by the Contractor or upon the terms and conditions under which the Contractor will continue the work, the notice of suspension shall be deemed to be a notice of termination pursuant to GC41.

GC41 Termination of Contract

- 41.1 The Minister may terminate the contract at any time by giving a notice of termination in writing to the Contractor in accordance with GC11.
- 41.2 When a notice referred to in GC41.1 is received by the Contractor in accordance with GC11, he shall, subject to any conditions stipulated in the notice, forthwith cease all operations in performance of the contract.
- 41.3 If the contract is terminated pursuant to GC41.1, Her Majesty shall pay the Contractor, subject to GC41.4, an amount equal to
- 41.3.1 the cost to the contractor of all labour, plant and material supplied by him under the contract up to the date of termination in respect of a contract or part thereof for which a Unit Price Arrangement is stipulated in the contract, or
 - 41.3.2 the lesser of
 - 41.3.2.1 an amount, calculated in accordance with the Terms and Payment, that would have been payable to the Contractor had he completed the work, and
 - 41.3.2.2 an amount that is determined to be due to the Contractor pursuant to GC49 in respect of a contract or part thereof for which a Fixed Price Arrangement is stipulated in the contract
- less the aggregate of all amounts that were paid to the Contractor by Her Majesty and all amounts that are due to Her Majesty from the Contractor pursuant to the contract.
- 41.4 If Her Majesty and the Contractor are unable to agree about an amount referred to in GC41.3 that amount shall be determined by the method referred to in GC50.

GC42 Claims Against and Obligations of the Contractor or Subcontractor

- 42.1 Her Majesty may, in order to discharge lawful obligations of and satisfy claims against the Contractor or a subcontractor arising out of the performance of the contract, pay any amount that is due and payable to the Contractor pursuant to the contract directly to the obligees of and the claimants against the Contractor or the subcontractor but such amount if any, as is paid by Her Majesty, shall not exceed that amount which the Contractor would have been obliged to pay to



such claimant had the provisions of the Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, been applicable to the work. Any such claimant need not comply with the provisions of such legislation setting out the steps by way of notice, registration or otherwise as might have been necessary to preserve or perfect any claim for lien or privilege which claimant might have had;

42.2 Her Majesty will not make any payment as described in GC42.1 unless and until that claimant shall have delivered to Her Majesty:

42.2.1 a binding and enforceable Judgment or Order of a court of competent jurisdiction setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.2 a final and enforceable award of an arbitrator setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.3 the consent of the Contractor authorizing a payment.

For the purposes of determining the entitlement of a claimant pursuant to GC42.2.1 and GC42.2.2, the notice required by GC42.8 shall be deemed to replace the registration or provision of notice after the performance of work as required by any applicable legislation and no claim shall be deemed to have expired, become void or unenforceable by reason of the claimant not commencing any action within the time prescribed by any applicable legislation.

42.3 The Contractor shall, by the execution of his contract, be deemed to have consented to submit to binding arbitration at the request of any claimant those questions that need be answered to establish the entitlement of the claimant to payment pursuant to the provisions of GC42.1 and such arbitration shall have as parties to it any subcontractor to whom the claimant supplied material, performed work or rented equipment should such subcontractor wish to be adjoined and the Crown shall not be a party to such arbitration and, subject to any agreement between the Contractor and the claimant to the contrary, the arbitration shall be conducted in accordance with the Provincial or Territorial legislation governing arbitration applicable in the Province or Territory in which the work is located.

42.4 A payment made pursuant to GC42.1 is, to the extent of the payment, a discharge of Her Majesty's liability to the Contractor under the contract and may be deducted from any amount payable to the Contractor under the contract.

42.5 To the extent that the circumstances of the work being performed for Her Majesty permit, the Contractor shall comply with all laws in force in the Province or Territory where the work is being performed relating to payment period, mandatory holdbacks, and creation and enforcement of mechanics' liens, builders' liens or similar legislation or in the Province of Quebec, the law relating to privileges.

42.6 The Contractor shall discharge all his lawful obligations and shall satisfy all lawful claims against him arising out of the performance of the work at least as often as the contract requires Her



Majesty to pay the Contractor.

- 42.7 The Contractor shall, whenever requested to do so by the Departmental Representative, make a statutory declaration deposing to the existence and condition of any obligations and claims referred to in GC42.6.
- 42.8 GC42.1 shall only apply to claims and obligations
- 42.8.1 the notification of which has been received by the Departmental Representative in writing before payment is made to the Contractor pursuant to TP4.10 and within 120 days of the date on which the claimant
- 42.8.1.1 should have been paid in full under the claimant's contract with the Contractor or subcontractor where the claim is for money that was lawfully required to be held back from the claimant; or
- 42.8.1.2 performed the last of the services, work or labour, or furnished the last of the material pursuant to the claimant's contract with the Contractor or subcontractor where the claim is not for money referred to in GC42.8.1.1, and
- 42.8.2 the proceedings to determine the right to payment of which, pursuant to GC42.2. shall have commenced within one year from the date that the notice referred to in GC42.8.1 was received by the Departmental Representative, and
- the notification required by GC42.8.1 shall set forth the amount claimed to be owing and the person who by contract is primarily liable.
- 42.9 Her Majesty may, upon receipt of a notice of claim under GC42.8.1, withhold from any amount that is due and payable to the Contractor pursuant to the contract the full amount of the claim or any portion thereof.
- 42.10 The Departmental Representative shall notify the Contractor in writing of receipt of any claim referred to in GC42.8.1 and of the intention of Her Majesty to withhold funds pursuant to GC42.9 and the Contractor may, at any time thereafter and until payment is made to the claimant, be entitled to post, with Her Majesty, security in a form acceptable to Her Majesty in an amount equal to the value of the claim, the notice of which is received by the Departmental Representative and upon receipt of such security Her Majesty shall release to the Contractor any funds which would be otherwise payable to the Contractor, that were withheld pursuant to the provisions of GC42.9 in respect of the claim of any claimant for whom the security stands.

GC43 Security Deposit – Forfeiture or Return

- 43.1 If
- 43.1.1 the work is taken out of the Contractor's hands pursuant to GC38,
- 43.1.2 the contract is terminated pursuant to GC41, or
- 43.1.3 the Contractor is in breach of or in default under the contract,



Her Majesty may convert the security deposit, if any, to Her own use.

- 43.2 If Her Majesty converts the contract security pursuant to GC43.1, the amount realized shall be deemed to be an amount due from Her Majesty to the Contractor under the contract.
- 43.3 Any balance of an amount referred to in GC43.2 that remains after payment of all losses, damage and claims of Her Majesty and others shall be paid by Her Majesty to the Contractor if, in the opinion of the Departmental Representative, it is not required for the purposes of the contract.

GC44 Departmental Representative's Certificates

44.1 On the date that

44.1.1 the work has been completed, and

44.1.2 the Contractor has complied with the contract and all orders and directions made pursuant thereto,

both to the satisfaction of the Departmental Representative, the Departmental Representative shall issue a Final Certificate of Completion to the Contractor.

44.2 If the Departmental Representative is satisfied that the work is substantially complete he shall, at any time before he issues a certificate referred to in GC44.1, issue an Interim Certificate of Completion to the Contractor, and

44.2.1 for the purposes of GC44.2 the work will be considered to be substantially complete,

44.2.1.1 when the work under the contract or a substantial part thereof is, in the opinion of the Departmental Representative, ready for use by Her Majesty or is being used for the purpose intended; and

44.2.1.2 when the work remaining to be done under the contract is, in the opinion of the Departmental Representative, capable of completion or correction at accost of not more than

44.2.1.2.1 -3% of the first \$500,000, and

44.2.1.2.2 -2% of the next \$500,000, and

44.2.1.2.3 -1% of the balance

of the value of the contract at the time this cost is calculated.

44.3 For the sole purpose of GC44.2.1.2, where the work or a substantial part thereof is ready for use or is being used for the purposes intended and the remainder of the work or a part thereof cannot be completed by the time specified in A2.1, or as amended pursuant to GC36, for reasons beyond the control of the Contractor or where the Departmental Representative and the Contractor agree not to complete a part of the work within the specified time, the cost of that part of the work



which was either beyond the control of the Contractor to complete or the Departmental Representative and the Contractor have agreed not to complete by the time specified shall be deducted from the value of the contract referred to GC44.2.1.2 and the said cost shall not form part of the cost of the work remaining to be done in determining substantial completion.

44.4 An Interim Certificate of Completion referred to in GC44.2 shall describe the parts of the work not completed to the satisfaction of the Departmental Representative and all things that must be done by the Contractor

44.4.1 before a Final Certificate of Completion referred to in GC44.1 will be issued, and

44.4.2 before the 12-month period referred to in GC32.1.2 shall commence for the said parts and all the said things.

44.5 The Departmental Representative may, in addition to the parts of the work described in an Interim Certificate of Completion referred to in GC44.2, require the Contractor to rectify any other parts of the work not completed to his satisfaction and to do any other things that are necessary for the satisfactory completion of the work.

44.6 If the contract or a part thereof is subject to a Unit Price Arrangement, the Departmental Representative shall measure and record the quantities of labour, plant and material, performed, used and supplied by the Contractor in performing the work and shall, at the request of the Contractor, inform him of those measurements.

44.7 The Contractor shall assist and co-operate with the Departmental Representative in the performance of his duties referred to in GC44.6 and shall be entitled to inspect any record made by the Departmental Representative pursuant to GC44.6.

44.8 After the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, he shall, if GC44.6 applies, issue a Final Certificate of Measurement.

44.9 A Final Certificate of Measurement referred to in GC44.8 shall

44.9.1 contain the aggregate of all measurements of quantities referred to in GC44.6, and

44.9.2 be binding upon and conclusive between Her Majesty and the Contractor as to the quantities referred to therein.

GC45 Return of Security Deposit

45.1 After an Interim Certificate of Completion referred to in GC44.2 has been issued, Her Majesty shall, if the Contractor is not in breach of or in default under the contract, return to the Contractor all or any part of the security deposit that, in the opinion of the Departmental Representative, is not required for the purposes of the contract.

45.2 After a Final Certificate of Completion referred to in GC44.1 has been issued, Her Majesty shall return to the Contractor the remainder of any security deposit unless the contract stipulates otherwise.



- 45.3 If the security deposit was paid into the Consolidated Revenue Fund of Canada, Her Majesty shall pay interest thereon to the Contractor at a rate established from time to time pursuant to section 21(2) of the Financial Administration Act.

GC46 Clarification of Terms in GC47 to GC50

- 46.1 For the purposes of GC47 to GC50,
- 46.1.1 "Unit Price Table" means the table set out in the Articles of Agreement, and
- 46.1.2 "plant" does not include tools customarily provided by a tradesman in practicing his trade.

GC47 Additions or Amendments to Unit Price Table

- 47.1 Where a Unit Price Arrangement applies to the contract or a part thereof the Departmental Representative and the Contractor may, by an agreement in writing,
- 47.1.1 add classes of labour or material, and units of measurement, prices per unit and estimated quantities to the Unit Price Table if any labour, plant or material that is to be included in the Final Certificate of Measurement referred to in GC44.8 is not included in any class of labour, plant or material set out in the Unit Price Table; or
- 47.1.2 subject to GC47.2 and GC47.3, amend a price set out in the Unit Price Table for any class of labour, plant or material included therein if the Final Certificate of Measurement referred to in GC44.8 shows or is expected to show that the total quantity of that class of labour, plant or material actually performed, used or supplied by the Contractor in performing the work is
- 47.1.2.1 less than 85% of that estimated total quantity, or
- 47.1.2.2 in excess of 115% of that estimated total quantity.
- 47.2 In no event shall the total cost of an item set out in the Unit Price Table that has been amended pursuant to GC47.1.2.1 exceed the amount that would have been payable to the Contractor had the estimated total quantity actually been performed, used or supplied.
- 47.3 An amendment that is made necessary by GC47.1.2.2 shall apply only to the quantities that are in excess of 115%.
- 47.4 If the Departmental Representative and the Contractor do not agree as contemplated in GC47.1, the Departmental Representative shall determine the class and the unit of measurement of the labour, plant or material and, subject to GC47.2 and GC47.3, the price per unit therefore shall be determined in accordance with GC50.

GC48 Determination of Cost – Unit Price Table



- 48.1 Whenever, for the purposes of the contract, it is necessary to determine the cost of labour, plant or material, it shall be determined by multiplying the quantity of that labour, plant or material expressed in the unit set out in column 3 of the Unit Price Table by the price of that unit set out in column 5 of the Unit Price Table.

GC49 Determination of Cost – Negotiation

- 49.1 If the method described in GC48 cannot be used because the labour, plant or material is of a kind or class that is not set out in the Unit Price Table, the cost of that labour, plant or material for the purposes of the contract shall be the amount agreed upon from time to time by the Contractor and the Departmental Representative.
- 49.2 For the purposes of GC49.1, the Contractor shall submit to the Departmental Representative any necessary cost information requested by the Departmental Representative in respect of the labour, plant and material referred to in GC49.1

GC50 Determination of Cost – Failing Negotiation

- 50.1 If the methods described in GC47, GC48 or GC49 fail for any reason to achieve a determination of the cost of labour, plant and material for the purposes referred to therein, that cost shall be equal to the aggregate of
- 50.1.1 all reasonable and proper amounts actually expended or legally payable by the Contractor in respect of the labour, plant and material that falls within one of the classes of expenditure described in GC50.2 that are directly attributable to the performance of the contract,
 - 50.1.2 an allowance for profit and all other expenditures or costs, including overhead, general administration cost, financing and interest charges, and every other cost, charge and expenses, but not including those referred to in GC50.1.1 or GC50.1.3 or a class referred to in GC50.2, in an amount that is equal to 10% of the sum of the expenses referred to in GC50.1.1, and
 - 50.1.3 interest on the cost determined under GC50.1.1 and GC50.1.2, which interest shall be calculated in accordance with TP9,

provide that the total cost of an item set out in the Unit Price Table that is subject to the provisions of GC47.1.2.1 does not exceed the amount that would have been payable to the Contractor had the estimated total quantity of the said item actually be performed, used or supplied.

- 50.2 For purposes of GC50.1.1 the classes of expenditure that may be taken into account in determining the cost of labour, plant and material are,
- 50.2.1 payments to subcontractors;
 - 50.2.2 wages, salaries and travelling expenses of employees of the Contractor while they are actually and properly engaged on the work, other than wages, salaries, bonuses, living



and travelling expenses of personnel of the Contractor generally employed at the head office or at a general office of the Contractor unless they are engaged at the work site with the approval of the Departmental Representative,

- 50.2.3 assessments payable under any statutory authority relating to workmen's compensation, unemployment insurance, pension plan or holidays with pay;
- 50.2.4 rent that is paid for plant or an amount equivalent of the said rent if the plant is owned by the Contractor that is necessary for and used in the performance of the work, if the rent of the equivalent amount is reasonable and use of that plant has been approved by the Departmental Representative;
- 50.2.5 payments for maintaining and operating plant necessary for and used in the performance of the work, and payments for effecting such repairs thereto as, in the opinion of the Departmental Representative, are necessary to the proper performance of the contract other than payments for any repairs to the plant arising out of defects existing before its allocation to the work;
- 50.2.6 payments for material that is necessary for and incorporated in the work, or that is necessary for and consumed in the performance of the contract;
- 50.2.7 payments for preparation, delivery, handling, erection, installation, inspection protection and removal of the plant and material necessary for and used in the performance of the contract; and
- 50.2.8 any other payments made by the Contractor with the approval of the Departmental Representative that are necessary for the performance of the contract.

GC51 Records to be kept by Contractor

51.1 The Contractor shall

- 51.1.1 maintain full records of his estimated and actual cost of the work together with all tender calls, quotations, contracts, correspondence, invoices, receipts and vouchers relating thereto.
- 51.1.2 make all records and material referred to in GC5.1.1 available to audit and inspection by the Minister and the Deputy Receiver General for Canada or by persons acting on behalf of either of both of them, when requested;
- 51.1.3 allow any of the person referred to in GC51.1.2 to make copies of and to take extracts from any of the records and material referred to in GC51.1.1; and
- 51.1.4 furnish any person referred to in GC51.1.2 with any information he may require from time to time in connection with such records and material.

- 51.2 The records maintained by the Contractor pursuant to GC51.1.1 shall be kept intact by the Contractor until the expiration of two years after the date that a Final Certificate of Completion referred to in GC44.1 was issued or until the expiration of such other period of time as the



Minister may direct.

- 51.3 The Contractor shall cause all subcontractors and all other persons directly or indirectly controlled by or affiliated with the Contractor and all persons directly or indirectly having control of the Contractor to comply with GC51.1 and GC51.2 as if they were the Contractor.

GC52 Conflict of Interest

- 52.1 It is a term of this contract that no former public office holder who is not in compliance with the Conflict of Interest and Post-Employment Code for Public Office Holders shall derive a direct benefit from this contract.

GC53 Contractor Status

- 53.1 The Contractor shall be engaged under the contract as an independent contractor.
- 53.2 The Contractor and any employee of the said Contractor is not engaged by the contract as an employee, servant or agent of Her Majesty.
- 53.3 For the purposes of GC53.1 and GC53.2 the Contractor shall be solely responsible for any and all payments and deductions required to be made by law including those required for Canada or Quebec Pension Plans, Unemployment Insurance, Worker's Compensation or Income Tax.



GENERAL CONDITONS

- IC 1 Proof of Insurance**
- IC 2 Risk Management**
- IC 3 Payment of Deductible**
- IC 4 Insurance Coverage**

GENERAL INSUANCE COVERAGES

- GCI 1 Insured**
- GIC 2 Period of Insurance**
- GIC 3 Proof of Insurance**
- GIC 4 Notification**

COMMERCIAL GENERAL LIABILITY

- CGL 1 Scope of Policy**
- CGL 2 Coverages/Provisions**
- CGL 3 Additional Exposures**
- CGL 4 Insurance Proceeds**
- CGL 5 Deductible**

BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

- BR 1 Scope of Policy**
- BR 2 Property Insured**
- BR 3 Insurance Proceeds**
- BR 4 Amount of Insurance**
- BR 5 Deductible**
- BR 6 Subrogation**
- BR 7 Exclusion Qualifications**

INSURER'S CERTIFICATE OF INSURANCE



General Conditions

IC 1 Proof of Insurance (02/12/03)

Within thirty (30) days after acceptance of the Contractor's tender, the Contractor shall, unless otherwise directed in writing by the Contracting Officer, deposit with the Contracting Officer an Insurer's Certificate of Insurance in the form displayed in this document and, if requested by the Contracting Officer, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the Insurance Coverage Requirements shown hereunder.

IC 2 Risk Management (01/10/94)

The provisions of the Insurance Coverage Requirements contained hereunder are not intended to cover all of the Contractor's obligations under GC8 of the General Conditions "C" of the contract. Any additional risk management measures or additional insurance coverages the Contractor may deem necessary to fulfill its obligations under GC8 shall be at its own discretion and expense.

IC 3 Payment of Deductible (01/10/94)

The payment of monies up to the deductible amount made in satisfaction of a claim shall be borne by the Contractor.

IC 4 Insurance Coverage (02/12/03)

The Contractor has represented that it has in place and effect the appropriate and usual liability insurance coverage as required by these Insurance Conditions and the Contractor has warranted that it shall obtain, in a timely manner and prior to commencement of the Work, the appropriate and usual property insurance coverage as required by these Insurance Conditions and, further, that it shall maintain all required insurance policies in place and effect as required by these Insurance Conditions.



INSURANCE COVERAGE REQUIREMENTS

PART I GENERAL INSURANCE COVERAGES (GIC)

GCI 1 Insured (02/12/03)

Each insurance policy shall insure the Contractor, and shall include, as an Additional Named Insured, Her Majesty the Queen in right of Canada, represented by the National Research Council Canada.

GIC 2 Period of Insurance (02/12/03)

Unless otherwise directed in writing by the Contracting Officer or otherwise stipulated elsewhere in these Insurance Conditions, the policies required hereunder shall be in force and be maintained from the date of the contract award until the day of issue of the Departmental Representative's Final Certificate of Completion.

GIC 3 Proof of Insurance (01/10/94)

Within twenty five (25) days after acceptance of the Contractor's tender, the Insurer shall, unless otherwise directed by the Contractor, deposit with the Contractor an Insurer's Certificate of Insurance in the form displayed in the document and, if requested, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the requirements of these Insurance Coverages.

GIC 4 Notification (01/10/94)

Each Insurance policy shall contain a provision that (30) days prior written notice shall be given by the Insurer to Her Majesty in the event of any material change in or cancellation of coverage. Any such notice received by the Contractor shall be transmitted forthwith to Her Majesty.

PART II COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy (01/10/94)

The policy shall be written on a form similar to that known and referred to in the insurance industry as IBC 2100 – Commercial General Liability policy (Occurrence form) and shall provide for limit of liability of not less than \$2,000,000 inclusive for Bodily Injury and Property Damage for any one occurrence or series of occurrences arising out of one cause. Legal or defence cost incurred in respect of a claim or claims shall not operate to decrease the limit of liability.

CGL 2 Coverages/Provisions (01/10/94)



The policy shall include but not necessarily be limited to the following coverages/provisions.

- 2.1 Liability arising out of or resulting from the ownership, existence, maintenance or use of premises by the Contractor and operations necessary or incidental to the performance of this contract.
- 2.2 "Broad Form" Property Damage including the loss of use of property.
- 2.3 Removal or weakening of support of any building or land whether such support be natural or otherwise.
- 2.4 Elevator liability (including escalators, hoists and similar devices).
- 2.5 Contractor's Protective Liability
- 2.6 Contractual and Assumed Liabilities un this contact.
- 2.7 Completed Operations Liability – The insurance, including all aspects of this Part II of these Insurance Conditions shall continue for a period of at least one (1) year beyond the date of the Departmental Representative's Final Certificate of Completion for the Completed Operations.
- 2.8 Cross Liability – The Clause shall be written as follows:

Cross Liability – The insurance as is afforded by this policy shall apply in respect to any claim or action brought against any one Insured by any other Insured. The coverage shall apply in the same manner and to the same extent as though a separate policy had been issued to each Insured. The inclusion herein of more than one Insured shall not increase the limit of the Insurer's liability.

- 2.9 Severability of Interests – The Clause shall be written as follows:

Severability of Interests – This policy, subject to the limits of liability stated herein, shall apply separately to each Insured in the same manner and to the same extent as if a separate policy had been issued to each. The inclusion herein of more than one insured shall not increase the limit of the Insurer's liability.

CGL 3 Additional Exposures (02/12/03)

The policy shall either include or be endorsed to include the following exposures of hazards if the Work is subject thereto:

- 3.1 Blasting
- 3.2 Pile driving and calsson work
- 3.3 Underpinning
- 3.4 Risks associated with the activities of the Contractor on an active airport



- 3.5 Radioactive contamination resulting from the use of commercial isotopes
- 3.6 Damage to the portion of an existing building beyond that directly associated with an addition, renovation or installation contract.
- 3.7 Marine risks associated with the contraction of piers, wharves and docks.

**CGL 4 Insurance Proceeds
(01/10/94)**

Insurance Proceeds from this policy are usually payable directly to a Claimant/Third Party.

**CGL 5 Deductible
(02/12/03)**

This policy shall be issued with a deductible amount of not more than \$10,000 per occurrence applying to Property Damage claims only.

**PART III
BUILDER'S RISK - INSTALLATION FLOATER - ALL RISKS**

**BR 1 Scope of Policy
(01/10/94)**

The policy shall be written on an "All Risks" basis granting coverages similar to those provided by the forms known and referred to in the insurance industry as "Builder's Risk Comprehensive Form" or "Installation Floater - All Risks".

**BR 2 Property Insured
(01/10/94)**

The property insured shall include:

- 2.1 The Work and all property, equipment and materials intended to become part of the finished Work at the site of the project while awaiting, during and after installation, erection or construction including testing.
- 2.2 Expenses incurred in the removal from the construction site of debris of the property insured, including demolition of damaged property, de-icing and dewatering, occasioned by loss, destruction or damage to such property and in respect of which insurance is provided by this policy.

**BR 3 Insurance Proceeds
(01/10/94)**

- 3.1 Insurance proceeds from this policy are payable in accordance with GC28 of the General Conditions "C" of the contract.
- 3.2 This policy shall provide that the proceeds thereof are payable to Her Majesty or as the Minister may direct.



- 3.3 The Contractor shall do such things and execute such documents as are necessary to effect payment of the proceeds.

BR 4 Amount of Insurance
(01/10/94)

The amount of insurance shall not be less than the sum of the contract value plus the declared value (if any) set forth in the contract documents of all material and equipment supplied by Her Majesty at the site of the project to be incorporated into and form part of the finished Work.

BR 5 Deductible
(02/12/03)

The Policy shall be issued with a deductible amount of not more than \$10,000.

BR 6 Subrogation
(01/10/94)

The following Clause shall be included in the policy:

"All rights of subrogation or transfer of rights are hereby waived against any corporation, firm, individual or other interest, with respect to which, insurance is provided by this policy".

BR 7 Exclusion Qualifications
(01/10/94)

The policy may be subject to the standard exclusions but the following qualifications shall apply:

- 7.1 Faulty materials, workmanship or design may be excluded only to the extent of the cost of making good thereof and shall not apply to loss or damage resulting therefrom.
- 7.2 Loss or damage caused by contamination by radioactive material may be excluded except for loss or damage resulting from commercial isotopes used for industrial measurements, inspection, quality control radiographic or photographic use.
- 7.3 Use and occupancy of the project or any part of section thereof shall be permitted where such use and occupancy is for the purpose for which the project is intended upon completion.



INSURER'S CERTIFICATE OF INSURANCE

(TO BE COMPLETED BY INSURER (NOT BOKER) AND DELIVERD TO NATIONAL RESEARCH COUNCIL CANADA WITH 30 DAYS FOLLOWING ACCEPTANCE OF TENDER)

CONTRACT

DESCRIPTION OF WORK	CONTRACT NUMBER	AWARD DATE
LOCATION		

INSURER

NAME
ADDRESS

BROKER

NAME
ADDRESS

INSURED

NAME OF CONTRACTOR
ADDRESS

ADDITIONAL INSURED

HER MAJESTY THE QUEEN IN RIGHT OF CANADA AS REPRESENTED BY THE NATIONAL RESEARCH COUNCIL CANADA

THIS DOCUENT CERTIFIES THAT THE FOLLOWING POLICES OF INSURANCE ARE AT PRESENT IN FORCE COVERING ALL OPERATIONS OF THE INSURE IN CONNECTION WITH THE CONTRACT MADE BETWEEN THE NAMED INSURED AND THE NATIONAL RESEARCH COUNCIL CANADA AND IN ACCORDANCE WITH THE INSURANCE CONDITIONS "E"

POLICY					
TYPE	NUMBER	INCEPTION DATE	EXPIRY DATE	LIMITS OF LIABILITY	DEDUCTIBLE
COMMERCIAL GENERAL LIABILITY					
BUILDERS RISK "AL RISKS"					
INSTALLATION FLOATER "ALL RISKS"					

THE INSURER AGREES TO NOTIFY THE NATIONAL RESEARCH COUNCIL CANADA IN WRITING 30 DAYS PRIOR TO ANY MATERIAL CHANGE IN OR CANCELLATION OF ANY POLICY OR COVERAGE SPECIFICALLY RELATED TO THE CONTRACT

NAME OF INSURER'S OFFICER OR AUTHORIZED EMPLOYEE	SIGNATURE	DATE:
		TELEPHONE NUMBER:

ISSUANCE OF THIS CERTIFIATE SHALL NOT LIMIT OR RESTRICT THE RIGHT OF THE NATIONAL RESEARCH COUNCIL CANADA TO REQUEST AT ANY TIME DUPLICATE COPIES OF SAID INSURANCE POLICIES



CS1 Obligation to provide Contract Security

- 1.1 The Contractor shall, at the Contractor's own expense, provide one or more of the forms of contract security prescribed in CS2.
- 1.2 The Contractor shall deliver to the Departmental Representative the contract security referred to in CS1.1 within 14 days after the date that the Contractor receives notice that the Contractor's tender or offer was accepted by Her Majesty.

CS2 Prescribed Types and Amounts of Contract Security

- 2.1 The Contractor shall deliver to the Departmental Representative pursuant to CS1
 - 2.1.1 a performance bond and a labour and material payment bond each in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, or
 - 2.1.2 a labour and material payment bond in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, and a security deposit in an amount that is equal to
 - 2.1.2.1 not less than 10% of the contract amount referred to in the Articles of Agreement where that amount does not exceed \$250,000, or
 - 2.1.2.2 \$25,000 plus 5% of the part of the contract amount referred to in the Articles of Agreement that exceeds \$250,000, or
 - 2.1.3 a security deposit in an amount prescribed by CS2.1.2 plus an additional amount that is equal to 10% of the contract amount referred to in the Articles of Agreement.
- 2.2 A performance bond and a labour and material payment bond referred to in CS2.1 shall be in a form and be issued by a bonding or surety company that is approved by Her Majesty.
- 2.3 The amount of a security deposit referred to in CS2.1.2 shall not exceed \$250,000 regardless of the contract amount referred to in the Articles of Agreement.
- 2.4 A security deposit referred to in CS2.1.2 and CS2.1.3 shall be in the form of
 - 2.4.1 a bill of exchange made payable to the Receiver General of Canada and certified by an approved financial institution or drawn by an approved financial institution on itself, or
 - 2.4.2 bonds of or unconditionally guaranteed as to principal and interest by the Government of Canada.
- 2.5 For the purposes of CS2.4
 - 2.5.1 a bill of exchange is an unconditional order in writing signed by the Contractor and addressed to an approved financial institution, requiring the said institution to pay, on demand, at a fixed or determinable future time a sum certain of money to, or to the order



of, the Receiver General for Canada, and

- 2.5.2 If a bill of exchange is certified by a financial institution other than a chartered bank then it must be accompanied by a letter or stamped certification confirming that the financial institution is in at least one of the categories referred to in CS2.5.3
- 2.5.3 an approved financial institution is
 - 2.5.3.1 any corporation or institution that is a member of the Canadian Payments Association,
 - 2.5.3.2 a corporation that accepts deposits that are insured by the Canada Deposit Insurance Corporation or the Régie de l'assurance-dépôts du Québec to the maximum permitted by law,
 - 2.5.3.3 a credit union as defined in paragraph 137(6)(b) of the *Income Tax Act*,
 - 2.5.3.4 a corporation that accepts deposits from the public, if repayment of the deposit is guaranteed by Her Majesty in right of a province, or
 - 2.5.3.5 The Canada Post Corporation.
- 2.5.4 the bonds referred to in CS2.4.2 shall be
 - 2.5.4.1 made payable to bearer, or
 - 2.5.4.2 accompanied by a duly executed instrument of transfer of the bonds to the Receiver General for Canada in the form prescribed by the Domestic Bonds of Canada Regulations, or
 - 2.5.4.3 registered, as to principal or as to principal and interest in the name of the Receiver General for Canada pursuant to the Domestic Bonds of Canada Regulations, and
 - 2.5.4.4 provided on the basis of their market value current at the date of the contract.



Contract Number / Numéro du contrat
Security Classification / Classification de sécurité

**SECURITY REQUIREMENTS CHECK LIST (SRCL)
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)**

PART A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine : National Research Council	2. Branch or Directorate / Direction générale ou Direction ASPM/SAGI
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3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant
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4. Brief Description of Work / Brève description du travail
UPLANDS CAMPUS ELECTRICAL UPGRADE

5. a) Will the supplier require access to Controlled Goods? / Le fournisseur aura-t-il accès à des marchandises contrôlées? No / Non Yes / Oui

5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? / Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques? No / Non Yes / Oui

6. Indicate the type of access required / Indiquer le type d'accès requis

6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? / Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? (Specify the level of access using the chart in Question 7. c) / Préciser le niveau d'accès en utilisant le tableau qui se trouve à la question 7. c) No / Non Yes / Oui

6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. / Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé. No / Non Yes / Oui

6. c) Is this a commercial courier or delivery requirement with no overnight storage? / S'agit-il d'un contrat de messagerie ou de livraison commerciale sans entreposage de nuit? No / Non Yes / Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès

Canada <input checked="" type="checkbox"/>	NATO / OTAN <input type="checkbox"/>	Foreign / Étranger <input type="checkbox"/>
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7. b) Release restrictions / Restrictions relatives à la diffusion

No release restrictions / Aucune restriction relative à la diffusion <input checked="" type="checkbox"/>	All NATO countries / Tous les pays de l'OTAN <input type="checkbox"/>	No release restrictions / Aucune restriction relative à la diffusion <input type="checkbox"/>
Not releasable / À ne pas diffuser <input type="checkbox"/>		
Restricted to: / Limité à: Specify country(ies): / Préciser le(s) pays: <input type="checkbox"/>	Restricted to: / Limité à: Specify country(ies): / Préciser le(s) pays: <input type="checkbox"/>	Restricted to: / Limité à: Specify country(ies): / Préciser le(s) pays: <input type="checkbox"/>

7. c) Level of information / Niveau d'information

PROTECTED A / PROTÉGÉ A <input type="checkbox"/>	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ <input type="checkbox"/>	PROTECTED A / PROTÉGÉ A <input type="checkbox"/>
PROTECTED B / PROTÉGÉ B <input type="checkbox"/>	NATO RESTRICTED / NATO DIFFUSION RESTREINTE <input type="checkbox"/>	PROTECTED B / PROTÉGÉ B <input type="checkbox"/>
PROTECTED C / PROTÉGÉ C <input type="checkbox"/>	NATO CONFIDENTIAL / NATO CONFIDENTIEL <input type="checkbox"/>	PROTECTED C / PROTÉGÉ C <input type="checkbox"/>
CONFIDENTIAL / CONFIDENTIEL <input type="checkbox"/>	NATO SECRET / NATO SECRET <input type="checkbox"/>	CONFIDENTIAL / CONFIDENTIEL <input type="checkbox"/>
SECRET / SECRET <input type="checkbox"/>	COSMIC TOP SECRET / COSMIC TRÈS SECRET <input type="checkbox"/>	SECRET / SECRET <input type="checkbox"/>
TOP SECRET / TRÈS SECRET <input type="checkbox"/>		TOP SECRET / TRÈS SECRET <input type="checkbox"/>
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) <input type="checkbox"/>		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) <input type="checkbox"/>

Security Classification / Classification de sécurité



Contract Number / Numéro du contrat
Security Classification / Classification de sécurité

PART A (continued) / PARTIE A (suite)

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets?
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS? No / Non Yes / Oui
If Yes, indicate the level of sensitivity:
Dans l'affirmative, indiquer le niveau de sensibilité :
9. Will the supplier require access to extremely sensitive INFOSEC information or assets?
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate? No / Non Yes / Oui

Short Title(s) of material / Titre(s) abrégé(s) du matériel :
Document Number / Numéro du document :

PART B - PERSONNEL (SUPPLIER) / PARTIE B - PERSONNEL (FOURNISSEUR)

10. a) Personnel security screening level required / Niveau de contrôle de la sécurité du personnel requis
- | | | | |
|---|---|---|--|
| <input checked="" type="checkbox"/> RELIABILITY STATUS
COTE DE FIABILITÉ | <input type="checkbox"/> CONFIDENTIAL
CONFIDENTIEL | <input type="checkbox"/> SECRET
SECRET | <input type="checkbox"/> TOP SECRET
TRÈS SECRET |
| <input type="checkbox"/> TOP SECRET - SIGINT
TRÈS SECRET - SIGINT | <input type="checkbox"/> NATO CONFIDENTIAL
NATO CONFIDENTIEL | <input type="checkbox"/> NATO SECRET
NATO SECRET | <input type="checkbox"/> COSMIC TOP SECRET
COSMIC TRÈS SECRET |
| <input type="checkbox"/> SITE ACCESS
ACCÈS AUX EMPLACEMENTS | | | |
- Special comments:
Commentaires spéciaux :

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.
REMARQUE : Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work?
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail? No / Non Yes / Oui
If Yes, will unscreened personnel be escorted?
Dans l'affirmative, le personnel en question sera-t-il escorté? No / Non Yes / Oui

PART C - SAFEGUARDS (SUPPLIER) / PARTIE C - MESURES DE PROTECTION (FOURNISSEUR)

INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS

11. a) Will the supplier be required to receive and store PROTECTED and/or CLASSIFIED information or assets on its site or premises?
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS? No / Non Yes / Oui
11. b) Will the supplier be required to safeguard COMSEC information or assets?
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC? No / Non Yes / Oui

PRODUCTION

11. c) Will the production (manufacture, and/or repair and/or modification) of PROTECTED and/or CLASSIFIED material or equipment occur at the supplier's site or premises?
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ? No / Non Yes / Oui

INFORMATION TECHNOLOGY (IT) MEDIA / SUPPORT RELATIF À LA TECHNOLOGIE DE L'INFORMATION (TI)

11. d) Will the supplier be required to use its IT systems to electronically process, produce or store PROTECTED and/or CLASSIFIED information or data?
Le fournisseur sera-t-il tenu d'utiliser ses propres systèmes informatiques pour traiter, produire ou stocker électroniquement des renseignements ou des données PROTÉGÉS et/ou CLASSIFIÉS? No / Non Yes / Oui
11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency?
Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale? No / Non Yes / Oui



Contract Number / Numéro du contrat
Security Classification / Classification de sécurité

PART C - (continued) / PARTIE C - (suite)

For users completing the form manually use the summary chart below to indicate the category(les) and level(s) of safeguarding required at the supplier's site(s) or premises.

Les utilisateurs qui remplissent le formulaire manuellement doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form online (via the Internet), the summary chart is automatically populated by your responses to previous questions.

Dans le cas des utilisateurs qui remplissent le formulaire en ligne (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category / Catégorie	PROTECTED / PROTÉGÉ			CLASSIFIED / CLASSIFIÉ			NATO				COMSEC							
	A	B	C	CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET	NATO RESTRICTED / NATO DIFFUSION RESTREINTE	NATO CONFIDENTIAL / NATO CONFIDENTIEL	NATO SECRET	COSMIC TOP SECRET / COSMIC TRÈS SECRET	PROTECTED / PROTÉGÉ			CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET		
											A	B	C					
Information / Assets / Renseignements / Biens / Production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IT Media / Support TI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IT Link / Lien électronique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED? No / Non Yes / Oui
 La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
 Dans l'affirmative, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED? No / Non Yes / Oui
 La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
 Dans l'affirmative, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquez qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).



Contract Number / Numéro du contrat
Security Classification / Classification de sécurité

PART D - AUTHORIZATION / PARTIE D - AUTORISATION

13. Organization Project Authority / Chargé de projet de l'organisme

Name (print) - Nom (en lettres moulées) Denis Labelle	Title - Titre Construction Project Manager	Signature
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Telephone No. - N° de téléphone 613-993-4923	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel denis.labelle@nrc-cnrc.gc.ca	Date July 22, 2015
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14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées) Jodi Norris CHARLOTTE CARRIER	Title - Titre Controlled Goods and Contracts Security Coordinator	Signature
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Telephone No. - N° de téléphone (613) 993-5093	Facsimile No. - N° de télécopieur (613) 990-0946	E-mail address - Adresse courriel Jodi.norris@nrc-cnrc.gc.ca	Date July 22, 2015
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15. Are there additional instructions (e.g. Security Guide, Security Classification Guide) attached?
Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes?

No / Non Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées) Marc Bédard	Title - Titre Senior Contracting Officer	Signature
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Telephone No. - N° de téléphone (613) 993-2274	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel marc.bedard@nrc-cnrc.gc.ca	Date 28/7/15
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17. Contracting Security Authority / Autorité contractante en matière de sécurité

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
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Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
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