Summerside Electric

Summerside Substation Transformer

Technical Specifications

192617.00-SP-E01

69-12.47 kV Substation Transformer

CBCL LIMITED
Consulting Engineers

CBCL PROJECT No.: **192617.00**
ISSUE DATE: **April 18th, 2019**
SUBMISSION DEADLINE: **May 10th, 2019**

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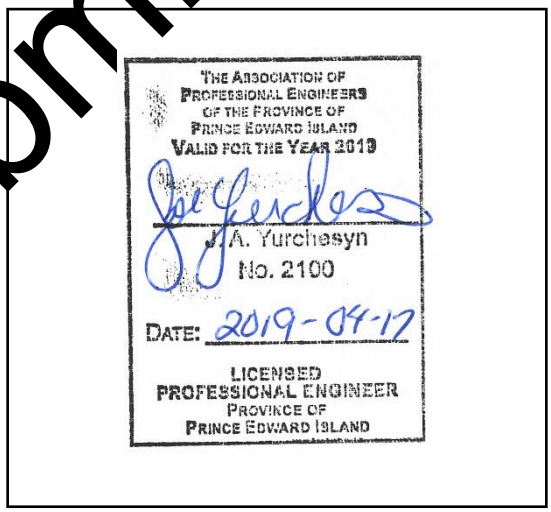
Proprietary Restriction Notice

Signed and Sealed on Behalf of

CBCL Limited



Joe Yurchesyn, P.Eng.

Issued for Quotation	Mark Chapman	April 17, 2019	Steve Hazel
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PART A

Bidding and Contract Requirements

Specification Document

192617.00-SP-E01

CBCL LIMITED

Consulting Engineers

I. INSTRUCTIONS TO BIDDERS

1 DEFINITIONS

1.1 **"Bidder"** means a person, firm, or corporation who proposes to submit, or who has submitted a quotation for the supply of the equipment.

1.2 **"Calendar Day"** means any day including Saturday, Sunday, statutory holiday, or statutory vacation day that is observed by the construction industry in the area of the Place of the Work.

1.3 **"Change Directive"** is a written instruction prepared by the Engineer and signed by the Owner directing the Vendor to proceed with a change in the work within the general scope of the Contract Documents prior to the Owner and the Vendor agreeing upon an adjustment in Contract Price and Contract Time.

1.4 **"Change Order"** is a written amendment to the Contract prepared by the Engineer and signed by the Purchaser stating their agreement upon:

1.4.1 A change in the Work.

1.4.2 The method of adjustment or the amount of the adjustment in the Contract Price, if any.

1.4.3 The extent of the adjustment in the Contract Time, if any.

1.5 **"Contract"** is the undertaking by the parties to perform their respective duties, responsibilities, and obligations as prescribed in the Contract Documents and represents the entire agreement between the parties.

1.6 **"Contract Documents"** mean those documents listed herein and amendments agreed upon between the parties.

1.7 **"Contractor"** means the person or persons, firm or company, whose bid for the installation of the works will be accepted by the Purchaser pursuant to a general contract.

1.8 **"Contract Price"** is the amount stipulated herein, based on a lump sum basis of payment.

1.9 **"Contract Time"** is the time stipulated herein from commencement of the Work to Substantial Completion of the Work.

1.10 **"Delivery Period"** means the period commencing on the date of mailing of the Purchaser's official order to the Vendor and ending on the date when delivery to the site designated for delivery, covered by the purchase order, has been complete.

1.11 **"Engineer"** means CBCL Limited (CBCL) or its duly appointed representative who has been authorized by the Owner to act on their behalf.

1.12 **"Owner"** means the corporate firm indicated in the "Owner and Engineer" data sheet, and includes the Owner's personal representatives or successors.

1.13 **"Place of the Work"** is the location indicated described in the "Owner and Engineer" data sheet.

1.14 **"Purchaser"** is the Owner.

1.15 **"Shop Drawings"** are drawings, diagrams, schematics, illustrations, schedules, performance charts, brochures, product data, manuals and other data that the Vendor provides to illustrate details of the Transformer.

1.16 **"Source Utility"** is the City of Summerside Electric Utility or Summerside Electric.

1.17 **"Specifications"** are that portion of the Contract Documents, wherever located and whenever issued, consisting of the written requirements and standards for products, systems, workmanship, and the services necessary for the performance of the Work.

1.18 **"Value Added Taxes"** means the Harmonized Sales Tax (HST), the collection and payment of which is by the Vendor as imposed by the tax legislation.

1.19 **"Vendor"** means the equipment supplier whose equipment has been selected by the Purchaser pursuant to a general contract.

2 QUOTATIONS SUBMISSION

2.1 Submit complete quotation—including completed Form of Quotation, Appendices 1, 2, and 9, and proposed layout drawing(s)—in Adobe Portable Document Format ("pdf"), or similar electronic format approved by the Engineer, via email using the information indicated in the "Owner and Engineer" data sheet, as follows:

SUBJECT LINE - **City of Summerside Electric Utility**: QUOTATION NO. **192617.00-SP-E10**

ADDRESS TO - **gerald.giroux**@city.summerside.pe.ca

CARBON COPY - **jyurchesyn**@cbcl.ca
mchapman@cbcl.ca

SALUTATION **Gerald Giroux**, P.Eng.

2.2 Delivery to the above address shall be no later than 13:00 (1:00 PM) Atlantic Standard Time on the date provided on the "Owner and Engineer" data sheet.

2.3 Electronic submission shall be followed immediately by submission of three (3) reproducible copies of the complete quotation—including completed Form of Quotation, Appendices 1, 2, and 9, and proposed layout drawing(s)—in a sealed envelope, and addressed as follows:

QUOTATION - **City of Summerside Electric Utility**
Summerside T7 Replacement
QUOTATION FOR: POWER TRANSFORMER
QUOTATION NO.: **192617.00-SP-E10**

and addressed to: **Tender Box**
The City of Summerside
First Floor, City Hall
275 Fitzroy Street
Summerside, PE, C1N 1H9

Telephone Number: (902) 786-8134
Fax Number: (902) 436-4255
Attention: **Gerald Giroux**, P.Eng.

2.4 Submit quotations on the Form of Quotation provided. Completely fill out forms in ink. The completed form shall be without interlineation, alterations, or erasures. Signatures must be witnessed.

2.5 No other Form of Quotation will be acceptable. The appending of any qualifying clauses to the Quotation or failure to comply with these instructions in the completing of any quotations renders such quotation liable to disqualification. The quotation as originally submitted shall be essentially complete to permit a full analysis without the need for additional information.

2.6 The Purchaser will not defray any expenses whatsoever incurred by Bidders in the preparation and submission of their quotations.

2.7 Submittal of quote signifies that Vendor fully understands all specifications listed.

2.8 Vendor shall submit quote based upon requirements noted in specification. Vendor is encouraged to quote as options that which appear to be more cost effective for this application. Any question as to the intent of the specifications or an apparent conflict or omission between this specification and other specifications shall be resolved by the Vendor contacting the Engineer for clarification.

2.9 The Vendor shall note that the Owner reserves the right to accept all or part of the full Quotation Submission, consisting of the following components:

2.9.1 Design, manufacture, factory testing, and delivery of substation transformers.

2.9.2 Dressing of the transformers, oil filling and filtering, field testing of the assemblies, and commissioning of the transformers.

3 CLARIFICATION AND ADDENDA

3.1 Notify Engineer of omissions, errors, or ambiguities found in the Quotation Documents. If Engineer considers that correction, explanation, or interpretation is necessary, a written addendum will be issued. All addenda will form part of the quotation documents.

3.2 No oral explanation in regard to the meaning of the quotation documents will be made and no oral instructions will be given before the selection of equipment.

3.3 Address questions using the information indicated in the "Owner and Engineer" datasheet, to **Joe Yurchesyn**, P.Eng, at CBCL Limited, Suite 901, 1505 Barrington Street, Halifax, NS, B3J 3K5, telephone (902) 421-7241, fax (902) 423-3938, e-mail: **jyurchesyn**@cbcl.ca, cc **mchapman**@cbcl.ca and **gerald.giroux**@city.summerside.pe.ca.

4 PURPOSE AND PROCEDURE

4.1 The purpose of receiving quotations in accordance with these documents is to permit examination of a variety of equipment on a comparable basis in order to select the equipment best fulfilling the Owner's requirements and to ensure that it is delivered on site at the appropriate time.

4.2 The procedure, in general, will be as follows:

4.2.1 Receive and assess quotations for equipment.

4.2.2 Select equipment.

4.2.3 Notify Vendor and conduct correspondence as required.

4.2.4 Place order for equipment.

4.2.5 Request shop drawings, examine and approve and return shop drawings.

5 INFORMATION WITH QUOTATION

5.1 Quotations shall be accompanied with all data requested in the Technical Specifications, including, but not limited to the following:

5.1.1 An engineering sketch showing estimated dimensions, mass, oil volume.

5.1.2 Height to remove bushings.

5.1.3 Height to remove core and coils.

5.1.4 General arrangement of bushings, control cabinet, radiators, conservator tank, etc.

5.1.5 Provide a sketch showing shipping dimensions, mass, center of gravity.

5.1.6 Heaviest lift required.

5.2 All Bidders must bid against the enclosed specification. In the case where a Bidder wishes to bid an alternative, they are invited to do so. However, full documentation of the potential advantages to the Owner together with reference to equivalent installation must be made.

5.3 Bidders are requested to submit a timeline indicating the full estimated duration of the contract, from the award of contract to the completion of commissioning as defined herein, and including any and all major milestones.

6 PRICES

6.1 Quoted transformer supply prices shall include for delivery to the site of the works (i.e. FOB Site). A separate price shall be quoted for site preparation, consisting of unloading at the site, dressing of the transformers, oil filling and filtering, and testing and commissioning of the works.

6.2 Quoted prices shall show all taxes separately.

6.3 The fixed quoted prices shall be in Canadian dollars, and shall include and cover all contingencies and provisional sums; all patents and licensing fees, duties, and handling charges, transportation and all other charges.

6.4 The prices contained in quotations shall be fixed and open for acceptance for a period of sixty (60) calendar days after the closing date for receipt of quotations. Provided that the Purchaser places a written order for the equipment within the above-mentioned period of validity of the quotation, there shall be no increase in the quoted price of the equipment.

6.5 The Bidder shall submit the quotation on the Form of Quotation without any connection, comparison of figures with, or knowledge of any other corporation, firm, or person making a quotation for similar equipment for this project and the quotation shall be in all respects fair and without collusion or fraud.

7 SHOP DRAWINGS AND PRODUCT INFORMATION MATERIAL

7.1 Following the award of contract, the Vendor shall submit to the Engineer for approval shop drawings and product information for the equipment to be supplied. Due to project schedule constraints, shop drawings may be submitted electronically or by fax with hard copies to follow by courier.

7.2 The expected schedule for receipt of Shop Drawings shall be as indicated by Appendix 4.

7.3 Include the cost of shop drawings in the quoted price.

7.4 The material and drawing information shall include, but not be limited to, the following:

7.4.1 Dimensional outlines, sections and detail of all equipment, with anchor bolt location plan and required clearances.

7.4.2 General assembly drawing with weights, service requirements, points of connection, recommended clearances.

7.4.3 Detailed instruction for the erection of equipment.

7.4.4 Nameplate diagram.

7.4.5 Detailed control wiring AC schematics and wiring diagrams.

7.4.6 Dimensional outlines and sections, with weights and recommended clearances, for all equipment as it is to be shipped.

7.4.7 Complete bill of materials.

7.4.8 Recommended spare parts.

7.5 Submit six (6) sets of drawings on or before the indicated dates.

7.6 The Engineer will review and mark comments as required on two (2) copies of the material and return them to the Vendor indicating "no apparent errors", "apparent errors noted", "rejected - see remarks", or "revise and resubmit", and the Engineer will retain three (3) copies. Review of the Vendor's shop drawings by the Engineer shall not relieve the Vendor of the responsibility for the correctness thereof or for the results arising from any errors or omission in details of the design. Resubmit all drawings marked "rejected - see remarks" or "revise and resubmit".

7.7 Review of shop drawings and acceptance of the equipment shall in any case be subject to final approval of the equipment and materials after they have been put in service, all guarantees being fulfilled and the general operation of the equipment and materials having been found satisfactory by the Engineer.

7.8 After the Engineer has reviewed the drawings, information and material, no change shall be made in them without the Engineer's written permission. In the event of any alterations or changes being authorized, six (6) copies of each of the final drawings and specifications indicating these changes shall be immediately furnished at the Vendor's expense.

7.9 The Purchaser will not accept responsibility for cost of changes necessary if any equipment is fabricated without prior review of shop drawings. Review of shop drawings does not relieve the Supplier of responsibility to meet the requirements of the specifications.

8 OPERATIONS AND MAINTENANCE MANUALS

8.1 The Vendor shall furnish to the Owner, through the Engineer, six (6) sets of operations and maintenance manuals specifying instructions for the following:

8.1.1 Receiving, handling, storage.

8.1.2 Installation, alignment checks.

8.1.3 Electrical connections.

8.1.4 Technical bulletins of all components.

8.1.5 Operation.

8.1.6 Maintenance procedures.

8.1.7 Relevant drawings.

8.1.8 Detailed spare parts list complete with current price list.

8.1.9 Safety instructions.

8.1.10 Tests and Vendor inspection procedures.

8.1.11 Factory and field test results.

8.2 Provide material not later than thirty (30) days prior to scheduled shipment of equipment. Include cost of providing this material in quoted price for supply of equipment.

9 IN-PLANT INSPECTION AND TESTING

9.1 The Owner, Purchaser, Engineer, and/or their authorized agents shall have the privilege of inspecting and witnessing all testing at all times during the manufacture of the equipment or materials ordered herein.

9.2 Provide advance notice of at least ten (10) days for inspection and testing.

9.3 Shop tests shall not constitute a waiver of requirements to meet actual field operating conditions or relieve the Vendor of their responsibility.

9.4 Provide three (3) copies of the official test results to the Engineer showing all tests conducted in accordance with this Document.

10 DELIVERY, STORAGE, AND HANDLING

10.1 Vendors shall include in quotation the cost of shipment FOB or DDP to site.

10.2 The Vendor shall be responsible for employing shipping preparations necessary to ensure that all equipment arrives at the destination in excellent working condition when handled by commercial carriers. All equipment shall be suitably packaged so as to ensure delivery in good condition. The Vendor shall identify any omissions, discrepancies, or damage evident on delivery to the Engineer and the Owner, and make said omissions, discrepancies, or damage good.

10.3 Vendors will provide a schedule of milestone events and, in the case of partial shipments, the Vendor will provide a proposed schedule at the time of bidding.

10.4 Unless otherwise indicated, all equipment shall be shipped completely assembled where possible. Large fabricated assemblies shall be shipped in sub-assemblies as large as practical from the point of view of moving them into and about the structures, and piece-marked to facilitate field erection, or as detailed in the Technical Specifications. Provide all clearly marked lifting points for packaged equipment.

10.5 The Vendor shall co-operate with the Purchaser in the matter of packaging, time of delivery, and shipping.

10.6 The Vendor shall quote a guaranteed delivery period from the date of the purchase order for each item of equipment for which a quotation is submitted.

10.7 The quoted delivery period shall allow for:

10.7.1 The time required by the Purchaser's official order to reach the Vendor by mail.

10.7.2 A two-week period for the Engineer to review and comment on the Vendor's shop drawings for the equipment to be supplied.

10.7.3 Delivery of anchor bolts and parts to be embedded that are required in advance of taking delivery of equipment shall be made when required by the Purchaser.

10.8 The Vendor or their authorized agent at the Site shall sign the carrier's pro bill to indicate receipt of the required number of crates, packages, and shall note any apparent shortages of or visible damage to such crates and packages. The Vendor shall furnish to the Purchaser lists showing the contents of the crates and packages available at the job site when delivery of the equipment and appurtenances is made.

10.9 Provide prior notice to the Owner and the Engineer of transformer(s) leaving factory with estimated time for delivery to the Place of Work that either may, at their individual discretion, be in attendance at the Place of Work if deemed necessary.

11 SERVICES REQUIRED AT SITE

11.1 The Vendor shall provide the services required as per Part B—Section iii, “Site Preparation”.

11.2 The Vendor shall, in the presence of the Owner’s operating staff, operate and demonstrate the equipment.

12 AMENDMENT OR WITHDRAWAL OF QUOTATION

12.1 Quotations may be amended or withdrawn by letter or facsimile prior to the date and time of closing.

12.2 Head amendment or withdrawal, using the information indicated in the “Owner and Engineer” data sheet, as follows:

12.2.1 "Amendment/Withdrawal of Quotation ***Summerside T7 Replacement 192617.00-SP-E10***".

12.2.2 Sign and seal as required for Quotation, and submit at address provided for receipt of quotations prior to time of closing.

13 RIGHT TO ACCEPT OR REJECT ANY QUOTATION

13.1 The Purchaser reserves the right to waive any irregularity and to accept or reject any offer whatsoever.

13.2 Quotations, which in the opinion of the Purchaser are considered to be informal or unbalanced, may be rejected.

13.3 The Purchaser will select a Bidder based on the total technical, delivery, warranty, and commercial content of the offer package. The Purchaser will not necessarily select the lowest cost offer/quote. The Purchaser reserves the right to reject any or all Quotations.

II. FORM OF QUOTATION

1 SALUTATION

1.1 To: The City of Summerside
275 Fitzroy Street
Summerside, PE, C1N 1H9

Attention: **Gerald Giroux**, P.Eng.

1.2 For: **Summerside T7 Replacement**
Quotation for: 69-12.47 kV Substation Power Transformer
Quotation No.: 192617.00-SP-E01 Substation Transformer

1.3 From: _____

_____

_____

We, the undersigned Bidder, having carefully examined the Quotation Documents in respect of quotations for the equipment listed in the Form of Quotation, and Specifications herewith submit in accordance with the terms set out in the documents our quotation for the specified equipment.

We agree that, in case of any conflict between the terms and conditions set out in our accompanying quotation and the terms and conditions set out in the quotation documents, the provisions of the quotation documents shall take precedence and shall govern.

The Bidder expressly warrants and guarantees to the Purchaser that in the event of the equipment, or part thereof, offered by the Bidder in the Form of Quotation being ordered by the Owner, such equipment, or part thereof, when supplied pursuant to a purchase order will be deemed to have been supplied upon the terms of the Owner's quotation documents with such amendments, if any, as may be required or agreed upon in writing by the Vendor and the Owner before the issuance of the said purchase order.

We declare that our quotation for the equipment is made without any connection, comparison of figures, or arrangement with, or knowledge of any other corporation, firm, or person making a quotation for similar equipment for this project and is in all respects fair, without collusion or fraud.

We undertake to keep our quotation valid and open for acceptance for a period of three (3) months after the closing date for submission of quotations, and to make the equipment quoted on hereunder, or any item thereof available for sale to the Owner during the said period at the price and delivery stated herein.

The prices quoted shall be in Canadian dollars and shall include and cover all contingencies and provisional sums; all duties and handling charges, transportation and all other. Prices exclude Harmonized Sales Tax.

2 BID PRICE

2.1 Substation Power Transformer

2.1.1 Complete and attach Commercial Price Proposal Sheet (Appendix 9)

2.1.2 Delivery Period: _____ weeks

2.1.3 Payment Schedule

.1	Receipt of purchase order:	10 percent
.2	Issue shop drawings for approval:	10 percent
.3	Delivery to site:	60 percent
.4	Installed, commissioned, and energized:	20 percent

2.1.4 On site services of a skilled technical representative including travel and other expenses for each eight (8) hour day in addition to the commissioning included in the Technical Specifications $_____

2.2 SIGNATURE

DATED THIS _____DAY OF _____, 20____.

Name of Firm Quoting

[Seal]

_____	_____
Address	Telephone
_____	_____
Signature	Name and Title (Printed)
_____	_____
Signature	Name and Title (Printed)
_____	_____
Witness	Name and Title (Printed)

*NOTE: Quotations submitted by or on behalf of any Corporation must be signed in the name of such corporation by a duly authorized officer or agent, who shall also subscribe own name and office. Affix seal.

PART B

Technical Specifications

Specification Document

192617.00-SP-E01

CBCL LIMITED

Consulting Engineers

I. GENERAL

1 SCOPE OF SUPPLY

1.1 The Bidder is hereby requested to provide bid prices for the following:

1.1.1 Option A: One (1) 12/16 MVA, 69Δ/12.47Y kV, oil-filled power transformer, accessories, site services, and provisions as defined herein.

1.1.2 Option B: One (1) 15/20 MVA, 69Δ/12.47Y kV, oil-filled power transformer, accessories, site services, and provisions as defined herein.

1.2 **Liquid-Filled Power Transformer**

1.2.1 Design, manufacture, test, assemble, deliver to the Place of Installation, and provide a written guarantee for the following liquid-filled power transformer with the following specifications:

.1 MVA rating per above, 69Δ -12.47Y kV (line-to-line), delta-connected primary, wye-connected secondary, and as further specified in the Appendix 7, Specific Technical Requirements Data Sheets.

.2 Complete with accessories and special tools as defined herein, including but not limited to the following:

.1 All bushings and terminations defined herein.

.2 All current transformers defined herein.

.3 All gauges, relays, indicators, and valves defined herein.

.4 Transformer oil as defined herein.

.5 Radiators and cooling fans as defined herein.

.6 All control devices and cabinetry defined herein.

.7 Provide, deliver to construction site, install on provided power transformer, and provide a written guarantee for one (1) on-load tap changing apparatus for each power transformer provided as defined herein, including all control and monitoring equipment and wiring.

1.3 **Site Preparation of Liquid-Filled Power Transformer**

1.3.1 Arrange onsite off-loading of items of items provided per Part B, Section i, Clause 1.2, above.

1.3.2 Arrange onsite assembly and installation of items defined in Part B, Section ii.

1.3.3 Fill, filter, and test transformer oil for Substation Transformer defined in Part B, Section ii.

1.3.4 Provide site testing and commissioning of the liquid-filled power transformer defined herein following installation and prior to energization, including all tests defined herein.

1.4 **Equipment, Apparatus, Materials and Services Supplied and Installed By Others**

1.4.1 Primary power (i.e. high voltage) conductors and connections.

1.4.2 Field wiring to the device (i.e. external power supply, CT, and PT wiring).

1.4.3 Underground conduit.

1.4.4 Concrete foundations and support structures unless otherwise indicated.

II. POWER TRANSFORMERS

1 SCOPE OF WORK

1.1 This specification covers the technical requirements for the supply of two winding, sealed tank, liquid filled power transformers with a base rating of up to 30 MVA and a high voltage winding up to 138 kV.

2 SERVICE CONDITIONS

2.1 The service conditions are as listed in the Service Conditions Data Sheet.

3 COMPLIANCE WITH STANDARDS AND CODES

3.1 The Transformer Assembly shall conform to or exceed the applicable requirements of the current edition following standards and codes unless otherwise indicated herein:

3.1.1 CSA Standards

.1	C13-M	Instrument Transformers
.2	C22.1	Canadian Electrical Code Part I
.3	C22.2 #94	Special Purpose Enclosures 2, 3, 4, and 5
.4	C50	Insulating Oil, Electrical, for Transformers and Switches
.5	C88-M	Power Transformers and Reactors
.6	W47.1	Certification of companied for fusion welding of steel structures
.7	W59	Welded steel construction (Metal-Arc Welding)
.8	W178.1	Certification of Welding Inspection Organizations

3.1.2 EEMAC Standards

.1	GL1 3	Transformer and Apparatus Bushings
.2	B6-1	Insulating Mineral Oil for New Electrical Apparatus

3.1.3 ANSI/IEEE Standards

.1	C57.12.00	Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

.2	C57.12.10	Safety Requirements 230 kV and Below 833/958 through 8333/10417 kVA, Single-Phase; and 750/862 through 60,000/80,000/100,000, kVA Three-Phase
.3	C57.12.70	Terminal Markings and Connections for Distribution and Power Transformers
.4	C57.12.80	Terminology for Power and Distribution Transformers
.5	C57.12.90	Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers
.6	C57.19.00	General Requirements and Test Procedure for Outdoor Power Apparatus bushings
.7	C57.19.01	Performance Characteristics and Dimensions for Outdoor Apparatus Bushing
.8	C57.19.100	Guide for Application of Power Apparatus Bushings
.9	C57.91	Guide for Loading Mineral-Oil-Immersed Transformers
.10	C57.92	Guide for Loading Mineral-Oil-Immersed Power Transformers Up to 100MVA with 55OC or 65OC Average Winding Rise
.11	C57.100	Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution and Power Transformers
.12	C57.104	Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers
.13	C57.106	Guide for Acceptance and Maintenance of Insulating Oil in Equipment
.14	C57.109	Guide for Transformers Through-Fault-Current Duration
.15	C57.111	Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers
.16	C57.113	Guide for Partial Discharge Measurement in Liquid-Filled Power Transformers and Shunt Reactors
.17	C57.114	Seismic Guide for Power Transformers and Reactors
.18	C57.120	Loss Evaluation Guide for Power Transformers and Reactors
.19	B21	Pipe Threads (except dry-seal)

3.1.4 NEMA Standards

.1 TR-1 0.06 Transformers, Regulators and Reactors (noise level requirements only)

.2 TR-98 Guide for Loading Power Transformers, Oil-Immersed, with 65°C Average Winding Rise

3.1.5 ISO Standards

.1 ISO 9000 Quality Assurance

.2 Unless otherwise noted, CSA Standards shall be given precedence when and where conflicts arise.

4 QUALITY ASSURANCE

4.1 The manufacturer shall provide evidence that a manufacturing quality program, in accordance with ISO 9001, has been established and is being maintained.

4.2 The Purchaser reserves the right to appoint an outside inspector to verify the manufacturer's quality assurance program.

4.3 The transformer will require inspection for CSA acceptance.

5 EQUIPMENT

5.1 General

5.1.1 The transformer shall be of a "Sealed Tank" design with a cushion of N2 gas or dry air above the oil in the tank. Other sealed tank types of designs such as an Inert Gas Pressure System or a Conservator/Diaphragm system shall only be considered as alternate proposals.

5.1.2 The transformer shall be supplied with insulating oil conforming to CSA C50 Type II & EEMAC B6.1. The insulating oil shall not contain more than 2 ppm of PCB's.

5.1.3 The location and ordering of the external terminal bushings shall be as per CSA C88.

5.1.4 A common H0/X0 terminal, if required, may be located adjacent to either the H1 or X1 terminal.

5.1.5 The external terminal bushings, whether cover or side wall mounted, shall be arranged such that the H2 and X2 terminal share the same centreline, with the other H and the other X terminals symmetrically arranged on either side of this centre-line. If possible, the H2/X2 centre-line shall, preferably align with the corresponding centre-line of the main tank.

5.1.6 The minimum phase-to-phase and phase-to-ground clearances for the live parts of terminal bushings and transformer mounted surge arresters, based on the BIL of the associated transformer winding, shall be as per the CSA C88 table of External Air Clearances for LIL's above 170 kV. For LIL's of 170 kV and lower, the minimum phase to phase and phase to ground clearances shall be 500 mm.

5.1.7 All external hardware and external fasteners (nuts and bolts, etc.) ½" and smaller shall be 316 stainless steel. Plated hardware and fasteners are not acceptable. All nuts and bolts greater than ½" shall be hot dipped galvanized or 316 stainless steel.

5.1.8 Wiring on the exterior of the transformer shall be protected by rigid stainless steel, type 304 or better; or flex conduit with protective coating unaffected by oil, sunlight, or other agents. EMT is not acceptable.

5.2 Performance

5.2.1 Specific ratings and operating duties shall be as specified in the Specific Technical Requirements data sheet.

5.2.2 All transformers including those with directed, forced oil cooling shall be designed for an average winding temperature rise of 65°C above the ambient.

5.2.3 Ancillary equipment such as bushings, bushing current transformers, winding leads, tap changer, etc. shall not restrict the transformer loading to levels below those permitted by the winding conductor and other metallic part hot spots.

5.2.4 The basic impulse level shall be based on solidly grounded primary and secondary neutral connections.

5.2.5 The short circuit design of the transformer shall be based solid neutral grounding.

5.2.6 The short circuit design shall be based on the maximum short circuit level specified in the Service Conditions data sheet. As a minimum, the short circuit design capability shall be based on the source impedances tabulated in CSA C88.

5.2.7 Sound pressure level of the transformer shall be 10 dB below the standard sound pressure level values listed in CSA C88 unless specified otherwise at the time of quote.

5.3 Loss Evaluation

5.3.1 The supplier shall guarantee the following losses for each transformer:

.1 No Load loss in kilowatts at rated voltage and rated frequency.

.2 Load loss in kilowatts at rated output and rated frequency.

.3 Total losses in kilowatts at rated output, rated voltage and rated frequency.

.4 Auxiliary losses.

5.3.2 Load losses shall be evaluated on the ONAN 65°C rating for each transformer.

5.3.3 The transformer load loss determined under tests shall be corrected to 85°C. The no load loss shall not be corrected.

5.3.4 For comparison of quotes, the transformer cost will be evaluated as follows:

.1 Evaluated Cost = C + [L1 • $A] + [L2 • $B] where:

.1 L1 = no load losses in watts

.2 L2 = load losses in watts

.3 C = quoted price in dollars

.4 $A = $12.530 / watt

.5 $B = $4.303 / watt

5.3.5 The cost of losses will be specified in the Specific Technical Requirements data sheet at the time of inquiry.

5.4 Non-Conformance

5.4.1 The Vendor shall provide a guaranteed value of excitation loss at the time of quotation. If the excitation loss as measured exceeds the guaranteed value by more than 7.5% (tolerance permitted by CSA C88), then the incremental cost of no-load loss evaluation shall apply as liquidated damages.

5.4.2 The Vendor shall provide a guaranteed value of the total no-load and load losses at the time of quotation. If the total loss as measured exceeds the guaranteed value by more than 5% (tolerance permitted by CSA C88), then the incremental cost of total loss evaluation shall apply as liquidated damages. There shall be no tolerance for cooling and auxiliary losses.

5.4.3 There shall be no tolerance for cooling and auxiliary losses.

5.4.4 If a transformer exceeds the 65°C temperature rise during tests at rated load, resulting in a de rating of capacity, then 1.5% of the transformer purchase price for each °C by which the temperature rise is exceeded shall apply as liquidated damages.

5.4.5 If the maximum sound pressure level value as measured exceeds the guaranteed sound pressure level value, then 1% of the transformer purchase price for each dB by which the sound pressure level value is exceeded shall apply as liquidated damages.

5.4.6 There will be no credit or payment of premium if actual values are better than the guarantee values.

5.5 Pressure/Vacuum

5.5.1 Complete transformer assembly including tank, and radiators shall be capable of withstanding full vacuum (zero absolute pressure).

5.5.2 The diverter switch compartment of a load tap changing transformer shall withstand full vacuum with normal pressure in the main tank and vice versa.

5.6 Transformer Tank

5.6.1 The tank shall be of welded, sheet steel construction, free from distortion and provided with a channel or I beam structural steel base to permit rolling and skidding of transformer in any direction.

5.6.2 All welding shall conform to the requirements of CSA W59. The welders shall be qualified in accordance with CSA W47.1.

5.6.3 The tank cover shall be peaked or sloped to prevent water accumulation.

5.6.4 The tank cover shall be welded to the tank using flanges to facilitate removal. Manholes shall be provided to permit removal or installation of bushings, inspection of core and windings, tap changer mechanism and similar components. All manholes, bushing and other major openings in the cover shall have flanges of 10 mm minimum elevation around the edges to prevent entry of water when cover is removed.

5.6.5 Manhole covers and hand hole covers shall be provided with (hand hold) handles.

5.6.6 Bushing turrets shall be watertight and condensation proof.

5.6.7 Gasketed joints shall be designed with stops to limit and maintain an even and effective pressure to ensure oil tightness without over stressing the gasket.

5.6.8 The bottom plate of the transformer tank shall be at least 3 mm thicker than that required by design strength requirements to allow for possible rusting.

5.6.9 A permanently mounted ladder is not required. Space shall be reserved on the transformer for positioning and securing a temporary, portable ladder. Suitable anchors shall be provided at the top of the tank to set the position of the ladder, to restrain the top of the ladder from moving side to side and to allow the top of the ladder to be secured by tying.

5.6.10 Fall Arrest shall be via a portable anchor post attached to a welded on base plate, based on the Unique Concepts Ltd. (UCL) Advanced Safety Systems, available from the Canadian company Capital Safety. The required base plate is Capital Safety Part # 85-17412, in association with the Capital Safety post # 85-16691.

.1 At least one welded on base plate shall be provided and positioned such that:

.1 The maximum distance to the edge of the transformer cover is less than 1,800 mm.

.2 The maximum distance to the inside edge of any manhole allowing confined space entry is less than 900 mm, to allow use of the optional davit arm accessory for the anchor post.

.3 If these maximum distance requirements cannot be met by one base, additional bases are required. Also, each baseplate shall be positioned and oriented such that the securing pin for the mast can be installed when the transformer is fully assembled.

5.6.11 If the transformer manufacturer utilizes a fence based fall arrest system attached to the transformer in its production facility, technical details and dimensional specifications pertaining to the posts, rigid or flexible rails and toe kicks that are used shall be provided in the instruction manual. This is to facilitate the Purchaser procuring compatible fencing materials that would utilize the fence attachments on the transformer.

5.6.12 The minimum mounting height for all bushings with exposed live parts shall be 3,000 mm above the base of the transformer.

5.6.13 Insulator support brackets shall be welded to the tank wall near each neutral bushing. Insulators and the down-lead from the neutral terminal will be supplied and installed by others.

5.6.14 Four (4) NEMA standard, two hole tank grounding pads shall be provided at - one near each corner - approximately 150 mm above the bottom of the tank.

5.6.15 One (1) NEMA standard, two hole grounding pad shall be provided high up on the transformer tank wall below and near each neutral or normally grounded bushing.

5.6.16 Insulator mounting brackets spaced a maximum of 1m, shall be welded to the tank wall near and below each neutral terminal or normally grounded terminal. Each bracket shall have eight holes on a 3" bolt circle spaced 45° with the first hole vertically above the centre of the circle and with a ninth hole at the centre of the circle. Each hole shall be of a size to accommodate ½" mounting bolts. Post insulators, type TR-202 or approved equivalent, copper alloy, mechanical connectors and the copper down lead from each of these bushings shall also be supplied.

5.6.17 If high and/or low voltage surge arrester mounting brackets are specified on the Specific Technical Requirements data sheet, one (1) NEMA standard, two hole grounding pad shall be provided high up on the transformer tank wall below and near each bushing being associated with a surge arrester. Three (3) or six (6) grounding pads shall be provided in total.

5.6.18 Space provisions shall be made to securely place two (2) magnetically attached, impact recorders to the tank during shipping as described herein.

5.7 Moving Facilities

5.7.1 Hook type lifting lugs with rounded edges, drilled for a shackle of sufficient size to lift the completely assembled and filled transformer shall be supplied.

5.7.2 Jacking steps shall be attached to the tank at each corner at a height not less than 300 mm or more than 480 mm. The jacking surface shall be not less than 200 mm x 250 mm, unobstructed and level.

5.7.3 Pulling eyes, minimum 50 mm diameter shall be provided on the transformer base, two per side, to permit pulling the transformer in any direction and shall be braced to withstand a pull up to 15° vertically from the horizontal.

5.7.4 The transformer base shall be reinforced to permit moving the assembled and filled transformer on rollers in any direction.

5.7.5 The location of the "shipping" and "dressed" centre of gravity shall be painted on all four sides of the tank. The horizontal position of the "dressed" centre of gravity shall also be painted on all four sides of the tank near the bottom.

5.8 Control Cabinet

5.8.1 The control cabinet shall be enclosure NEMA 4X and made of sheet 316 stainless steel with a minimum No. 10 gauge thickness. The top of the cabinet shall be sloped to prevent water accumulation and a drip shield shall be provided above the cabinet door. The bottom shall be located approximately 700 mm above the transformer base. It shall be rigidly braced and secured to avoid amplifying transformer sound level.

5.8.2 The cabinet shall be equipped with an exterior hinged and pad-lockable door (10 mm shackle) capable of being latched open or closed. The inside pocket on the door shall contain one copy of the instruction manual. All hinges, latches, pins, etc. shall be made of stainless steel. Piano type hinges are not acceptable. All external cables, piping, etc., shall enter the control cabinet from the side or bottom of the cabinet. Top entry is not permitted.

5.8.3 The cabinet shall be equipped with an internal luminaire controlled by a door switch. The fixture shall accept a 120VAC lamp featuring an E26 screw base and be suitable for a North American, A19, E26, 100W incandescent lamp, or today's CFL or LED equivalent lamps.

5.8.4 A pre-set, thermostat controlled heater shall be provided in the cabinet for anti-condensation. An OSHA rated safety guard shall be provided over this heater for personnel safety. The cabinet shall preferably be insulated with non-combustible insulation. The exposed interior surface of the control cabinet shall be either white or reflective silver.

5.8.5 A 120 Volt, 15 Amp, non-locking, CSA C22.1 Type 5-15R, weatherproof convenience duplex receptacle complete with ground fault protection shall be provided on the exterior of one side of the cabinet. A molded case circuit breaker for this outlet shall be located inside the cabinet. The ground fault protection may be using a molded case, GFCB device, or alternatively a CSA-approved, 125V, 15A, Class A, GFCI, duplex receptacle may be substituted for the receptacle.

5.8.6 All devices shall be clearly identified and labeled with suitable nameplates in the English language and all terminal blocks shall be numbered.

5.8.7 Sufficient space and clearances shall be provided at the bottom of the cabinet to facilitate customer's cable entry and termination.

5.8.8 The bottom of the cabinet shall be provided with a removable plate, of minimum size of approximately 150 x 300 mm, to facilitate Owner's cable entry and termination.

5.8.9 The bottom of the cabinet below the terminal blocks shall be provided with a grounding bar to individually grounding current transformers, control cable shields, etc. This ground bar shall be mounted on insulators and bonded to the inside of the control cabinet with a #2 AWG copper bond, to facilitate the application of a frame leakage (tank ground) protection scheme.

5.8.10 All external cables, conduits, etc., which the manufacturer will install between the control cabinet and exterior devices on the transformer shall enter the control cabinet preferably from the bottom of the cabinet. Top entry is not permitted.

5.8.11 Screened vents, with filters shall be provided in the cabinet for air circulation.

5.9 Paint Finish

5.9.1 The exterior paint colour shall be light grey ANSI 70 unless otherwise specified.

5.9.2 The corrosion resistance of the paint surface shall conform to ANSI C57.12.28, latest revision, except the salt spray acceptance criteria shall be 1,500 hours. The painted panel used for the salt spray test shall conform to ANSI C57.12.29. The scribe through the paint for evaluation shall be at right angles to the weld bead. The painted panel test samples shall be made using normal production, welded material and equipment.

5.9.3 The total dry film thickness shall be not less than 0.127 mm (5 mils).

5.9.4 Anti-skid paint shall be applied to the top of the transformer tank.

5.9.5 For skid base transformers, the tank base and underside of the tank shall be coated with asphalt mastic or a coal tar epoxy-polyamide paint system, such as Intertuf JBA016 black high build, available from International Paints (Canada) Limited.

5.9.6 The interior of the transformer tank shall be painted white using a paint, which will not react with or contaminate the transformer oil.

5.9.7 Unless unpainted galvanized radiators are specified, radiators shall be painted by a flow coating process and inverted following the application of each coat.

5.9.8 A suitable quantity of primer and finish paint shall be supplied with the equipment for touch up purposes.

5.10 Bushings

5.10.1 Bushings conforming to ANSI/IEEE C57.19.00 shall be supplied, unless specified otherwise in the Specific Technical Requirements data sheet. In addition, one bushing

of each type installed on the transformer shall be supplied as a spare, if so specified in the Specific Technical Requirements data sheet.

5.10.2 Bushings shall be porcelain, grey in colour unless specified otherwise in the Specific Technical Requirements data sheet. The porcelain shells of the bushings shall be one piece without any gaskets. For draw lead bushings, the inner conductor and the top cap-nut shall be made of the same material.

5.10.3 All condenser type bushings shall include a test tap.

5.10.4 The minimum metal to metal clearance between the live part of a bushing to the transformer tank and accessories shall be not less than the distance between the bushing live part and mounting flange. The installation of bushings shall preferably be possible without lowering the oil below the top of the core and coils.

5.10.5 If not indicated on the Specific Technical Requirements data sheet, the minimum leakage distance for bushings and surge arresters shall be 21 mm/kV(ph-ph) based on the rated phase to phase voltage of the associated winding.

5.10.6 The leads to draw lead bushing shall be adequately tied for shipping, but release of the tie shall be readily accomplished through the bushing portal.

5.10.7 The material of the external HV end of the bushing and the requirement for a connection shall be as indicated on the Specific Technical Requirements data sheet.

5.11 Current Transformers

5.11.1 Bushing current transformers shall be supplied in quantities, locations and ratios as specified in the Specific Technical Requirements data sheet. ANSI standard multi-ratios conforming to 5 secondary winding connections shall be typically supplied.

5.11.2 Bushing mounted, slip on current transformers shall not be provided unless requested on the Specific Technical Requirements data sheet.

5.11.3 The continuous, thermal, current rating factor for bushing current transformers shall be 2.0 based on temperature rise in accordance with CSA C13, unless specified differently on the Specific Technical Requirements data sheet.

5.11.4 When the CT's are located inside the transformer tank and suspended from the tank cover, the secondary leads shall be carried through eyelets welded to the tank cover. Spacing between the eyelets shall not exceed 600 mm.

5.11.5 All current leads passing through the tank wall shall employ bolted through type bushings. Plug in receptacle type connections shall not be used.

5.11.6 Current transformers installed on external leads operating at ground potential shall be rated 600V and shall be suitable for outdoor use, including weather proof secondary junction box.

5.11.7 All current transformer secondary wiring shall be brought back to terminal blocks located within the transformer control cabinet, including all taps for each transformer. This wiring shall be connected to short-able terminal blocks.

5.11.8 To ensure secure connections, all CT wiring terminated on "stud type" terminals shall be "double nutted" and double screw, rail mounted terminals for the CT connections are assumed.

5.12 Forced Cooling

5.12.1 Cooling shall be deemed to include the supply of all necessary contacts in the winding temperature relay and wiring them to the control cabinet terminal block. In addition, space shall be provided for all necessary control and power equipment and terminal blocks shall be provided for connection.

5.12.2 The associated drawings and instruction book shall contain details including the part numbers for all required items and the drawings shall show location of all equipment.

5.12.3 Transformers designed to this specification shall not use forced (i.e. pumped) oil cooling.

5.12.4 With staged cooling, the loss of one stage of cooling shall not reduce the transformer capacity by more than 33%.

5.12.5 Fans shall not be mounted directly to the radiators to prevent damage to the radiator paint finish and to facilitate possible future radiator replacement. Fans shall be mounted on a separate, removable structure affixed to the transformer tank.

5.12.6 Fans shall not be located under the radiators where they can become blocked by snow.

5.12.7 Fans shall, also, not be located on top of the radiators.

5.12.8 The fan blades and all external fastener hardware shall be aluminum or type 304, or better, stainless steel.

5.12.9 Fan motors shall be totally enclosed and weatherproof with sealed ball bearings.

5.12.10 Each fan motor shall have internal built in overload protection.

5.12.11 Wiring to the fans shall be run radially from junction points and not daisy-chained from fan to fan.

5.12.12 Fan guards shall be galvanized and meet OSHA safety requirements.

5.13 Radiators

5.13.1 All transformers rated 5 MVA and larger and all suitable smaller units shall be equipped with tank mounted, detachable radiators.

5.13.2 Painted steel radiators shall be supplied unless specified otherwise on the Specific Technical Requirements data sheet.

5.13.3 The preferred radiator mounting location is on the HV face of the tank.

5.13.4 Radiators shall not be positioned over manholes, hand-holes or inspection covers.

5.13.5 Fin type radiators shall feature a welded on, diagonal brace on both sides and the external bracing shall be sufficient to prevent vertical and lateral movement, and vibration.

5.13.6 Each removable radiator shall have lifting eyes and be equipped with a drain valve with a non-ferrous plug at the bottom and a non-ferrous vent plug at the top.

5.13.7 The design and construction of the headers and fins shall be such as to prevent the creation of crevasses to inhibit the collection and retention of moisture and formation of rust.

5.13.8 The attachment to the main tank shall be by means of oil tight isolating valves with position indicators, affixed to the main tank and capable of withstanding a full head of oil. Preferably, these valves should be securable in both the open and closed positions. Blanking plates for all openings shall also be supplied.

5.13.9 For the purpose of possible future radiator replacement, drawings shall be included in the instruction manual to illustrate the radiator unit and mounting details, including but not limited to the following information: overall radiator unit dimensions, fin spacing, length of mounting flange extension, top and bottom header dimensions, mounting flange centerline distance, flange details (i.e. bolt hole dimensions and placement, inside dimension of header pipe, gasket grooves, etc.), radiator volume, surface area and empty weight, spacing of each radiator and external bracing details, as well as the isolating valve details and the transformer mounting flange details including any protrusion of the valve disk into the radiator header when open.

5.14 Conservator Volumes, Valves, Pipes and Wells

5.14.1 All conservator volumes shall have sufficient capacity to ensure that oil will not be below the low oil alarm level at an ambient temperature of -40°C and will not overflow at an ambient temperature of +40°C with transformer loaded beyond its nameplate in accordance with ANSI/IEEE C57.91.

5.14.2 A "main tank oil" expansion space accommodated within the main tank is assumed in this specification. This conservator space shall be sealed without use of a diaphragm using pressure/vacuum regulator. A dehydrating breather shall be installed to minimize the entry of humid air, if the pressure regulator allows air entry to relieve a high vacuum condition.

5.14.3 If an OLTC requires a separate, elevated conservator tank, then such a tank shall be provided. This conservator tank may be free breathing or sealed without use of a diaphragm using a pressure/vacuum regulator. In both cases, a dehydrating breather shall be installed to minimize the entry of humid air.

5.14.4 An OLTC conservator shall be sloped 1° to assist in draining; and shall be provided with a drain pipe brought to 1,500 mm above the base of the transformer and clamped to the main tank for support.

5.14.5 The connecting pipe between the conservator and its associated main oil volume shall protrude 25 mm into the conservator tank to prevent sludge pickup.

5.14.6 If applicable, a manhole shall be located at the lower end of the conservator tank for cleaning and inspection purposes.

5.14.7 The transformer tank shall be provided with the following superior quality valves and fittings. High placed valves shall be brought down to within 1,500 mm from the transformer tank base where indicated.

.1 Main Tank:

.1 Oil drain valve, main tank (gate, 2" min. complete with plug).

.2 Oil sampling valve, main tank, near main drain (globe, ½", complete with plug).

.3 Vacuum pump connection (gate, 3" min., top cover of tank)

.1 Complete with 3" pipe to 1,500 mm and 3" indicating ball valve complete with plug on 1500 mm end).

.4 Vacuum probe (gate, 2¼" min., c/w plug, top cover of tank)

.5 On-line gas monitor (provision) isolation valves (2 required, 2" gate, complete with plug)

.1 On the tank side of top and bottom radiator shut-off/isolation valves

.2 For an end radiator, with a maximum distance of 300 mm to the end of the valve.

.6 Pressure/vacuum regulator and gauge isolation valve (1" ball)

.7 Radiator shut-off/isolating valve - TOP (butterfly, size not specified)

.8 Radiator shut-off/isolating valve - BOTTOM (butterfly, size not specified)

.9 Spare temperature probe well (top cover of tank, or top of side wall)

.2 Radiators:

.1 Radiator drain valve (gate, ¾" min. c/w plug, bottom header of radiator)

.2 Radiator vent plug (¾" min., top header of radiator)

5.14.8 The transformer OLTC tank shall be provided with the following valves and fittings from its manufacturer.

.1 Oil drain valve, OLTC

.2 Oil sampling valve, OLTC

.3 Oil filter connection OLTC - top

.4 Oil filter connection OLTC - bottom

.5 De-hydrating breather isolation, if applicable

5.14.9 All valves sizes shall be in Imperial units (i.e. inches). Metric size valves are not acceptable

5.14.10 All valves shall be made from a non-corrodible material and equipped with non-ferrous plugs.

5.14.11 The valves shall be installed using fittings and hardware with a minimal susceptibility to corrosion.

5.15 Core

5.15.1 The core shall be designed to allow the transformer to operate continuously at 110% voltage without load, as per CSA C88.

5.15.2 Core clamps shall be insulated from the core and electrically connected to the tank. The clamps shall be painted white.

5.15.3 The core shall, preferably, have an approximated circular cross section; and shall be composed of individually stacked laminations. The corner joints shall feature an overlapped mitre design.

5.15.4 Stepped bracing shall be provided on the bottom of the core to support the laminations.

5.15.5 The top and bottom core clamps shall be mechanically held through the use of tie plates that are placed either adjacent to the core and within the windings or by mechanical tie connections external to the windings.

5.15.6 Bolts through the core may be used for core assembly, provided non-metallic bolts of sufficient strength are used. These non-metallic bolts shall also be installed in an insulated manner consistent with the use of metallic bolts.

5.15.7 The core and windings shall be braced to prevent displacement or distortion during short circuit. Temporary blocking, if any, shall be marked in red to facilitate identification for removal, and noted in the installation instructions.

5.15.8 The electrical grounding of the core to the tank shall be via an insulated ground lead extending through the tank cover or wall via a 2 kV (min.) rated bushing. A removable

connection shall be made from the bushing to the outside of the tank to allow testing. The bushing and external ground connection shall be housed in a weather tight, condensation proof box.

5.15.9 The core ground connection shall be of sufficient cross-sectional area to withstand a fault current of 20 kA RMS for one second without fusing.

5.16 Windings

5.16.1 The winding material shall be copper.

5.16.2 Windings shall be circular. Rectangular windings are not acceptable.

5.16.3 Foil, or sheet type, windings are not acceptable.

5.16.4 The clamping design for the cables shall allow for an adequate creepage distance to ground and to the outer windings after the cabling has drooped over time.

5.16.5 Delta connected windings shall be provided with a link, readily accessible through a hand hole in the cover, to allow opening of the delta for testing purposes. When a delta connected winding is buried, one corner of the winding shall be brought out through a bushing for grounding and testing purposes.

5.16.6 For dual or multiple voltage winding combinations, the series-parallel connections shall be brought to an off circuit selector switch or a manual tap board, as specified. The selector switch or tap board shall be accessible through a hand hole in the cover or wall of the transformer and access shall require the removal of little or no oil from the main tank.

5.16.7 The handle of a tap selector switch should preferably be located on the side of the tank and shall be lock-able with a padlock having a 10 mm diameter shackle.

5.16.8 As a minimum, the windings shall be braced for the impedance limited, fault current level specified in CSA C88 (C88-M90, Clause 10.2.1.3(a) and Table 3A).

5.16.9 The pressure plate used on the top and bottom ends of each winding stack shall be a complete ring of uniform thickness. The mechanical design of the pressure plate shall such that sufficient restraining force is provided to the portion of the windings located between the top and bottom yokes of the core.

5.16.10 All winding to winding and winding to cable connections shall be crimped, brazed and formed; and all cable to cable connections shall be crimped and formed.

5.16.11 The clamps used to securing cables shall be sized appropriately, and provided in sufficient quantity, for the weight of the cables and the dynamic forces encountered during faults and during shipping.

5.16.12 The cabling design shall avoid passing the cables over the top of the core and coils assembly.

5.17 Off-Circuit (De-Energized) Tap Changer

5.17.1 Either an off circuit tap switch or a manual tap board shall be supplied as specified in the Specific Technical Requirements data sheet.

5.17.2 The handle of a tap changer should preferably be located on the side of the tank and shall be lock-able with a padlock having a 10 mm diameter shackle.

5.17.3 The tap change switch or tap board shall be accessible through a hand hole in the cover of the transformer and shall require the removal of little or no oil from the main tank.

5.17.4 All taps shall have full load capacity.

5.18 On-Load Tap Changer (OLTC)

5.18.1 An on-load tap changer shall be supplied as specified in the Specific Technical Requirements data sheet.

5.18.2 The minimum continuous tap changer current rating shall be sufficient to enable continuous operation of the transformer at its rated maximum load (2 stages of supplemental cooling).

5.18.3 The mode of transformer operation shall be independent of the winding location of the OLTC and the transformer shall be designed assuming the following:

.1 The transformer will be operated with the LV terminals are maintained at a constant voltage.

.2 The normal direction of power flow (HV to LV or LV to HV) shall be as specified on the Specific Technical Requirements data sheet.

5.18.4 The tap changer shall be a high speed resistance type or the Reinhausen model RMV reactance type.

5.18.5 Taps shall be so arranged that for a fixed primary voltage, the lowest numbered tap gives the lowest secondary voltage; and successive increasing tap numbers give increasing voltage.

5.18.6 The arcing/diverter switches shall be installed in an oil tank with an oil system completely separate from the oil in the main tank.

5.18.7 The diverter switch tank shall be either of a sealed, or a free breathing conservator tank design, each type being provided with its own de-hydrating breather.

5.18.8 Design of the diverter switch shall be such that it will not stop between steps if the motor supply is interrupted before the step is completed.

5.18.9 The tap changer mechanism shall cause the tap changer to move only one step per operation.

5.18.10 The diverter switch contacts shall be rated for at least 200,000 transitions at its rated current, before requiring replacement; and the contacts shall be easily accessible.

5.18.11 An operations counter shall be provided.

5.18.12 The drive motor shall have thermal overload protection and a means shall be provided for isolating the motor from the supply. The supply voltage and number of phases will be as specified in the Specific Technical Requirements data sheet.

5.18.13 Tap position indication shall be provided as a mA, analogue signal and/or as a digital signal, as specified on the Specific Technical Requirements data sheet. The interface electronic device shall feature a wide input range, AC/DC power supply. The input power connection to the device shall be run through a double fuse, fuse holder and then be connected to terminals in the control cabinet. The required AC or DC power connection shall be connected to these terminals as per the Specific Technical Requirements data sheet. Also, if the primary measurement of tap position is via a potentiometer, the three terminals of the potentiometer shall be wired to accessible terminal blocks.

5.18.14 An auxiliary contact from the tap changer that is closed during tap changer travel shall be wired to terminals in control cabinet for a "Tap Change in Progress" indication.

5.18.15 The following control equipment shall be provided in the OLTC control cabinet:

.1 Switch for "Local" and "Remote" control functions ("Off" position optional). (The "Local" and "Off" (if applicable) positions shall have an indication contact.)

.2 Manual Raise/Lower Controls (Intended for maintenance purposes only)

.3 Operations Counter

.4 Tap Position Indicator with Drag Hands

.5 Tap position indication equipment complete with analogue or digital output

.6 Terminal blocks for cable connections by Purchaser

5.18.16 The following control equipment shall be provided in the main control cabinet:

.1 Switch for "Local Manual", "Local Auto" and "Remote" control functions (each position shall have an indication contact.)

.2 Manual Raise/Lower Controls

.3 Automatic voltage control equipment

.4 Terminal blocks for cable connections for remote control by Purchaser

5.18.17 The OLTC control cabinet and the main control cabinet shall be near and preferably on the same side as the transformer. Alternatively the two cabinets may be combined.

Interconnecting wiring between the main and OLTC cabinets shall be via terminal blocks in the main control cabinet. Direct connections to devices within the main control cabinet are not to be made.

5.18.18 A complete control and indication schematic for the OLTC system shall be provided. It shall include and incorporate a simplified illustration of the schematic provided by the OLTC manufacturer. Interface terminals for wiring connections between the main and OLTC mechanism control cabinets shall be clearly illustrated. Interface terminals for the wiring connections to be made by the Purchaser shall be clearly illustrated.

5.19 Accessories

5.19.1 All transformers shall be supplied with the accessories listed below. All auxiliary contacts from these devices shall be rated for 125VDC and wired to the terminal blocks in the control cabinet.

.1 Oil and Winding Temperature Indicators - Mechanical

.1 Unless indicated otherwise on the Specific Technical Requirements data sheet, mechanical temperature indicators shall be provided.

.2 The oil temperature indicator shall monitor the "top of the tank temperature" of the oil and the winding temperature indicator shall monitor the simulated "hottest spot temperature" in the winding. Both temperature indicators shall feature drag hands to record the minimum and maximum measured temperatures; and both temperature indicators shall have four adjustable, normally open contacts.

.3 The first and second stage, cooling initiation contacts from each indicator shall be wired to terminal blocks in the control cabinet. Each pair of functionally equivalent contacts shall then be then paralleled on these terminal blocks and from there wired into the cooling control circuit. The other two contacts annunciate alarm conditions and shall be wired to Owner's use terminals in the control cabinet.

.4 The temperature at which the four contacts from each gauge will be adjusted to operate shall be set as follows:

	Top Oil Gauge	**Winding Gauge**
First Stage Cooling	45°C	70°C
Second Stage Cooling	50°C	75°C
Alarm	80°C	105°C
Trip	95°C	120°C

.5 Both temperature indicators shall be installed inside the control cabinet and mounted such that they may be viewed through a window, without having to open the control cabinet door.

.6 Wires from the winding temperature well heater and from the WTI current transformer shall each be first terminated on suitable terminals

or test link blocks, in the control cabinet to facilitate measurement of the current when under load and for test injecting the heater element from an external power source.

5.19.2 Oil and Winding Temperature Indicators - Electronic

.1 If indicated on the Specific Technical Requirements data sheet, an electronic temperature indicator shall be provided.

.2 The oil temperature function shall monitor the "top of the tank temperature" of the oil; and the winding temperature function shall simulate a "hottest spot temperature" in the winding based on the measured top oil temperature and the output current flow from the WTI CT. Both temperature functions shall feature drag hands to record the minimum and maximum measured temperatures; and the monitor shall have four programmable, normally open output contacts.

.3 The first and second stage, cooling initiation contacts from each indicator shall be wired to terminal blocks in the control cabinet and from there wired into the cooling control circuit. The other two contacts annunciate alarm conditions and shall be wired to Owner's use terminals in the control cabinet.

.4 The function temperature at which each of the four contacts will be programmed to operate shall be set as follows:

	Monitor Contact Output Contact	Top Oil Function	Winding Function
First Stage Cooling	#1	45°C	70°C
Second Stage Cooling	#2	50°C	75°C
Alarm	#3	80°C	105°C
Trip	#4	95°C	120°C

.5 The electronic temperature monitor shall also include a cooling bank exerciser and bank swapping algorithm. The exerciser shall have an adjustment range capable of starting the cooling every 1 to 30 days and running it for a period of between 1 minute and 24 hours.

.6 The temperature monitor shall be installed inside the control cabinet and mounted such that it may be viewed through a window, without having to open the control cabinet door.

.7 Wires from the WTI current transformer shall each be first terminated on suitable terminals or test link blocks, in the control cabinet to facilitate measurement of the current when under load and for test injecting the heater element from an external power source.

.8 The monitor shall feature a wide input range, AC/DC power supply. The input power connection to the device shall be run through twin fuse holders and then be connected to terminals in the control cabinet. The required AC or DC power

connection shall be connected to these terminals as per the Specific Technical Requirements data sheet.

.9 The analogue output signals shall be wired to terminals in the control cabinet, for connection by the Purchaser. This wiring connection shall use a shielded, twisted pair cable, such as Beldin 8441, with the shield floating on the device end terminated on a terminal block on the opposite end.

5.19.3 Oil Level Gauges

.1 The magnetic oil level gauges, Qualitrol Series 032, or Engineer approved equal, with a (min.) 6" dial shall be supplied. A "top style" dial (or scale), labelled "Min", "25°C", and "Max" (i.e. Qualitrol MINMAC25/T dial option) shall, preferably, be provided.

.2 Each oil level gauge shall feature two, electrically independent, Form-C level contacts that are individually settable. All three terminals for each contact shall be wired to Owner use terminals in the control cabinet.

.3 One gauge shall monitor the main oil volume and the other gauge shall be monitor the conservator (or expansion) volume associated with the main oil volume.

.1 This specification assumes that conservator (or expansion) volume is physically in the main tank, the two gauges are attached to the main tank at two different heights.

.4 The use of each oil level contact in each gauge shall be as follows:

Oil Level	Monitored Oil Volume	Contact Set Point Relative to Gauge Level	Contact Function
#1	Conservator	Low Oil Contact #1 - Higher	Low Oil Alarm
#2	Conservator	Low Oil Contact #2 - Lower	Trigger Oil Containment
#3	Main	Low Oil Contact #1 - Higher	Use with Vacuum Pump
#4	Main	Low Oil Contact #2 - Lower	Low Oil Trip

.1 Contact #1 in the gauge monitoring the conservator volume will be set to operate at an oil level consistent with a low oil level state and this contact will be used to alarm this condition. Contact #2 in the same gauge shall be set operate at slightly lower oil level and will be reserved to trigger a mechanical oil containment system.

.2 Contact #2 in the gauge monitoring the main oil volume will be set to operate at an oil level just above that which will begin to expose the core and coils. This contact will be used to de-energize the transformer.

Contact #1 shall operate at a slightly higher oil level. This second contact will be reserved for use with vacuum filling equipment to alert the operator that the main oil volume is almost filled.

.5 A similar arrangement shall be used to monitor the oil in an OLTC compartment, as follows:

.1 OLTC requiring an external conservator tank:

Oil Level	Monitored Oil Volume	Contact Set Point Relative to Gauge Level	Contact Function
#1	Conservator	Low Oil Contact #1 - Higher	Low Oil Alarm #1
#2	Conservator	Low Oil Contact #2 - Lower	Trigger Oil Containment
#3	OLTC	Low Oil Contact #1 - Higher	Low Oil Alarm #2
#4	OLTC	Low Oil Contact #2 - Lower	Low Oil Trip

.2 OLTC not requiring an external conservator tank:

Oil Level	Monitored Oil Volume	Contact Set Point Relative to Gauge Level	Contact Function
#1	OLTC	Low Oil Contact #1 - Higher	Low Oil Alarm
#2	OLTC	Low Oil Contact #2 - Lower	Low Oil Trip

.3 It is assumed that gauge monitoring the OLTC oil volume will be supplied by the OLTC manufacturer and it may not the gauge specification in clauses 5.19.3.1 & .2.

5.19.4 Pressure Relief Device

.1 A spring loaded diaphragm type relief device, Qualitrol Type 213 complete with a SPDT alarm contact shall be mounted on tank near the top. It shall be equipped with a flow deflector to direct oil downward and away from the control cabinet location and any other operationally frequented locations.

.1 As an alternative, the Qualitrol Type XPRD pressure relief device complete with an integrated directional discharge outlet and SPDT alarm contact may be supplied.

.2 The device shall be labeled "Pressure Relief Value" and the indication contacts shall be wired to terminal blocks in the control cabinet.

.3 A functionally similar device with one normally open electrical contact wired to terminals in the control cabinet shall be installed on any OLTC tank.

5.19.5 Gas Detection/Protection

.1 Sudden Pressure Relay (For Pressurized, Sealed Transformer Design)

.1 A Rapid Pressure Rise Relay, Qualitrol type 910, sampling the gas space of the transformer tank, shall be supplied.

.2 The SPDT contacts shall be wired to terminal blocks in the control cabinet.

5.19.6 Pressure/Vacuum Monitor (For Pressurized, Sealed Transformer Design)

.1 A pressure-vacuum monitoring assembly consisting of the following shall be mounted on the side of the transformer tank:

.1 Pressure/vacuum regulator c/w gauge, Qualitrol type 070-35C (included pressure/vacuum regulator type 351-2A and pressure/vacuum gauge type 050-35E), or utility approved equal.

.2 Pressure-vacuum switch shall include a SPDT contact for both a vacuum alarm and a pressure alarm. The set point of the contacts shall be adjustable.

.3 An indicating type ball valve shall be installed between the transformer tank and the pressure/vacuum regulator and gauge to allow calibration of the gauge at site.

.4 The atmospheric side of the pressure/vacuum switch shall be connected to a dehydrating breather.

5.19.7 Bushing Terminals Connectors

.1 When indicated on the Specific Technical Requirements data sheet, bushing terminal connectors shall be supplied.

5.19.8 Surge Arrester Mounting Brackets

.1 Removable, surge arrester mounting brackets shall be supplied unless specifically not requested on the Specific Technical Requirements data sheet.

.2 Mounting brackets for the surge arresters shall be located as to provide, as a minimum, the same phase metal to phase metal clearance as for the associated bushings - as per clause 5.1.6.

.3 The surge arrester mounting bracket shall include six mounting holes sized to accept a ½" bolt, for the attachment of the surge arrester. These shall be on a 10" (254 mm) diameter bolt circle; with the first holes placed on a line oriented perpendicular to the main tank and with two holes spaced 120°apart from the first; and with the fourth holes placed 30° CW or CCW from the first hole and the last two holes spaced 120° apart from the fourth.

5.19.9 Surge Arresters

.1 Surge arresters shall be supplied unless specifically not requested on the Specific Technical Requirements data sheet. The mounting brackets supplied for the surge arresters shall permit the same minimum phase metal to phase metal clearance as for the associated bushings - as per clause 5.1.6.

.2 The supplied surge arresters shall meet the following technical requirements:

.1 Designed and tested to ANSI/IEEE Std C62.11 [IEEE Std. for Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV)]

.2 Suitable for use under ANSI/IEEE Std C62.22 [IEEE Guide for Application of Metal-Oxide Surge Arresters for AC Systems]

.3 Station Class, gapless metal-oxide type.

.4 Upright vertical mounting.

.5 3 bolt mounting on 10" bolt circle.

.6 A removable cap like top terminal with 4 hole NEMA pad.

.7 Eyebolt ground terminal accepting up to a #4/0 awg cu conductor.

.8 Galvanized steel or aluminum external hardware suitable for outdoor use.

.9 Porcelain or polymer housing as per specific tech. Requirements data sheet.

.10 Min. Leakage distance to be 21 mm/kvph-ph based on the rated phase to phase voltage of the associated winding, or as per spec. Tech. Req. Data sheet

.11 Min. Height shall be based on a max. Voltage stress of 60 kvph-grd/meter of dry arc distance (i.e. Min. Height of 16.67 mm/kvph-grd) based on the rated voltage of the associated winding, or as per Spec. Tech. Req. data sheet

.12 Max. Continuous operating voltage (mcov) as per spec. Tech. Req. Data sheet

.13 Energy absorption to be 5.0 kj/kvmcov up to 48 kvmcov and 9.0 kj/kvmcov above 48 kvmcov

.14 Min. Residual, working cantilever strength of 675 n-m

.15 Affixed manuf.'s nameplate identifying pertinent elect. & mech. Data.

5.19.10 LV Cable Junction Enclosure

.1 When specified on the Specific Technical Requirements data sheet, a weather proof enclosure shall be provided for the termination of power cables up to 34.5 kV.

.2 The enclosure shall be sufficiently spacious, as to provide the same impulse level as the associated transformer winding. This is to eliminate the requirement to cover the bolted connections to the associated bushings with electrical insulating tape - so as to facilitate periodic, future disconnection and re-connection for maintenance testing.

.3 Any requirement for internal bus bars to facilitate the support and termination of multiple cable per phase shall be specified on the Specific Technical Requirements data sheet.

5.19.11 NGR Mounting Bracket

.1 When specified on the Specific Technical Requirements data sheet, provision shall be made for mounting a NGR on the tank of the transformer.

.2 The power resistor is typically short time rated to 1 minute and enclosed in a ventilated stainless steel enclosure. Specific physical details about the transformer and resistor would be provided as a part of the drawing approval process.

5.20 Tap Changer Controller

5.20.1 The Voltage Regulating Relay (i.e. tap changer controller) shall be as per the Specific Technical Requirements data sheet, or an approved equivalent with the features listed below.

5.20.2 Control Functions

.1 **Band centre:** adjustable from 100 V to 135 V in 0.1 V increments.

.2 **Bandwidth:** adjustable from 1 V to 6 V in 0.1 V increments.

.3 **Line Drop Compensation:** R and X compensation; adjustable from -24 V to +24 V in 1 V increments. Z compensation available with adjustment of voltage raise from 0 V to +24 V, in increments of 1 V.

.4 **Time Delay:** Definite; adjustable from 5 sec. to 120 sec. in 1 second increments. Inverse; adjustable from 5 sec. to 120 sec. in 1 second increments.

.5 **Inter-Tap Time Delay:** Used to introduce time delay between tap operations when control is in sequential mode; adjustable from 0 to 10 seconds in 1.0 second increments. Counter input required.

.6 **Selectable Outputs:** continuous or pulsed. Normally, an output (raise or lower) signal is maintained when the voltage remains outside the band. A pulsed output is programmable from 1 to 5 seconds, in increments of 0.1 second.

.7 **Reverse Power Operation:**

.1 Transformer LTC Application: Can be set to ignore or block operation with reverse power.

.2 Single-Phase Regulators: If "keep track" tap position indication is applicable, unit may be set to "Regulate Reverse". This feature allows separate set-points and regulation in the reverse direction without the installation of source-side VTs.

.8 **CT to VT Phasing Correction**: adjustable from 0° to +330° in 30° increments.

.9 **Real-Time Metering:** the following measured and calculated values are available in real-time:

.1	Local Voltage	• Load kVA, or MVA
.2	Load Centre Voltage	• Load kW, or MW
.3	Line Current	• Load kVAr, or MVAr
.4	Power Factor	• Line Frequency

.10 **Demand Meter**: time interval selected as 15, 30, or 60 minutes.

.1 The following "drag-hand" values are stored with date & time stamp and averaged over 32 sec:

.1 Minimum Local Voltage

.2 Maximum Local Voltage

.2 The following "drag-hand" values are stored with date & time stamp and calculated over the demand time interval (15, 30, or 60 minutes) as selected by the user:

.1 Maximum Primary Line Current

.2 Maximum Load kW, or MW

.3 Maximum Load kVAr, or MVAr

.4 Maximum Load kVA, or MVA (and Power Factor at time of Max. Load kVA, or MVA)

.11 Line Overcurrent Tap Change Inhibit: adjustable from

.1 200 mA to 640 mA of line current for 200 mA CT, or

.2 1.0 A to 3.2 A for 1 A CT display, and

.3 5.0 to 16.0 A for 5 A CT display.

.4 External auxiliary CT required for 1.0 A and 5 A CT inputs.

.12 **Voltage Limits, Tap Position Limits, and Runback:** Overvoltage and under-voltage limits are independently adjustable from 95 V to 135 V in 0.1 V increments. Upper and lower tap position limits may be set by user, with tap position knowledge active. An adjustable dead-band (above the undervoltage limit) of 1 V to 4 V is available, which can be used to set the runback limit.

.13 **Voltage Reduction (i.e. Brown Out):** three independent steps, each adjustable from 0% to 10% in 0.1% increments of the band-center set-point.

.14 **External Inhibit of Auto Tap Change:** blocks automatic tap changer operation in response to external contact closure.

.15 **Sequential or Non-Sequential Operation:** non-sequential operation resets the time delay upon momentary external contact closure at the non-sequential input.

.16 **Paralleling:** may be implemented by circulating current method using separate balancing equipment or with external master-follower circuitry.

.17 **VT Ratio Correction:** VT correction from -10 V to +10 V in 0.1 V increments.

.18 **Self-Test Alarm Output Contacts:** alerts operator to loss of power or malfunction of control.

.19 **User Programmable Alarm Contacts:** alerts to one or more of the following system conditions:

.1 Communications Block invoked, Block Raise Voltage Limit exceeded, Block Lower Voltage Limit exceeded.

.2 Voltage Reduction (any step) invoked, Reverse Power Flow condition detected, Line Current Limit exceeded.

.3 Tap Block Raise in effect, and Tap Block Lower in effect.

.20 **Tap Position Knowledge:** Transformer LTC: Unit receives a signal from a position transducer.

.21 **Operations Counter:** a software counter increments by one or two counts (user-selected) per close/open cam switch operation, and may be pre-set by the user.

.22 **Resettable Operations Counter**: a second software counter, similar to the operations counter, which may be reset by the user.

5.20.3 Inputs

.1 **Control Voltage Input**: nominal 120 V ac, 60 Hz (50 Hz optional); operates properly from 90 V ac to 140 V ac. If set at 60 Hz, the operating system frequency is from 50 to 65 Hz. The burden imposed on the input is 8 VA or less. The unit should be powered from a voltage transformer connected at the controlled voltage bus. The unit will withstand twice the voltage input for one second and four times the voltage input for one cycle.

.2 **Motor Power Input**: nominal 120 VAC to 240 VAC, 60 Hz (50 Hz optional) at up to 6 A as required by the load, with no wiring changes required.

.3 **Line Current Input**: line drop compensation is provided by a current transformer input with a 0.2 A full scale rating. The burden imposed on the current source is 0.03 VA or less at 200 mA. The input will withstand 400 mA for two hours and 4 A for 1 sec.

.4 **Circulating Current Input:** parallel operation of regulators or transformers is accommodated by a current transformer input with a 0.2 A full scale rating. The burden imposed on the current source is 0.03 VA or less at 200 mA. The input will withstand 400 mA for two hours and 4 A for 1 sec.

5.20.4 Outputs

.1 **Raise Output:** capable of switching 6 A at 120 VAC to 240 VAC motor power.

.2 **Lower Output:** capable of switching 6 A at 120 VAC to 240 VAC motor power.

.3 **Alarm Contact Outputs (2):** one normally open programmable contact and one normally closed self-test alarm contact; capable of switching 3 A at 120 VAC.

5.20.5 LED Indicators

.1 Front panel LED indicators show the following control conditions: Out-of-Band Raise, Out-of-Band Lower, Reverse Power Flow detected, and CPU OK.

5.20.6 Human Interface

.1 Menu-driven access to all functions by way of three pushbuttons and an alphanumeric display. There shall be programmable passwords available to provide various levels of access to the functions.

5.20.7 Communications

.1 Communication ports shall provide access to features, including metering, software updates, and programming of all functions. This is accomplished via modem or direct serial connection for any IBM PC-compatible personal

computer running the SCADA communications software. COM1 shall be available with RS-232, RS-485, or Fiber Optic. COM2 is an RS-232 front port for local communications.

5.20.8 Protocols

.1 The following standard protocols shall be included: BECO 2200, BECO 2179, Cooper 2179 and DNP3.0. UCA2.0 protocol is available as an option. COM2 uses BECO 2200 for local communications.

5.20.9 Communication Ports and Format

.1 The unit shall come with two RS-232 communications ports, COM1 and COM2.

.1 Communications via Direct Connection:

.1 Control via a serial "null modem" cable with a 9-pin connector (DB9P) for the controller and the applicable connector (usually DB9S or DB25S) for the PC, or Fiber Optic communication using ST standard or two-wire RS-485.

.2 Communications via Modem

.1 Remote (modem) communications

.3 Communications Using Networking

.1 Addressing capability to allow networking of multiple tap changer controls. Each tap changer control can be assigned an address. Selected commands may be broadcast to all controls on the network.

5.20.10 Application

.1 The control shall act as the monitoring point for all voltage, current, and related power quantities, thereby simplifying operation while avoiding transducers and multiple Remote Terminal Unit (RTU) analog inputs. The protocols implement half-duplex, two-way communications. This allows all functions, which would otherwise require the presence of an operator at the control, to be performed remotely. Capabilities shall include the following:

.1 Interrogation and modification of set-points.

.2 Broadcast of commands, such as tap change inhibit and voltage reduction (up to three steps) to networked controls.

.3 Recognition of alarm conditions, such as voltage extremes and excessive load.

.4 Selective control of raise and lower tap change operations.

.5 Re-configuration of the control, such as a change to the demand integration time period or a selection of different alarm parameters.

5.20.11 Testing Specifications

.1 **High Voltage:** All input and output terminals will withstand 1500 VAC rms to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA, for all terminals to ground. Input and output circuits are electrically isolated from each other, from other circuits and from ground.

.2 **Surge Withstand Capability:** All input and output circuits are protected against system transients. Units pass all requirements of ANSI/IEEE C37.90.1-1989 defining surge withstand capability.

.3 **Radiated Electromagnetic Withstand Capability:** All units are protected against electromagnetic radiated interference from portable communications transceivers.

.4 **Control Accuracy Specification:** Voltage accuracy of ±0.7% in accordance with ANSI/IEEE C57.15-1986 defining control accuracy of operation.

.5 **ESD:** Conforms to IEC 1000-4-2 Standard.

5.20.12 Industrial Certifications

.1 ULC/ CSA Listed

5.20.13 Environmental

.1 **Temperature:** stated accuracies maintained from -40° C to + 80° C.

.2 **Humidity:** stated accuracies are maintained up to 95% relative humidity (non-condensing).

.3 **Fungus Resistance:** a conformal coating is used on the printed circuit board to inhibit fungus growth.

5.21 Control Wiring and Auxiliary Power

5.21.1 All internal circuit breaker wiring shall be clearly and consistently identified with respect to the pole assignment, such that all equipment related solely to the operation of each circuit breaker pole is readily identifiable as belonging to the function of that pole.

5.21.2 All wiring shall be switchboard wire, 600 V rated, 7 or 19 strand copper, moisture resistant or thermosetting and be #14 AWG minimum, unless otherwise indicated.

5.21.3 All control wiring shall be minimum #14 AWG stranded copper (2.1 mm2), secondary wiring to the bushing current transformers shall be minimum #10 AWG stranded copper (5.3 mm2) and all auxiliary power related wiring shall be copper and comply with the minimum sizing requirements of C22.1 - Canadian Electrical Code Part I.

5.21.4 All external auxiliary power and control wiring will be routed in conduit or feed-through wire-way to the control cabinet.

5.21.5 Rail mounted terminal blocks shall be supplied complete with required blanking plates, insulating plates, end blocks and tags. A minimum of 20% spare terminal blocks shall be supplied on each terminal strip, or as directed during the drawing approval process.

5.21.6 All fuse blocks shall be the dead front type, Cooper-Bussmann "Red Spot" series, or equivalent and capable of accepting the following CSA approved Cooper-Bussmann fuses, or equivalent:

Up to 20A	RS20H Holder	(1-20A)_CIF21	HRC Form I Class CA fuse,	600VAC, 250VDC
Up to 30A	RS32H Holder	(25-30A)_CIH07	HRC Form I Class K fuse,	600VAC
25 to 60A	RS63H Holder	(35-60A)_CIK07	HRC Form I Class K fuse,	600VAC
60 to 100A	RS100H Holder	(80-100A)_CIK14	HRC Form I Class K fuse,	600VAC

5.21.7 The following terminal blocks, or Engineer approved Weidmuller or other equivalents shall be used:

.1 Control Circuits - Phoenix Contact Type UK-16 (single screw)

.2 Current Circuits - Phoenix Contact Type URK-ND2 (double screw)

5.21.8 All blocks with voltages above 120VAC or 125VDC shall be fitted with insulating covers to prevent accidental contact.

5.21.9 Insulated wire connectors shall be used for terminating wires on device terminals.

.1 All wires to devices shall be terminated compression, insulate wire connectors. Soldered terminals shall not be permitted.

.2 Terminals shall be CSA certified for use with size of copper wire being terminated and also feature colour-coded insulation, crimp-able PVC or nylon shroud, 600V rating.

.3 Three type of compression terminals may be used. Their use and specific functional application shall be as specified in the Specific Technical Requirements data sheet:

.1 **Ferrule** - connections to mechanical connectors (i.e. rail mounted terminals)

.2 **Ring** - connections to screw and stud terminals

.3 **Fork** - connections to screw and stud terminals

.4 Acceptable terminals to be used are as follows:

Ferrule Terminals	Ring Terminals	Fork Terminals
Burndy Type YF-I	Burndy Type TP	Burndy Type TP-F
Phoenix Contact Type AI	Penn Union Type R6A	Penn Union Type BS6
Approved Equivalents…	Approved Equivalents…	Approved Equivalents…

.5 Terminate no more than two wires to any one stud or terminal unless the terminal is expressly identified by the manufacturer as being suitable for additional terminations.

5.22 Rating Plate

5.22.1 The nameplate shall be fabricated from stainless steel, and permanently engraved with data in accordance with CSA C88.

5.22.2 A schematic representation of main winding and CT connections shall be shown on nameplate. Ratios and polarities shall be indicated for all current transformers. The Owner purchase order number shall be stamped on the nameplate.

5.22.3 Measured values of positive and zero sequence impedance shall be shown, based on the ONAN rating. Positive and zero sequence impedances between windings shall be shown.

5.22.4 A label made of laminated plastic approx. 50 mm x 75 mm, with white letters on a black background, indicating PCB level in the oil along with date of test shall be affixed near the rating plate.

5.22.5 When a load tap changer is supplied, a separate nameplate with data in accordance with CSA C88, shall be mounted on the tap changer or the tap changer control cabinet.

5.23 Inspection and Testing

5.23.1 All transformers on a purchase order shall be tested in accordance with CSA C88 but with modifications and additions described below:

.1 **Resistance:** Resistance measurements shall be taken at all tap positions. Phase to phase and per phase resistance values shall be recorded.

.2 **Ratio:** Ratio shall be measured at all tap positions.

.3 **Excitation Current:** Excitation current shall be measured at 100%, 105% 110% and 115% of the rated voltage at principal tap connection.

.4 **Excitation Loss:** Excitation loss shall be measured at 100%, 105% and 110% of the rated voltage at principal tap connection.

.5 **One Hour Excitation:** This test shall be performed on all transformers.

.6 **Positive Sequence Impedance:** Positive Sequence Impedance tests shall be performed for maximum boost, nominal and maximum buck positions of the OLTC with off circuit tap switch, if provided, in the nominal ratio position.

.7 **Zero Sequence Impedance:** Zero Sequence Impedance tests shall be performed for maximum boost, nominal and maximum buck positions of the OLTC with off circuit tap switch, if provided, in the nominal ratio position.

.8 **Load Loss:** Load loss shall be measured at rated load and at rated voltage.

.9 **Temperature Rise:** Temperature rise test shall be performed on all transformers.

.10 **Gas in Oil Analysis:** Samples for dissolved gas in oil analysis shall be taken both before and after each temperature rise test, as follows:

Test	Location	
	Top	Bottom
Before Temperature Rise Test	1	0
After Temperature Rise Test	2	2

.1 The "Before" sample and two "after" samples, one from each of the top and bottom, will be analysed. The remaining top and bottom samples will be retained for possible later analyses, if necessary.

.2 The pass/fail criteria shall be an increase in gas content during the temperature rise test of less than the following maximum limits:

Component	PPM
Hydrogen (H_2)	10
Methane (CH_4)	1
Ethane (C_2H_6)	1
Ethylene (C_2H_4)	1
Acetylene (C_2H_2)	0
Carbon Monoxide (CO)	25
Carbon Dioxide (CO_2)	150

.11 **Induced Potential Test:** The tap changer shall be set to include full winding for this test. A three phase test shall be performed. The test voltage and duration for these transformers shall be as required by CSA Std. C88.

.12 **Partial Discharge:** In addition to RIV, partial discharge measurements using the apparent charge method shall be recorded. Apparent charge shall not exceed 500 pC.

.13 **Lightning Impulse (Full Wave):** Lightning Impulse tests shall be performed on all transformer terminals including neutrals.

.14 **Chopped Wave Impulse:** The chopped wave test is not a routine CSA C88 requirement and shall be performed when specified in the Specific Technical Requirements data sheet. Crest of the chopped wave shall be same as that of the Lightning Impulse wave. The minimum time to flash over shall be 3 microseconds.

.15 **Core Insulation:** Core insulation tests (minimum 1,000 Volt insulation tester) shall be repeated after transformer is loaded on the carrier immediately prior to shipping. Results to be shown on test report, including the resistance and voltage of tester.

.16 **Insulation Power Factor:** Insulation power factor tests for the transformer winding shall be performed in accordance with ANSI C57.12.90 Method II (test with guard circuit). The power factor value measured at a temperature range between 20°C to 30°C and corrected to 20°C shall not exceed 0.5%.

.17 **Bushing Power Factor:** Power Factor tests shall be performed for all capacitive bushings with a power factor recorded on the bushing nameplate and recorded in the test results. This test shall be conducted for both the "C1" and "C2" capacitances.

.18 **Sound Level Test:** When specified in the Specific Technical Requirements data sheet, a sound level test shall be performed.

.19 **Pressure Test:** A pressure test on the tank and cooling system shall be performed using hot oil with a min. initial temperature of 50°C and at a pressure of 35 kPa (5 psi) maintained for a period of 24 hours. If any leaks appear they shall be repaired and the test shall be repeated.

.20 **Vacuum Test:** A vacuum test shall be performed on all tanks and cooling systems designed for vacuum filling.

.21 **Current Transformers:** Current transformers shall be tested after installation in the power transformer from their terminals in the control cabinet. The tests shall be conducted in accordance with CSA C13. The following tests are required:

.1 Ratio Test

.2 Polarity Test

.3 Saturation Curve

.4 Applied Potential Test

.5 Induced Potential Test

.6 DC Resistance

.22 **Winding Temperature:** The results of calibration tests on winding temperature devices (hot spot indicator) shall be shown on the test report.

.23 **Control Wiring Insulation Test:** Control wiring shall be tested at two times the rated circuit voltage plus 1000 volts (1500 V minimum) 60 Hz to ground for one minute.

.24 **Functional Tests:** Secondary circuit wiring of fans, etc. shall be checked to ensure correct functioning from initiating source to actual component operation from terminals for Owner connection.

.25 **Paint Thickness:** The thickness of the external paint coating shall be measured at 12 locations selected by the Purchaser or his representative. Minimum acceptable thickness shall be 0.115 mm).

5.23.2 Upon completion of tests, two paper copies of official test results shall be supplied to the Purchaser at the same address as for final drawings; and an electronic copy in the Adobe ".pdf" file format shall also be sent via e-mail attachment or an ftp site. A copy shall also be included in all paper copies of the instruction manual. The test results shall show all tests conducted in accordance with this specification.

5.24 Drawings

5.24.1 The following drawings are required for approval:

.1 Outline and General Assembly:

.1 This drawing shall show transformer assembly details including mass, dimensions, location of accessories, hand-holes, manholes, centre of gravity, lifting & moving details, etc. This drawing shall also indicate the distance from the underside of the top cover to the top of the oil for the Min, Max and 25°C oil levels marked on the main tank oil level dial.

.2 Bill of Materials:

.1 This shall include, but not be limited to the following:

.1 Rating, type, leakage distance, model and manufacturer of the bushings

.2 Type, catalogue no., material and manufacturer of connectors, when supplied.

.3 Type, catalogue no., manufacturer of accessories, e.g. gauges, indicators, pressure relief devices, breathers

.4 Type, catalogue no., manufacturer, size and material of valves, pipes and fittings

.5 Type, rating, model and manufacturer of OLTC

.6 Quantity, rating, capacity and manufacturer of fans, pumps

.7 Type, catalogue no. and manufacturer of control switches, terminal blocks, fuses, instruments and relays in the control cabinet(s)

.3 Nameplate Diagram:

.4 Schematic Diagrams:

.1 As a minimum, schematic diagrams shall be provided for load tap changer control, cooling (fan and pump) control, winding temperature indication and alarm and indication contacts.

.2 These schematic drawing shall clearly indicate the Owner connection terminals, if applicable.

.3 Each of these schematics shall be complete and preferably, represented on a single drawing sheet. If a schematic diagram requires more than one sheet, the interface points common to each combination of drawing sheets shall be clearly illustrated on each.

.4 Incomplete schematic representations or partial schematic representations using wiring drawing interface points are not acceptable.

.5 Shipping Drawing: This drawing shall show the following information:

.1 Rating, type, leakage distance, model and manufacturer of the bushings

.2 Shipping heights, width, length and base dimensions

.3 Shipping weight of heaviest piece

.4 Centers of gravity in shipping condition

.5 Location of jack steps, rolling areas and blocking areas.

.6 Slinging requirements and restrictions, if any, for crane off-loading.

.7 Position of gas bottles, regulators and gauges if shipped gas filled.

.8 Details of gas shipping conditions and pressure checks to be made.

.9 Status of OLTC compartment as to whether oil or gas filled.

.10 Location of core ground, test link.

.11 Complete Bill of Materials indicating parts shipped separately.

.12 Position of impact recorders installed for shipment.

.6 Drawings for approval shall be distributed to the Purchaser, as per the following:

.1 Two (2) paper copies to Purchaser

.2 One (1) electronic copy to Purchaser

.3 In a file format conforming to the following order of preference:

.1 ".dwg" AutoCAD file format

.2 ".pdf" file format

.3 ".dxf" file format

.7 Final drawings shall be distributed to the Purchaser, as per the following:

.1 Two (2) paper copies to Purchaser

.2 One (1) paper copy in each Instruction Manual

.3 One (1) electronic copy to Purchaser

.4 In a file format conforming to the following order of preference:

.1 ".dwg" AutoCAD file format

.2 ".pdf" file format along with a ".dxf" format file

.5 For pdf files of scaled dimensional drawing, the required sheet size shall be noted.

5.25 Instruction Manuals

5.25.1 The instruction manual shall include the following:

.1 Instructions for receiving storage and initial oil filling.

.2 Detail of accessories supplied with the transformer.

.3 Drawings and details of the radiators supplied with the transformer, including overall dimensions, surface area, mounting flange details and centre-to-centre spacing, and weight: empty and filled.

.4 Details of pumps, motors and fans.

.5 Details of gas detection relay.

.6 Details of de-hydrating breather(s).

.7 Details of bushing current transformers.

.8 Drawings and instructions for bushings.

.9 Details and instructions for the tap changers including control devices.

.10 Details of gaskets, including list, material, thickness and dimensional details of all gaskets.

.11 List of all valves including size, manufacturer and type number, ads appropriate.

.12 Procedures to calibrate and adjust switches, contacts, oil level gauges, temperature indicators, etc.

.13 Procedure to test and calibrate winding hot spot temperature.

.14 Test reports.

.15 Spare parts lists complete with all reference numbers.

.16 All approved drawings.

.17 Other Drawings

.1 The instruction manuals shall include internal assembly drawings for the Purchaser's use for maintenance. These drawings may be non-dimensional and marked "Confidential" and shall include the following:

.1 Inside assembly - High Voltage and Low Voltage

.2 Inside assembly - Plan and End Views

.3 Connections to series-multiple terminal board and tap switches, if so equipped.

In addition to, or in lieu of, high resolution photographs may be included in the instruction book documenting various views of the finished core and coil assembly, including as a minimum, the four side views.

5.25.2 The instruction manuals shall be distributed to the purchaser, as per the following:

.1 One (1) electronic copy in a ".pdf" document file format to Purchaser

.2 Two (2) paper copies to Purchaser

.3 Two (2) paper copies with the unit

5.26 Shipment

5.26.1 Transformers shall be shipped dry air filled, unless mutually agreed and specified otherwise on purchase order(s).

5.26.2 For transformers shipped filled with dry air, the following shall apply:

5.26.3 Transformers shall be shipped dry air filled, unless mutually agreed and specified otherwise on

.1 Gas pressurization shall be sufficient to keep transformer dry during shipment and for one month after arrival.

.2 Pressure gauges, valves and gas cylinder physically attached to the transformer and suitably protected from damage shall be supplied for replenishing gas pressure during transit and storage.

.3 Type of gas, initial pressure and temperature, as well as minimum pressure requirements, shall be tagged to the cylinder in a weather proof manner.

.4 Instructions shall be provided for the initial tests on arrival (pressure and moisture requirements).

5.26.4 A three way impact recorders positioned to prevent damage during transit shall be mounted on all transformers shipped by rail. The recorder shall be removed only in the presence of the Purchaser's representative on arrival.

.1 The Purchaser reserves the right to have its own solar powered, magnetically attached impact recorder mounted by the manufacturer without regard to the method of shipment.

5.26.5 When auxiliary equipment such as bushings, conservator tank or radiators are shipped separately, each container shall be clearly marked with the Purchase Order and Serial Number of the transformer with which it is associated. A detailed packing slip shall accompany each shipment.

5.26.6 Any auxiliary equipment not designed for indefinite outdoor storage shall be packed separately and the container clearly marked "for indoor storage." For parts requiring special precautions during storage, the details shall be shown on the outside of each container, or in a durable envelope attached to the container and labeled "Storage Instructions."

5.26.7 Before a transformer is shipped, all the necessary drawings and information relating to position of oil filling valves and vacuum pump attachments with complete oil filling instructions and special precautions must be sent to the Purchaser. All drawings necessary for the handling and assembly of the transformer including internal arrangement shall be shipped to the Purchaser prior to shipment of the transformer.

5.26.8 The method of oil shipment will be as specified in the Specific Technical Requirements data sheet. Arrangements for oil shipment must be confirmed with the Purchaser prior to shipment.

5.26.9 A spare set of gaskets for use during site assembly shall be shipped with the unit.

III. SITE PREPARATION AND COMMISSIONING

1 OVERVIEW

1.1 General

1.1.1 In general, provide electrical services in the installation, testing, and commissioning of the Substation Transformers at the Place of Installation.

1.1.2 The scheduling of all work shall be coordinated with the Owner to ensure that delays due to any and all Owner-supplied materials are minimized and that no delays are caused by interference between persons operating on site under different contracts.

1.1.3 The Vendor shall allow a maximum of ten (10) Working Days for the Installation, or indicate with the Bid Submission if more time is required and adjust bid accordingly.

1.1.4 The Vendor shall allow a maximum of five (5) Working Days for the Testing and Commissioning, weather-permitting.

1.1.5 Note that the work shall also include the supply and installation of sundry items and all items that are required elsewhere in these specifications or related drawings, or that are necessary to provide a complete installation.

1.1.6 The Vendor is asked to provide a per diem rate for site supervision of the services detailed in the Installation, in the event that the Owner deems necessary to remove Installation from the scope of this Technical Specification document.

1.1.7 Note that the work shall also include the supply of all test equipment to fulfill the requirements of the Contract.

1.1.8 Should any test results be deemed unacceptable, whether due to test conditions, Vendor error, or required correction of an equipment deficiency, the Vendor shall be responsible for repeating the applicable test or tests.

1.1.9 The Vendor and the Engineer shall review all tests prior to the testing personnel leaving the site.

1.2 Compliance with Standards and Codes

1.2.1 The installation, testing, and commissioning shall confirm that the Product conforms to or exceeds the applicable requirements of the current edition of all standards and codes contained herein where applicable.

1.2.2 The Vendor shall adhere to the following standards during the process of testing and commissioning:

.1 Prince Edward Island Standards

.1 Prince Edward Island Occupational Health and Safety Act

.2 Prince Edward Island Labour Act

.2 CSA Standards

.1	C22.1-06	Canadian Electrical Code Part I
.2	C22.3	Canadian Electrical Code Part III
.3	Z462-08	Workplace Electrical Safety
.4	C88-M	Power Transformers & Reactors

.3 ANSI/IEEE Standards

.1	C57.12.90	Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
.2	C57.19.00	General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
.3	C57.12.90	Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
.4	C57.19.00	General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
.5	Std. No. 472	Guide for Surge Withstand Capability (SWC) Tests

2 INSTALLATION

2.1 Scope of Work

2.1.1 The Bidder shall identify in the Quotation all Subcontractors to be used in the Installation process.

2.1.2 Install and dress power transformers as defined in Section ii herein.

.1 Dressing shall include installation of all necessary components shipped loose with the transformer. Vendor shall be responsible for supply and placement of the crane for off-loading the transformer, including, but not limited to, the addition and removal of temporary fill for the use of out-riggers.

.2 Dressing shall include installation of the provided surge arresters and grounding of the arresters to the tank.

.3 Termination of high and medium voltage phase conductors and low voltage field cabling shall be by others.

2.1.3 Install lamicoid nameplates on the substation transformer as indicated.

2.1.4 All sundry materials, components and parts required for the on-site installation shall be supplied by the Vendor.

.1 All sundry materials, components and parts required for the on-site installation shall be new and of the highest quality and of current and readily available manufacture. Vendor shall clearly indicate the name of the manufacturer's catalog/serial number of each component, quantity, rating and type of components on the package that is being furnished.

2.2 Remediation

2.2.1 The Vendor shall be responsible for any and all remediation following the substantive completion of the installation required to provide a fully operational and safe system.

3 SITE TRANSFORMER TESTING

3.1 Equipment

3.1.1 The Vendor shall be responsible for the supply of all test equipment including but not limited to the following:

.1 10 kV Doble Type pf Test Set (or equivalent)

.2 Meggar Test Set (or equivalent)

.3 Fluke Meter (or equivalent)

.4 Three-phase generator

.5 Current meter

.6 Voltage meter

.7 Testing cables

.8 Disconnect switch

.9 Current transformer tester.

3.2 Test Procedures

3.2.1 General

.1 The Vendor shall test the power transformer, insulating oil, and all accessories to the satisfaction of the Engineer as defined herein; the Vendor shall indicate and include any additional Vendor-recommended tests with the provided Bid.

.2 The Vendor shall provide the qualifications of the field testing team to the Engineer prior to engagement of the testing agency.

.3 The Vendor shall not perform any test during weather conditions that would be deemed detrimental to the accuracy of the test.

.4 All test results shall be provided to the Engineer in written form within 24 hours of completion by fax or email. If neither method is readily available, the Engineer shall be informed and the results forwarded to the Engineer at the first available opportunity.

.5 Submittal of the test results notwithstanding, the Engineer shall be informed immediately of any readily-apparent deficiencies noted by the tests.

.6 All test reports shall include the following information:

.1 Name of testing firm.

.2 Date of test.

.3 Ambient temperature at time of test.

.4 Relative humidity at time of test.

.5 Weather conditions at time of test (i.e. rain, clear, cloud cover, etc.).

.6 Confirmation that test results are acceptable.

.7 Initialled by Vendor.

3.2.2 Transformer Testing

.1 The Vendor shall be required to provide the following tests, in addition to a visual inspection, on the Transformer and its auxiliary devices:

.1 Winding Tests

.1 **Insulation/Power Factor Testing:** Using Doble test set (or equivalent) at a 10kV test voltage, measure the power factors/capacitances of each transformer winding in picofarads

.2 **Dielectric Testing:** Required test results measured at one (1) minute for five (5) equally spaced voltage levels not exceeding two-thirds of the energized winding's rated voltage:

.1 Leakage current (micro-Amperes)

.2 Insulation resistance (mega-Ohms)

.3 Energized winding to tank (Volts)

.4 Energized winding to grounded winding or windings (V)

.5 Repeat test procedure for each of the following conditions:

Test No. 1: HV shorted and energized XV and YV shorted and grounded.	**Test No. 6:** XV shorted and energized HV shorted and guarded YV grounded.
Test No. 2: HV shorted and energized XV shorted and guarded YV grounded.	**Test No. 7:** YV energized HV and XV shorted and grounded.
Test No. 3: HV shorted and energized XV shorted and grounded YV guarded.	**Test No. 8:** YV energized XV shorted and grounded. HV shorted and guarded.
Test No. 4: XV shorted and energized HV and YV shorted and grounded.	**Test No. 9:** YV energized. XV shorted and guarded. HV shorted and grounded.
Test No. 5: XV shorted and energized HV shorted and grounded YV guarded.	

.3 **Magnetization Current Measurement:** Required test results:

.1 Red-phase current (IR, milli-Amperes)

.2 Yellow-phase current (IY, milli-Amperes)

.3 Blue-phase current (IB, milli-Amperes)

.4 Phase-to-phase voltage (Volts).

.4 **Vector Grouping Test:** Required test results (H1 connected to X1):

.1 Voltage H2 - X3 (V)

.2 Voltage H3 - X2 (V)

.3 Voltage H1 - H2 (V)

.4 Voltage H2 - X2 (V).

.5 **Positive Sequence Impedance Test:** Required test results:

.1 %Z(H - X)1.

.6 **Zero Sequence Impedance Test:** Required test results:

.1 %Z(H - X)0

.2 %Z(H - Y)0

.3 %Z(X - YT)0.

.7 **Turns Ratio Test:** Test transformer ratio; confirm all tap changer tap ratios.

.2 Core Ground

.1 Megger Test

.1 Using the Megger Test set (or equivalent), measure the impedance from the core to ground in addition to the same test performed prior to off-loading at the Place of Installation.

.3 Current Transformer Tests

.1 The Vendor shall perform the following tests on each transformer CT for all taps, based on the Manufacturer's recommended test procedures:

.1 Ratio Test

.2 Magnetization Curve Test

.3 Secondary Resistance Test

.4 Bushings

.1 **Insulation/Power Factor Testing:** Using Doble test set (or equivalent) at a 10kV test voltage, measure the power factors/capacitances of each transformer bushing (H1, H2, H3, X0, X1, X2, X3, Y3) in picofarads.

.5 Winding Temperature Gauges

.1 Operational Test

.1 The Vendor shall test each set point and reset point for all winding temperature gauges and record the results.

.2 The Vendor shall record discrepancies between the listed and actual winding temperature gauge settings.

.6 Oil Temperature Gauges

.1 Operational Test

.1 The Vendor shall test each set point and reset point for all winding temperature gauges and record the results.

.2 The Vendor shall record discrepancies between the listed and actual winding temperature gauge settings.

.7 Liquid Level

.1 Operational Test

.1 The Vendor shall test the operate and reset points of the main tank liquid level indicator and record the results.

.2 The Vendor shall test the operate and reset points of the tap changer liquid level indicator and record the results, if applicable.

.8 Gas Alarm and Trip

.1 Operational Test

.1 The Vendor shall test the operate and reset points of the rapid pressure rise alarm contact and record the results.

.2 The Vendor shall test the operate and reset points of the rapid pressure rise trip contact and record the results.

.9 Radiator Fan Motors

.1 Operational Test

.1 The Vendor shall test the performance of the stage 1 fan bank and record the voltage and current of each phase during operation.

.2 The Vendor shall test the performance of the stage 2 fan bank and record the voltage and current of each phase during operation.

.10 Hot Spot Compensation Current Transformers

.1 Functional Test

.1 The Vendor shall apply current to the winding monitored by the Hot Spot Compensation CT.

.2 The Vendor shall observe the temperature of the winding at elapsed times of 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, and 50 minutes.

.11 Tap Changer Tests (as required)

.1 Functional Tests

.1 The Vendor shall manually confirm operation of the tap changer and exercise the device by raising and lowering the tap positions through their full range of operation.

.2 The Vendor shall confirm correct automatic operation of the on-load tap changer throughout the tap changer's full range of operation.

.3 The Vendor shall give the Engineer one (1) week notification prior to commencement of testing of the on-load tap changer.

.4 The Vendor shall enter the following set-points, provided by the Engineer, into the tap changer control mechanism:

- Band centre (volts).
- Bandwidth (volts).
- Time delay (seconds).

.5 The Vendor shall apply a simulated voltage signal to the on-load tap changer control and observe that the operation is in accordance with the above mentioned set-points.

.6 The Vendor shall test the automatic operation of the on-load tap changer through the full range of operation, both raising and lowering.

.7 In addition to testing the operating handle mechanism, the Vendor shall test the operation of the electrically-controlled Manual Raise and Lower pushbuttons through the full range of tap positions.

.2 CSA-C88 Defined Tests

.1 The Vendor shall include the tap changer in all listed transformer tests or otherwise repeat the test for the tap changer.

.12 Oil Testing

.1 Dielectric Strength Test.

.2 Oil Power Factor Test.

.3 Contaminant Test

.1 Following all other required tests, a sample of the transformer insulating oil shall be drawn and tested for moisture and dissolved gas content, including but not limited to the following:

- Hydrogen (H_2)
- Oxygen (O_2)
- Methane (CH_4)
- Carbon Monoxide (CO)
- Carbon Dioxide (CO_2)
- Ethylene (C_2H_4)
- Ethane (C_2H_6)
- Acetylene (C_2H_2)

3.3 Commissioning

3.3.1 Co-ordination with the Source Utility

.1 The Vendor shall be responsible for providing for the Source Utility inspection of plant following testing and commissioning, and prior to energization, if applicable.

3.3.2 Co-ordination with Local Electrical Inspection Authority

.1 The Vendor shall be responsible for providing for the Local Electrical Inspection Authority inspection of plant following testing and commissioning, and prior to energization, if applicable.

3.3.3 The Vendor shall note that the Local Inspection Authority is a separate entity from the Source Utility.

3.3.4 The Vendor shall be responsible for providing for a Field Certification of plant following testing and commissioning, and prior to the Local Electrical Inspection Authority inspection of plant, if applicable; Field Certification shall be performed by a recognized Authority as deigned by the Local Electrical Inspection Authority at the time of commissioning.

.1 Current recognized Field Certification Authorities include:

.1 CSA

.2 Entela

.3 QPS

3.3.5 Release for Energization

.1 The Contractor shall issue a formal letter of Release for Energization to the Engineer, upon fulfillment of the following conditions:

.1 Substantial Completion of the Work.

.2 The Engineer's acceptance of the initial field test results as complete to the requirements of the Contract Documents.

.3 The Contractor's review and approval of the field test results as acceptable for energization and operation of the Product.

.4 Confirmation of Source Authority Inspection and rectification of any and all noted deficiencies.

.5 Receipt of written acceptance of installation by the Electrical Inspection Authority.

3.4 Documentation

3.4.1 Official Test Results

.1 Initial test reports provided to the Engineer within 24 hours of completion notwithstanding, the Vendor shall provide six (6) copies of final, official test reports, type-written with the Vendor's signature of approval, to the Engineer following the completion of Testing.

.2 The Vendor shall include the results of all on-site testing described herein, and the information defined in Part B, Section iii, Clause 3.2.1.6.

.3 The Vendor shall include with the test results a description of the test performed or indication that the test was performed as defined by this document, as well as name the equipment used to perform the test.

.1 The Vendor shall accompany the official test report with written approval that the field test results have been reviewed and the power transformer and all accessories have been found acceptable for energization and operation, including the Appendix 4, Formal of Release for Energization.

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

1.0	**TRANSFORMER RATING**	Item No. _____
1.1	Manufacturer	_____
1.2	No. of Phases and Frequency	_____, _____
1.3	Rated Capacity @ 65°C	_____ / _____ / MVA
1.4	Cooling	_____ / _____ / _____
1.5	H Winding - Voltage and Connection	_____ kV, _____
1.6	H Winding BIL - Line End and Neutral End	_____ kV, _____ kV
1.7	X Winding - Voltage and Connection	_____ kV, _____
1.8	X Winding BIL - Line End and Neutral End	_____ kV, _____ kV
1.9	Regulation @ 0.80 PF	_____
1.10	Estimated Hot Spot Temp. Rise	_____ °C
1.11	Exciting Current at Rated Voltage	_____ A
1.12	Magnetizing kVA at Rated Voltage	_____ kVA
1.13	Impedance H X	_____ %
1.14	Zero Sequence Impedance H X	_____ %
1.15	Guaranteed No Load Loss	_____ kW
1.16	Guaranteed Load Loss @ ONAN	_____ kW
1.17	Load Losses @ Maximum Rating	_____ kW
1.18	Auxiliary Losses @ Maximum Rating	_____ kW
1.19	Noise Level @ ONAN Rating	_____ dB
1.20	Noise Level @ Maximum Rating	_____ dB
1.21	Compliance to Standards (CSA C88)	_____
1.22	Compliance to Standards (Other)	_____

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

2.0	**TRANSFORMER CONSTRUCTION**	Item No. _____
2.1	Type (i.e. Sealed, Conservator)	_____
2.2.1	H Winding Material	_____
2.2.2	H Winding Type	_____
2.3.1	X Winding Material	_____
2.3.2	X Winding Type	_____
2.4	Top Pressure Plate is a Single Ring?	_____
2.5	Bottom Pressure Plate is a Single Ring?	_____
2.6	Static Plate is required and included?	_____ , _____
2.7	Fault Level Rating for Winding Bracing Design	_____ MVA
2.8	Winding to Cable Connection	crimped _____ , brazed _____, formed ____
2.9	Winding to Cable Connection	crimped _____ , brazed _____, formed ____
2.10	Cable to Cable Connection	crimped _____ , brazed _____, formed ____
2.11	Type of Core Design (i.e. Shell, Core)	_____
2.12	Thickness of core steel laminations	_____
2.13	Is the core steel etched?	_____
2.14	Stepped supports for bottom of the core?	_____
2.15	Top to bottom "core clamp ties"	internal / external to windings
2.16.1	Does core clamping include through bolts?	_____
2.16.2	Do core bolts, if installed, meet clause 5.12.6?	_____
2.17	Flux Density @ Rated Voltage	_____
2.18	Flux Density @ 115% Rated Voltage	_____
2.19	Does operation at 110% voltage meet clause 5.12.1?	_____
2.20	Number of Cooling Fans per Stage	_____

TECHNICAL RESPONSE DATA SHEETS

2.21	Fan Motor Rating	_____ W, _____ HP
2.22	Fan Motor Voltage and Phase	_____ V, _____ Phase
2.23	Fan Motor Current FLA and LRA	_____ A, _____ A
2.24	Mass Core	_____ kg
2.25	Mass Core and Coils	_____ kg
2.26	Mass. Tank and Fittings	_____ kg
2.27	Oil Mass/Volume	_____ kg, _____ litres
2.28	Total Mass	_____ kg
2.29	Shipping Mass of Heaviest Piece	_____ kg
2.30	Transf. Shipping (oil/gas filled, by truck/rail/…)	_____
2.31	Oil Shipping (by tanker truck/rail, barrels…)	_____
2.32	Top-up Oil Shipping (in unit, barrels…)	_____
2.23	Oil Manuf. and Type (if supplied with unit)	_____, _____
2.34	Manufacturer Supplied Impact Recorders?	_____

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

3.0 TAPS Item No. _____

3.1 **Series/Parallel Tap Switch or Tap Board (if supplied)**

3.1.1	Type	switch / tap board
3.1.2	Winding	_____
3.1.3	Range	_____ %
3.1.4	No. of Steps	_____
3.1.5	Manufacturer (if switch)	_____
3.1.6	Model (if switch)	_____
3.1.7	Rated BIL	_____ kV
3.1.8	Rated Voltage	_____ kV
3.1.9	Rated Current	_____ A
3.1.10	Temperature rise @ rated current	_____ C

3.2 **Off Circuit Tap Switch or Tap Board (if supplied)**

3.2.1	Type	switch / tap board
3.2.2	Winding	_____
3.2.3	Range	_____ %
3.2.4	No. of Steps	_____
3.2.5	Manufacturer (if switch)	_____
3.2.6	Model (if switch)	_____
3.2.7	Rated BIL	_____ kV
3.2.8	Rated Voltage	_____ kV
3.2.9	Rated Current	_____ A
3.2.10	Temperature rise @ rated current	_____ C

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

3.3 **Load Tap-changer (if supplied/required)**

3.3.1	Manufacturer	_____
3.3.2	Model	_____
3.3.3	Type (Resistor, Reactor)	_____
3.3.4	Winding	_____
3.3.5	Range	_____ %
3.3.6	No. of Steps	_____
3.3.7	Rated BIL	_____ kV
3.3.8	Rated Voltage	_____ kV
3.3.9	Rated Current	_____ A
3.3.10	No. of Operations @ Rated Current	_____
3.3.11	Temperature rise @ Rated Current	_____ C
3.3.12	Rated Overload Current	_____ A
3.3.13	No. of Operations @ Overload Current	_____
3.3.14	Type of Diverter switch (i.e. oil or vacuum contact)	_____
3.3.15	Oil Mass/Volume	_____ kg, _____ litres
3.3.16	Oil Manufacturer/Type (if supplied with unit)	_____
3.3.17	Motor Voltage and Phase	_____ V, _____ Phase
3.3.18	Voltage Regulating Relay Manufacturer	_____
3.3.19	Voltage Regulating Relay Model	_____
3.3.20	Load Drop Compensation provided?	_____
3.3.21	Brown Out Control provided?	_____
3.3.22	Parallel Operation provided?	_____

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

4.0 TRANSFORMER BUSHINGS Item No. _____

4.1	H Bushing Manufacturer	_____
4.2	H Bushing Type / Cat #	_____, _____
4.3	H Bushing Style	Draw-Lead / Bolt-On
4.4	H Bushing BIL	_____ kV
4.5	H Bushing Current Rating	_____ A
4.6	H Bushing Creepage (offered)	_____ mm
4.7	H Bushing Dry Arc Distance (offered)	_____ mm
4.8	H Bushing Colour	_____
4.9	H Bushing Top Terminal Description & Material	_____, _____
4.10	H Bushing Terminal Connector Manuf. / Cat #	_____, _____
4.11	H_O Bushing Manufacturer	_____
4.12	H_O Bushing Type / Cat #	_____, _____
4.13	H_O Bushing Style	Draw-Lead / Bolt-On
4.14	H_O Bushing BIL	_____ kV
4.15	H_O Bushing Current Rating	_____ A
4.16	H_O Bushing Creepage (offered)	_____ mm
4.17	H_O Bushing Dry Arc Distance (offered)	_____ mm
4.18	H_O Bushing Colour	_____
4.19	H_O Bushing Top Terminal Description & Material	_____, _____
4.20	H_O Bushing Terminal Connector Manuf. / Cat #	_____, _____
4.31	X Bushing Manufacturer	_____
4.32	X Bushing Type / Cat #	_____, _____
4.33	X Bushing Style	Draw-Lead / Bolt-On

TECHNICAL RESPONSE DATA SHEETS

4.34	X Bushing BIL	_____ kV
4.35	X Bushing Current Rating	_____ A
4.36	X Bushing Creepage (offered)	_____ mm
4.37	X Bushing Dry Arc Distance (offered)	_____ mm
4.38	X Bushing Colour	_____
4.39	X Bushing Top Terminal Description & Material	_____, _____
4.40	X Bushing Terminal Connector Manuf. / Cat #	_____, _____
4.41	X_O Bushing Manufacturer	_____
4.42	X_O Bushing Type / Cat #	_____, _____
4.43	X_O Bushing Style	Draw-Lead / Bolt-On
4.44	X_O Bushing BIL	_____ kV
4.45	X_O Bushing Current Rating	_____ A
4.46	X_O Bushing Creepage (offered)	_____ mm
4.47	X_O Bushing Dry Arc Distance (offered)	_____ mm
4.48	X_O Bushing Colour	_____
4.49	X_O Bushing Top Terminal Description & Material	_____, _____
4.50	X_O Bushing Terminal Connector Manuf. / Cat #	_____, _____

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

5.0 CURRENT TRANFORMERS Item No. _____

	Bushing	Qty (/Bushing)	Ratio	Accuracy
5.1.1	H (Location A)			
5.1.2	H (Location B)			
5.1.3	H (Location C)			
5.1.4	H (Location D)			
5.1.5	H2 (Location E) (WTI)			
5.2.1	H_O (Location A)			
5.2.2	H_O (Location B)			
5.2.3	H_O (Location C)			
5.2.4	H_O (Location D)			
5.3.1	X (Location A)			
5.3.2	X (Location B)			
5.3.3	X (Location C)			
5.3.4	X (Location D)			
5.3.5	X1 (Location E) (LDC)			
5.3.6	X2 (Location E) (WTI)			

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

	Bushing	Qty (/Bushing)	Ratio	Accuracy
5.4.1	X_O (Location A)			
5.4.2	X_O (Location B)			
5.4.3	X_O (Location C)			
5.4.4	X_O (Location D)			
5.5.1	$H_{Winding\ (Delta)}$			
5.5.2	$H_{Winding\ (Wye)\ -\ Neutral\ End}$			
5.6.1	$X_{Winding\ (Delta)}$			
5.6.2	$X_{Winding\ (Wye)\ -\ Neutral\ End}$			
5.7.1	$Y_{Winding\ (Delta)}$			
5.7.2	$Y_{Winding\ (Wye)\ -\ Neutral\ End}$			
5.8.1	H_O External			
5.8.2	X_O External			
5.8.3	Y_O External			
5.8.4	Tank-Ground External			

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

6.0 TRANSFORMER ACCESSORIES Item No. _____

6.1 HV Surge Arresters Brackets _____

6.2 HV Surge Arresters

6.2.1 Manufacturer _____

6.2.2 Type / Style _____

6.2.3 Catalogue No. _____

6.2.4 Arrester Rated Voltage _____ kV

6.2.5 Arrester MCOV _____ kV

6.2.6 BIL (of Arrester Housing) _____ kV

6.2.7 Number of Stacked Units _____

6.2.8 Rated Voltage of each unit _____ kV

6.2.9 Energy Capability kJ/kVMCOV _____

6.2.10 Diameter of Metal Oxide Disc. _____

6.2.11 Volume of Metal Oxide Disc. _____

6.2.12 No. of Valve Columns _____

6.2.13 Arrester Current at MCOV _____ Peak

6.2.14 Resistive Component of Arrester Current _____ Peak

6.2.15 RIV at Arrester Rated Voltage _____

6.2.16 Maximum 8/5 uS Discharge Voltage @ 10kA _____ Peak

6.2.17 Maximum Switching Surge Protective Level _____ Peak

6.2.18 Maximum Discharge Voltage @ 10 kA 8/20 Current _____ Peak

6.2.19 Arrester Height _____ mm

6.2.20 Arrester Mass _____ kg

6.2.21 Arrester Mounting Base, Bolt Circle Dimensions _____ mm

TECHNICAL RESPONSE DATA SHEETS

6.2.22	Arrester Mounting Base, Hardware Diameter	_____	mm
6.2.23	Leakage Distance (Standard)	_____	mm
6.2.24	Leakage Distance (Offered)	_____	mm
6.2.25	Dry Arc Distance (Offered)	_____	mm
6.3	LV Surge Arresters Brackets	_____	
6.4	LV Surge Arresters		
6.4.1	Manufacturer	_____	
6.4.2	Type / Style	_____	
6.4.3	Catalogue No.	_____	
6.4.4	Arrester Rated Voltage	_____	kV
6.4.5	Arrester MCOV	_____	kV
6.4.6	BIL (of Arrester Housing)	_____	kV
6.4.7	Number of Stacked Units	_____	
6.4.8	Rated Voltage of each unit	_____	kV
6.4.9	Energy Capability kJ/kV MCOV	_____	
6.4.10	Diameter of Metal Oxide Disc.	_____	
6.4.11	Volume of Metal Oxide Disc.	_____	
6.4.12	No. of Valve Columns	_____	
6.4.13	Arrester Current at MCOV	_____	Peak
6.4.14	Resistive Component of Arrester Current	_____	Peak
6.4.15	RIV at Arrester Rated Voltage	_____	
6.4.16	Maximum 0.5 uS Discharge Voltage @ 10kA	_____	Peak
6.4.17	Maximum Switching Surge Protective Level	_____	Peak

TECHNICAL RESPONSE DATA SHEETS

6.4.18	Maximum Discharge Voltage @ 10 kA 8/20 Current	_____	Peak
6.4.19	Arrester Height	_____	mm
6.4.20	Arrester Mass	_____	kg
6.4.21	Arrester Mounting Base, Bolt Circle Dimensions	_____	mm
6.4.22	Arrester Mounting Base, Hardware Diameter	_____	mm
6.4.23	Leakage Distance (Standard)	_____	mm
6.4.24	Leakage Distance (Offered)	_____	mm
6.4.25	Dry Arc Distance (Offered)	_____	mm
6.5	Electronic Temperature Indicators	_____	
6.5.1	Manufacturer	_____	
6.5.2	Model/Catalogue No.	_____	
6.5.3	Input Power range	_____	
6.6	Electronic Voltage Regulating Relay	_____	
6.6.1	Manufacturer	_____	
6.6.2	Model/Catalogue No.	_____	
6.6.3	Input Power range	_____	
6.7	Bushing Terminal Connectors Included	_____	
6.7.1	H Bushing, Manufacturer, Part Number	_____, _____	
6.7.2	H Bushing, Material	_____	
6.7.3	H Bushing Flat Pad or Wire Size Range	_____	
6.7.4	H_0 Bushing, Manufacturer, Part Number	_____, _____	
6.7.5	H_0 Bushing, Material	_____	

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

6.7.6 H_0 Bushing Flat Pad or Wire Size Range _____

6.7.7 X Bushing, Manufacturer, Part Number _____, _____

6.7.8 X Bushing, Material _____

6.7.9 X Bushing Flat Pad or Wire Size Range _____

6.7.10 X_0 Bushing, Manufacturer, Part Number _____, _____

6.7.11 X_0 Bushing, Material _____

6.7.12 X_0 Bushing Flat Pad or Wire Size Range _____

6.7.13 Y Bushing, Manufacturer, Part Number _____

6.7.14 Y Bushing, Material _____

6.7.15 Y Bushing Flat Pad or Wire Size Range _____

6.7.16 Y_0 Bushing, Manufacturer, Part Number _____, _____

6.7.17 Y_0 Bushing, Material _____

6.7.18 Y_0 Bushing Flat Pad or Wire Size Range _____

6.8 Galvanized Radiators Included _____

6.9 NGR Mounting Bracket Included _____

6.10 Tertiary Winding Grounding Provisions Included _____

APPENDIX 1

TECHNICAL RESPONSE DATA SHEETS

7.0 TRANSFORMER TESTS Item No. _____

Confirm if the following tests, as specified in Section 5.23 of the specification, are included:

7.1	Winding Resistance	_____
7.2	Ratio	_____
7.3	*Polarity and Phase Relationships*	_____
7.4	Excitation Current	_____
7.5	Excitation Loss	_____
7.6	One Hour Excitation	_____
7.7	Positive Sequence Impedance	_____
7.8	Zero Sequence Impedance	_____
7.9	Load Loss	_____
7.10	Temperature Rise	_____
7.11	Gas in Oil Analysis (before & after Temp. Rise test)	_____
7.12	Induced Potential Test	_____
7.13	Partial Discharge	_____
7.14	Lightning Impulse (Full Wave)	_____
7.15	Chopped Wave Impulse	_____ *(Data Sheet Specified)*
7.16	Core Insulation	_____
7.17	Insulation Power Factor	_____
7.18.1	Bushing Power Factor	_____
7.18.2	Bushing "C1" & "C2" Capacitance	_____
7.19	Sound Level	_____ *(Data Sheet Specified)*
7.20	(Hot Oil) Pressure	_____
7.21	Vacuum	_____
7.22	CT's (ratio, polarity, saturation, etc.)	_____
7.23	Winding Temperature (indication calibration)	_____
7.24	Control Wiring Insulation	_____
7.25	Functional Tests (cooling, control, indication, etc.)	_____
7.26	Paint Thickness	_____
7.27	OLTC (*functional testing*)	_____

APPENDIX 2

TECHNICAL CONFORMITY STATEMENT

BIDDER is to duly complete and sign the appropriate section below and return with his proposal.

A) No technical deviations/exceptions:

We _____ hereby confirm that our proposal No. dated _____ in response to Request for Quotation No. 192617.00-SP-E01 is in full compliance with CBCL Limited technical requirements.

B) Technical deviations/exceptions.

We _____ hereby confirm that our proposal No. dated _____ in response to Request for Quotation No. 192617.00-SP-E01 is not in full compliance with all CBCL Limited technical requirements and the following deviations/exceptions are taken.

CBCL Limited Technical Requirement	Technical Deviations/Exceptions

_____

Name of Bidder

_____

Authorized Signature

_____

Date

APPENDIX 3

OWNER AND ENGINEER DATA SHEETS

OWNER:	Tender Box City of Summerside Electric Utility First Floor, City Hall 275 Fitzroy Street Summerside, Prince Edward Island C1N 1H9
OWNER CONTACT:	Gerald Giroux Address: 94 Ottawa Street Summerside, PE, C1N 1W3 Telephone: (902) 786-8134 Fax: (902) 436-4255 E-mail: gerald.giroux@city.summerside.pe.ca
PLACE of WORK:	Bounded by Ottawa St. & King St. & Harvard St. (City of) Summerside, Prince Prince Edward Island Outdoor substation site
ENGINEERING FIRM:	CBCL Limited Suite 901, 1505 Barrington Street Halifax, NS, B3J 3Y6 Telephone: (902) 421-7241 Fax Number: (902) 423-3938
ASSIGNED ENGINEER:	Joe Yurchesyn, P. Eng. Telephone: (902) 421-7241 Ext: 2490 E-mail: jyurchesyn@cbcl.ca
CBCL CC CONTACT:	Mark Chapman, P. Eng. Telephone: (902) 421-7241 Ext: 2285 E-mail: mchapman@cbcl.ca
CBCL PROJECT REF:	192617.00
PROJECT NAME:	Summerside T7 Replacement
QUOTATION REF:	192617.00-SP-E10
QUOTATION SUBMISSION DEADLINE:	Delivery to the above owner address, as per Part A – Bidding and Contract Requirements, shall be no later than 13:00 (1:00 PM) Atlantic Standard Time on May 10th, 2019.

APPENDIX 4

SERVICE CONDITIONS DATA SHEET

1.1 Location

City of Summerside Substation
Bounded by Ottawa St. & King St. & Harvard St.
(City of) Summerside, Prince Co.
Prince Edward Island
Outdoor substation site

1.2 Application

Distribution Transformer to serve customer load

1.3 Environmental Data

Ambient Temperature Range:	-35°C to +40°C
Maximum Wind Speed:	153 km/hr
Maximum Seismic Rating:	not specified
Altitude above Mean Sea Level:	> 10 m
Climate:	temperate
Environment:	seacoast marine, high humidity
Atmospheric Corrosive Elements:	sea salt aerosols, road salt aerosols sulfur elements

1.4 System Data

Primary System

Nominal Service Voltage	kV rms	69
Rated (maximum) Voltage	kV rms	72.5
Basic Impulse Level (BIL)	kV	350
Numbers of Phases and Wiring		3
Neutral Grounding (Source)		Solidly Grounded
Nominal Frequency	Hz	60
Ultimate Symmetrical Fault Level	kA	29
	MVA	3,500
Current Max. Symmetrical Fault Level	kA	unknown
	MVA	unknown
X1/R Ratio		unknown
Current Min. Symmetrical Fault Level	kA	unknown
	MVA	unknown
X1/R Ratio		unknown
Current Max. Asymmetrical Fault Level	kA	unknown
	MVA	unknown
XO/X1 Ratio		unknown

APPENDIX 4

SERVICE CONDITIONS DATA SHEET

Current Min. Asymmetrical Fault Level	kA	unknown
	MVA	unknown
XO/X1 Ratio		unknown
Secondary System		
Nominal Service Voltage	kV rms	12.47
Rated (maximum) Voltage	kV rms	13.1
Basic Impulse Level (BIL)	kV	110
Numbers of Phases and Wires		3 pH / 4 Wir
Neutral Grounding (Source)		Solidly Grounded
Nominal Frequency	Hz	60
Ultimate Symmetrical Fault Level	kA	11.5
	MVA	250

APPENDIX 5

SPECIFIC TECHNICAL REQUIREMENTS

Item No.: One (1) Customer System # Reference: T7

Date Required: _____

Application: Supply distribution Location: Outdoor

TRANSFORMER RATING

Option A: MVA Rating @ 65°C: 12 / 16 / _____

Option B: MVA Rating @ 65°C: 15 / 20 / _____

Cooling: ONAN / ONAF / _____

Forced Oil (Cl. 5.12.3): Not Permitted

No. of Windings: Two (2) , Poly-Phase / ~~Single Phase~~

HV Winding (H): 69 kV nominal, Connected Delta

HV Winding BIL: 350 kV, Line End 110 kV, Neutral End

LV Winding (X): 12.47 kV nominal, Connected wye

LV Winding BIL: 110 kV, Line End 110 kV, Neutral End

Angular Displacement: As per CSA C88

Impedance (H-X): 5.9 % at Base Rating (minimum)

Neutral Grounding: Effectively / ~~Ungrounded / Resistance Ohms~~

Exterior Paint: Grey (ANSI 70)

Station Service Power: 120/240 VAC, 1 Phase, 125 VDC, Floating / Not Grounded

---

Sound Level: As per CSA C88 / ~~10 dB below C88 (Cl. 5.2.7) / _____ dB below C88~~

Price Option(s) for: ~~10 dB below C88 (Cl. 5.2.7)~~ / 3 dB below C88

Shipping Requirements: Transformer: ~~Oil Filled~~ / Gas Filled / ~~By Rail~~ / By Road /

Oil: ~~Barrels~~ / Truck Tanker(s) / ~~Rail Tank Car / N/A~~

Cost of No Load (i.e. Fe) Losses: $ 12.530 per kW

Cost of Load (i.e. Cu) Losses: $ 4.303 per kW

Dimensional and Weight Limitations: Refer to drawings provided in Appendix 7

Preference is for new transformer to fit on existing concrete pad, however pad can be modified or replaced if required. Height and width is limited by size of transformer bay.

Strong preference for radiators to be mounted on HV face of transformer tank.

APPENDIX 5

SPECIFIC TECHNICAL REQUIREMENTS

TAPS

Series-Multiple Connection:	~~Required~~ / Not Required	~~Required~~ / Not Required
Winding:	HV	LV
Voltage Selection:	_____	_____
Selector:	Switch / Tap Board	Switch / Tap Board

De-Energized Taps:	Required / ~~Not Required~~
Winding:	HV / ~~LV / Not Specified~~
Range:	- 5 % to + 5 %, # of Taps _____
Selector:	Switch / ~~Tap Board~~

On Load Tap Changer:	~~Required~~ / Not Required / ~~Optional Price Extra~~
Winding:	HV / LV / Not Specified Power Flow Direction: LV toward HV
LTC Range:	- _____ % to + _____ %, # of Taps _____
LTC Motor:	_____ VAC, _____ Phase
Tap Position Indication (Cl. 5.18.13):	_____ mA Analog, _____ Digital
Power Connection (Cl. 5.18.13):	120 VAC / 129 VDC

ON LOAD TAP CHANGER VOLTAGE REGULATING RELAY: ~~Required~~ / Not Required

Voltage Regulating Relay (Cl. 5.20.1):	As per spec. / _____
Line Drop Compensation:	Required / Not Required
Voltage Reduction (Brown Out) Control:	Required / Not Required
Parallel Operation:	Required / Not Required
Method:	Circulating Current / Master Follower / N/A

APPENDIX 5

SPECIFIC TECHNICAL REQUIREMENTS

TERMINAL BUSHING

H Bushings:	Oil-Air / ~~Oil-SF_6~~	Style (Cl. 5.10.1):	ANSI / IEC / EEMAC / _____
BIL:	350 kV	Leakage:	As per spec. (Cl. 5.10.5) / 2,000 mm
Amperage:	600 A	Type:	Condenser ~~/ Solid Dielectric / Not Specified~~
Housing:	Porcelain / ~~Synthetic~~	Colour:	Grey ~~/ Brown~~
Spare Req'd:	Yes ~~/ No~~	Top Terminal Material:	Copper ~~/ Aluminum~~

~~H_O Bushings:~~	~~Oil-Air / Oil-SF_6~~	~~Style (Cl. 5.10.1):~~	~~ANSI / IEC / EEMAC / _____~~
~~BIL:~~	~~_____ kV~~	~~Leakage:~~	~~As per spec. (Cl. 5.10.5) / _____ mm~~
~~Amperage:~~	~~_____ A~~	~~Type:~~	~~Condenser / Solid Dielectric / Not Specified~~
~~Housing:~~	~~Porcelain / Synthetic~~	~~Colour:~~	~~Grey / Brown~~
~~Spare Req'd:~~	~~Yes / No~~	~~Top Terminal Material:~~	~~Copper / Aluminum~~

X Bushings:	Oil-Air ~~/ Oil-SF_6~~	Style ~~(Cl. 5.10.1)~~:	ANSI / ~~IEC / EEMAC /~~ _____
BIL:	110 kV	Leakage:	As per spec. (Cl. 5.10.5) / 375 mm
Amperage:	1200 A	Type:	~~Condenser /~~ Solid Dielectric (preferred)
Housing:	Porcelain ~~/ Synthetic~~	Colour:	Grey ~~/ Brown~~
Spare Req'd:	Yes ~~/ No~~	Top Terminal Material:	Copper ~~/ Aluminum~~

XO Bushings:	Oil-Air ~~/ Oil-SF_6~~	Style (Cl. 5.10.1):	ANSI / ~~IEC / EEMAC /~~ _____
BIL:	110 kV	Leakage:	As per spec. (Cl. 5.10.5) / 375 mm
Amperage:	1200 A	Type:	~~Condenser /~~ Solid Dielectric (preferred)
Housing:	Porcelain ~~/ Synthetic~~	Colour:	Grey ~~/ Brown~~
Spare Req'd:	Yes ~~/ No~~	Top Terminal Material:	Copper ~~/ Aluminum~~

APPENDIX 5

SPECIFIC TECHNICAL REQUIREMENTS

BUSHING CURRENT TRANSFORMERS; AND INTERNAL AND EXTERNAL CURRENT TRANSFORMERS

Note: CT in Location A is closest to bushing flange and higher lettered locations are closer to the winding. Refer to drawing provided in Appendix 7.

Bushing	Qty (per Bushing)	Ratio	Accuracy	Secondary RF
H (Location A)	1	6/4/1.5/1 – 5A	C400	2.0
H (Location B)	1	6/4/1.5/1 – 5A	0.3 B 4.0	2.0
H (Location C)				
H (Location D)				
H2 (Location E) (WTI)	1	Not Specified	Not Specified	Not Specified
H_O (Location A)				
H_O (Location B)				
H_O (Location C)				
H_O (Location D)				
X (Location A)	1	6/4/1.5/1 – 5A	C400	2.0
X (Location B)				
X (Location C)				
X (Location D)				
X1 (Location E) (LDC)				
X2 (Location E) (WTI)	1	Not Specified	Not Specified	Not Specified
X_O (Location A)	1	6/4/1.5/1-5A	C200	2.0
X_O (Location B)				
X_O (Location C)				
X_O (Location D)				
$H_{Winding\ (Delta)}$				
$H_{Winding\ (Wye)\ -\ Neutral\ End}$				
$X_{Winding\ (Delta)}$				
$X_{Winding\ (Wye)\ -\ Neutral\ End}$				
$Y_{Winding\ (Delta)}$				
$Y_{Winding\ (Wye)\ -\ Neutral\ End}$				
H_O External				
X_O External				
Y_O External				
$Tank\text{-}Ground_{\ External}$				

APPENDIX 5

SPECIFIC TECHNICAL REQUIREMENTS

ACCESSORIES (Clause 5.19)

Mechanical Temperature Indicators (Cl. 5.19.1): Required / ~~Not Required~~

Electronic Temperature Indictor Model (Cl. 5.19.1): Qualitrol 104/TR6000

Electronic Temperature Indicators (Cl. 5.19.2): Required / ~~Not Required~~

Electronic Temperature Indictor Model (Cl. 5.19.2): APT/TTC-1000

Power Connection (Cl. 5.19.2.8): ~~120 VAC~~ / 125 VDC

Oil Level Gauges (Cl 5.19.3): Required / ~~Not Required~~

Oil Level Gauges Model: Qualitrol 032 Series

Pressure Relief Device (Cl 5.19.4): Required / ~~Not Required~~

Pressure Relief Device Model: Qualitrol Type 258 or SPRD

Gas Detection/Protection (Cl 5.19.5): Required / ~~Not Required~~

Sudden Pressure Relay Model: Qualitrol Type 910

Pressure Monitor (Cl 5.19.6): Required / Not Required

Pressure Monitor Model: Qualitrol Type 070-35C

Bushing, Terminal Connectors (Cl. 5.19.7): Required / ~~Not Required~~

	Qty	Type	Material	Conductor Range
HV:	3	4H NEMA Pad ~~/ Mech. Clamp~~	Cu ~~/ Al~~	N/A
~~H_O:~~		~~4H NEMA Pad / Mech. Clamp~~	~~Cu / Al~~	~~N/A~~
LV:	3	4H NEMA Pad ~~/ Mech. Clamp~~	Cu ~~/ Al~~	N/A
X_O:	1	4H NEMA Pad ~~/ Mech. Clamp~~	Cu ~~/ Al~~	N/A

SPECIFIC TECHNICAL REQUIREMENTS

ACCESSORIES (Continued)

HV Surge Arrester Mounting Bracket (Cl. 5.19.8): Required ~~/ Not Required~~

HV Surge Arresters (Cl. 5.19.9): ~~Required~~ / Not Required

Class:	Station / Intermediate	Energy Absorption:	_____ kJ/kV_{mcov}
MCOV:	_____ kV	Duty Cycle Rating:	_____ kV
Style:	metal top	Leakage:	As per spec. (Cl. 5.10.5) / _____ mm
Housing:	Porcelain / Synthetic	Colour:	Grey / Brown
Bottom Term:	Eye-Bolt for 4/0 AWG	Top Term.:	NEMA pad on removable cap / Integrated
Min. Height:	_____ mm	(←for min. *16.67 mm/$kV_{ph\text{-}grd}$ dry arc distance, Cl. 5.19.9.2*)	

Examples of typically acceptable models: _____

_____

LV Surge Arrester Mounting Bracket (Cl. 5.19.8): Required ~~/ Not Required~~

LV Surge Arresters (Cl. 5.19.9): ~~Required~~ / Not Required

Class:	Station / Intermediate	Energy Absorption:	_____ kJ/kVmcov
MCOV:	_____ kV	Duty Cycle Rating:	_____ kV
Style:	metal top	Leakage:	As per spec. (Cl. 5.10.5) / _____ mm
Housing:	Porcelain / Synthetic	Colour:	Grey / Brown
Bottom Term:	Eye-Bolt for 4/0 AWG	Top Term.:	NEMA pad on removable cap / Integrated
Min. Height:	_____ mm	(←for *min. 16.67 mm/$kV_{ph\text{-}grd}$ dry arc distance, Cl. 5.19.9.2*)	

Examples of typically acceptable models: _____

_____

APPENDIX 5

SPECIFIC TECHNICAL REQUIREMENTS

ACCESSORIES (Continued)

LV Cable Junction Enclosure (Cl. 5.19.10): ~~Required~~ / Not Required

NGR Mounting Bracket (Cl 5.19.11): ~~Required~~ / Not Required

OPTIONAL ACCESSORIES (pricing to be provided)

Temperature Monitoring and Cooling System Control (Clause 0)

Temperature Monitoring and Cooling System Control Model: Qualitrol QTMS

Online Dissolved Gas Analysis (Clause 0)

Dissolved Gas Analysis Model: Single Gas Qualitrol Serveron TM1

Dissolved Gas Analysis Model: Multi Gas Qualitrol Serveron TM8

Tap Changer Control (Clause 5.20)

Electronic Voltage Regulating Relay (Cl. 5.20): ~~Required /~~ Not Required

Electronic Voltage Regulating Relay (Cl. 5.20):

Power Connection (Cl. 5.20.1): ~~120 VAC / 129 VDC~~

Details required for Cable Termination:

MISCELLANEOUS

Additional Radiator Corrosion Protection (Cl. 5.13.2): ~~Galvanized / Stainless Steel~~ / Painted

Control Wiring: Acceptable Use Compression Wire Terminals (Cl. 5.21.9.3): ~~Ferrule /~~ Ring /~~ Fork~~

TESTS IN ADDITION TO CSA C88

Chopped Wave Test (Cl 5.23.1.14): Required ~~/ Not Required~~

Sound Level Test (Cl 5.23.1.18): ~~Required / Not Required~~ / Include with low-noise option

APPENDIX 6

OPTIONAL ACCESSORIES SPECIFICATION

TEMPERATURE MONITORING AND COOLING SYSTEM CONTROL

.1 When specified on the Specific Technical Requirements data sheet, provision shall be made for the installation of an integrated Transformer Monitoring System.

.2 The transformer monitor system shall be fully capable of monitoring the key parameters of transformers such as pressure rises, temperature swings (ambient, oil, simulated winding and direct winding), liquid level, DGA – gas formation and accumulation, partial discharges (PD) inside the transformer tank, capacitive bushing monitoring, Geomagnetically Induced Current (GIC), cooling system and Load Tap Changer (LTC) functionality.

.3 The transformer monitor system must have enough digital inputs to collect all transformers accessories alarms and trips.

.4 The system shall have relays that are 100% customer configurable and controlled by a signal matrix consisting of up to four control signals and three Boolean math functions.

.5 The relays of the forced air cooling system shall have the ability to be "bank switched" or alternating control to allow even wear on the cooling system, adjust the controlling set point value due to ambient conditions, adjust the controlling set point value according to the seasonal date, pre-cool according to transformer loading in addition to actuating on winding temperature.

.6 The relay functions of the monitor system will be customer selectable to be either failsafe/non-failsafe; latching/non latching; actuation counter and manual/ or automatic control. It shall include the Rate-of-Change feature which shall allow the user to set a dynamic set-point that will actuate due to a rate of change. In addition the transformer monitor relay outputs shall be fully configurable by the user with the use of web-based software without assistance from a factory technician.

.7 The system shall include a Bushing Monitoring module that connects up to 6 transformer bushing sensors/adaptors, the transformer monitor shall allow computing of the Power Factor % (or Tan δ) and capacitance in the transformer bushings (capacitive type bushings e.g. OIP, RIP, RBP, RIS, etc.) and include all the sensors.

.8 The system shall be capable to receive data from UHF (Ultra High Frequency) based PD (Partial Discharge) monitoring systems.

.9 The system display shall be located in the transformer control cabinet or swing panel mounted to provide visual measurements of real time read values, calculated values.

.10 The system must have the ability to be mounted directly on the transformer tank wall and operate to specification without susceptibility to vibration.

.11 The system shall have a LTC monitoring feature with the respective sensors shall be able to measure and record the tap counts for each individual tap position, the total run time on each tap in the load tap changer, the average make and break currents for each tap position. It shall be able to measure the steady state current of the load tap changer motor, the inrush current of the load tap changer motor. It shall be able to measure and record the load tap changer motor

actuation counts, shall be able to measure the duration of the load tap changer motor actuation time, shall be able to detect and alarm if there are multiple tap movements for one tap actuation, shall be able to measure and alarm on a total tap count set-point value, shall be able to measure and alarm on a total tap position run time set-point value, shall be able to measure and alarm on tap counts per tap period set-point value.

.12 The system shall have cooling control and monitoring feature for up to 8 cooling banks. The shall be able to measure the cooling system steady state current, the cooling system inrush current, the number of actuations of the cooling system, the total run time of the cooling system, it shall have individual alarm set-points and be field selectable as to which items will actuate the cooling system alarm.

.13 The system shall have the ability to estimate the moisture content in the insulation based on the moisture content in the oil, oil temperature, winding temperature (hot spot) and transformer load. The moisture sensor shall be integrated with the DGA monitoring package.

.14 The system shall have the ability to estimate temperature at which the insulation will release moisture bubbles to the oil tank based on the total pressure, gas content of oil and percent by weight of moisture in paper. The moisture sensor, Ambient PT100 RTD, oil PT100 RTD shall be integrated with the DGA (for 9 gases required) monitoring package if purchased.

.15 The system shall include the following communication ports: 10/100 Ethernet TX; RJ45 port; Serial Fiber Optic Port, ST connector; Serial Fiber Optic Port, ST connector; Ethernet FX, ST connector; RS485, 4-wire communications port; USB-A port; Display port for optional remote display.

.16 The system shall support all industry standard communication protocols DNP3.0, IEC 61850, and Modbus.

.17 The system shall be fully flexible to integrate third party monitoring systems from other manufactures using the industry typical protocols Modbus / IEC 61850 / DNP3.0 output.

.18 The system shall have of up to 100 variables; store rates 1 minute to 24 hours; 32 parameters at 15 second capture rate for 90 days without overwriting with 4 Gigabytes memory space.

.19 The system shall have the ability to record or log user actions and any user made changes to the systems configuration.

.20 The system shall provide, with password protection, access levels to different user groups being at least user level (only display all the information) and supervisor level.

.21 The system shall be equipped with a universal power supply of 90-264 VAC 50/60 Hz and 127-300 VDC. The power supply shall be provided.

APPENDIX 6

OPTIONAL ACCESSORIES SPECIFICATION

FIBRE-OPTIC WINDING TEMPERATURE SENSORS

.1 The sensors shall be directly installed in each phase of the transformer windings to measure the winding hotspot and oil temperatures. There will be a total of sixteen (16) sensors inside the transformer, including one for top oil and one for bottom oil temperature. Eight (8) sensors will be monitor and eight (8) will remain as spare.

.2 The locations shall be proposed by the Manufacturer and locations finalized by agreement of the Purchaser.

.3 All the fiber optic cables are to be brought out of the main tank through a tank wall optical feedthrough (solder-glass), which must withstand 200 PSI. A wall plate accommodating the feedthroughs shall be welded or bolted on the tank. A protective J-Box designed to mate with the wall plate shall be supplied to allow sixteen (16) optical feedthroughs and optical extensions on the transformer tank wall.

.4 The heat-run tests shall be made with the temperature monitoring system: during the heat-run, the hottest sensors for each phase shall be identified, and temperature data for all sensors recorded and reported in the test report.

ONLINE DISSOLVED GAS ANALYSIS

.5 When specified on the Specific Technical Requirements data sheet, provision shall be made for the installation of an Online Dissolved Gas Analysis System.

.6 For single-gas analysis, Qualitrol Serveron TM1, or utility approved equivalent shall be supplied, with the following features:

.1 Membrane free construction

.2 Oil immersed sensor

.3 Sensor must be 100% selective for hydrogen

.4 Sensor should not consume hydrogen

.5 Monitor should include a manual calibration adjustment feature

.6 Changing oil or ambient temperature should not affect concentration readings

.7 Oil should be actively circulated over sensor and not rely on convection alone

.7 For multi-gas analysis, Qualitrol Serveron TM8, or utility approved equivalent shall be supplied, with the following features:

.1 Dissolved Gas Analysis (DGA) measurements on the 8 DGA gases (Hydrogen, Oxygen, Methane, Carbon Monoxide, Carbon Dioxide, Ethylene, Ethane, Acetylene), and

OPTIONAL ACCESSORIES SPECIFICATION

Nitrogen within the transformer oil as well as Total Dissolved Combustible Gas (TDCG) and Total Hydrocarbons (THC) measurements.

.2 The gas measurement quality must be US NIST-traceable (US National Institute of Standards and Technology) and must utilize a gas chromatography system to make the measurements.

.3 The system must offer automatic, periodic self-verification and self-calibration of all 8 measured gases to a NIST-traceable 8 gas standard.

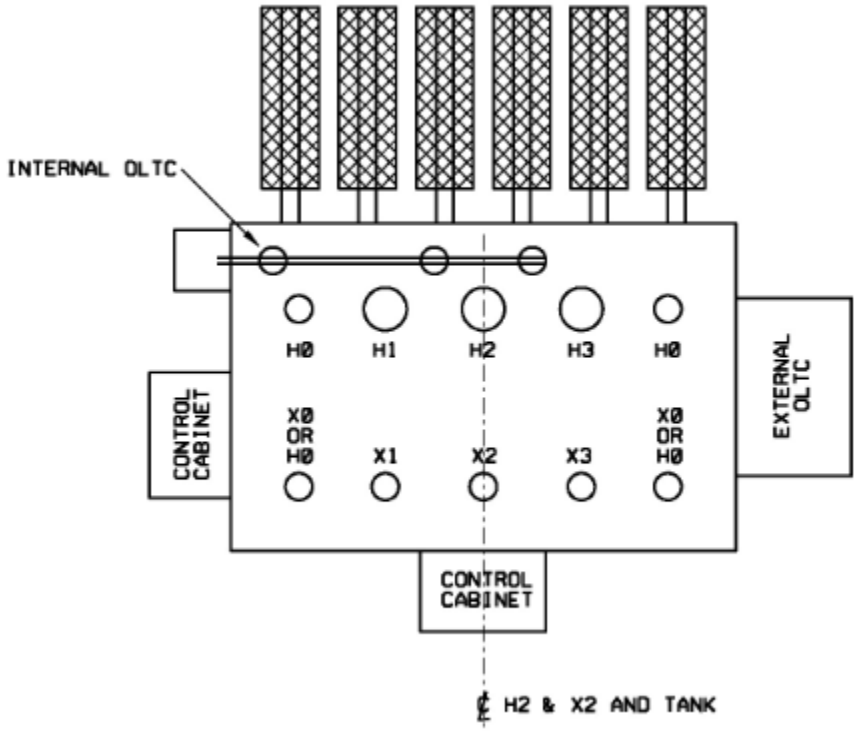
.4 The DGA monitor must pump transformer oil continuously from the transformer, extract the gas from the oil with a passive membrane system based around Method A of ASTM standard D 3612-02 or equivalent and return the oil back into the transformer without significantly de-gassing or otherwise altering the gas levels in the sampled oil. The gas extraction and measurement system must respond 100% within 1 hour to a change in gas concentration in the transformer oil sample.

.5 In addition to the gas-in-oil measurements above, the transformer monitor must also provide oil temperature measurements, moisture-in-oil measurements and correlate all these measurements (gas-in-oil, oil temperature, moisture-in-oil) with transformer load and ambient temperature.

.6 The operator must have the ability to create caution and alarm set points as well as Rate-of-Change (ROC) alarm values remotely from the transformer monitor. The monitor must report all data and alarm conditions every 4 hours, at a minimum. In addition the transformer monitor must offer relay contact closures for alarm conditions and power status.

APPENDIX 7

DRAWINGS



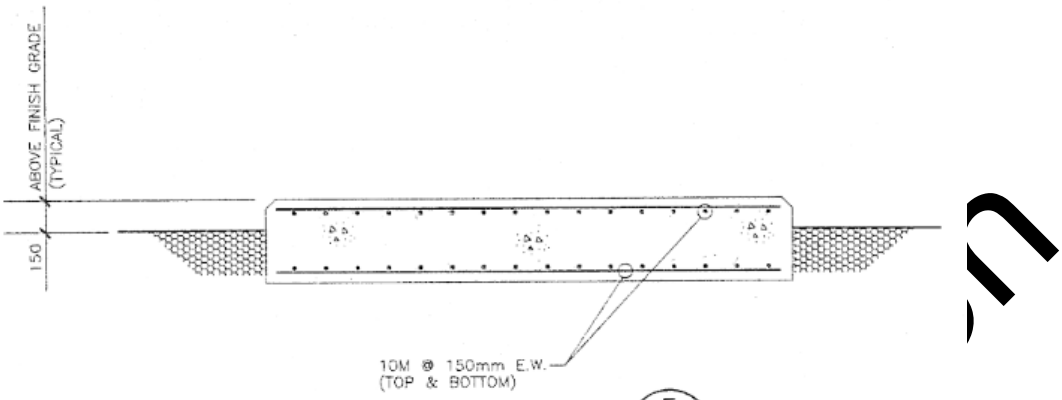
NOTE:

1. INTERNAL OLTC LOCATION CAN BE MIRROR IMAGED TO LV SIDE.
2. EXTERNAL OLTC AND CONTROL CABINET LOCATIONS CAN BE SWAPPED.
3. EXTERNAL OLTC & CONTROL CABINET CANNOT BE ADJACENT TO EACH OTHER ON THE SAME TANK FACE.

GENERAL ARRANGEMENTS

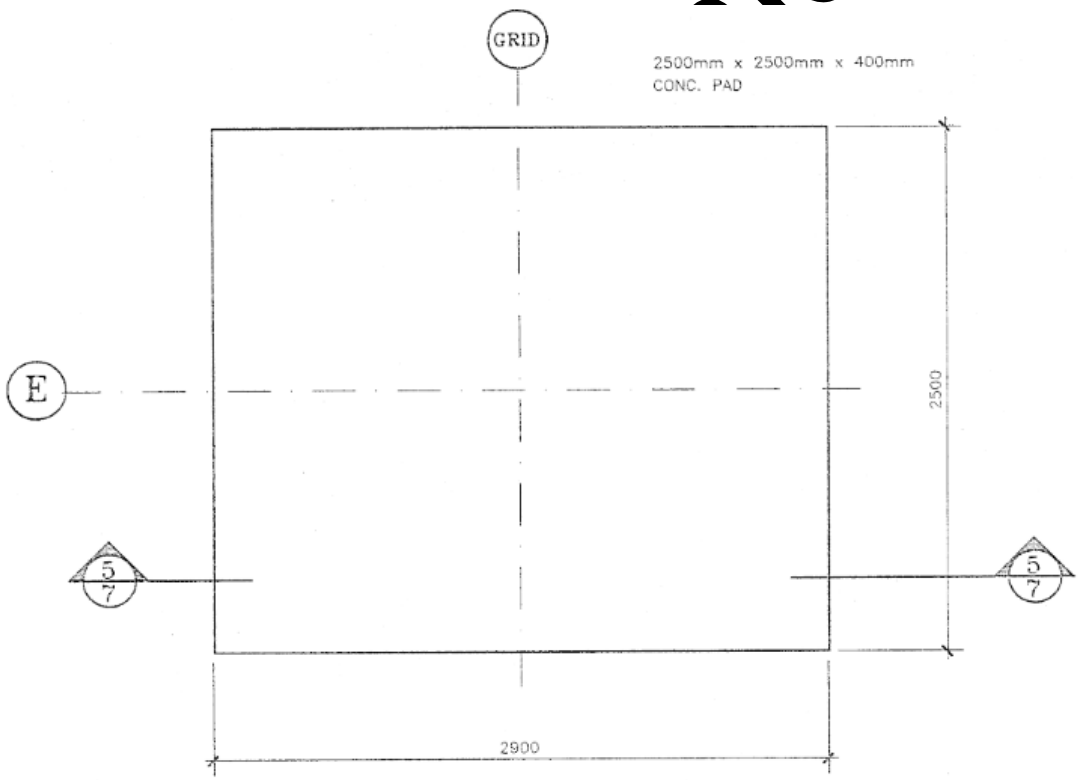
APPENDIX 7

DRAWINGS



SECTION 5/7

SCALE : NTS

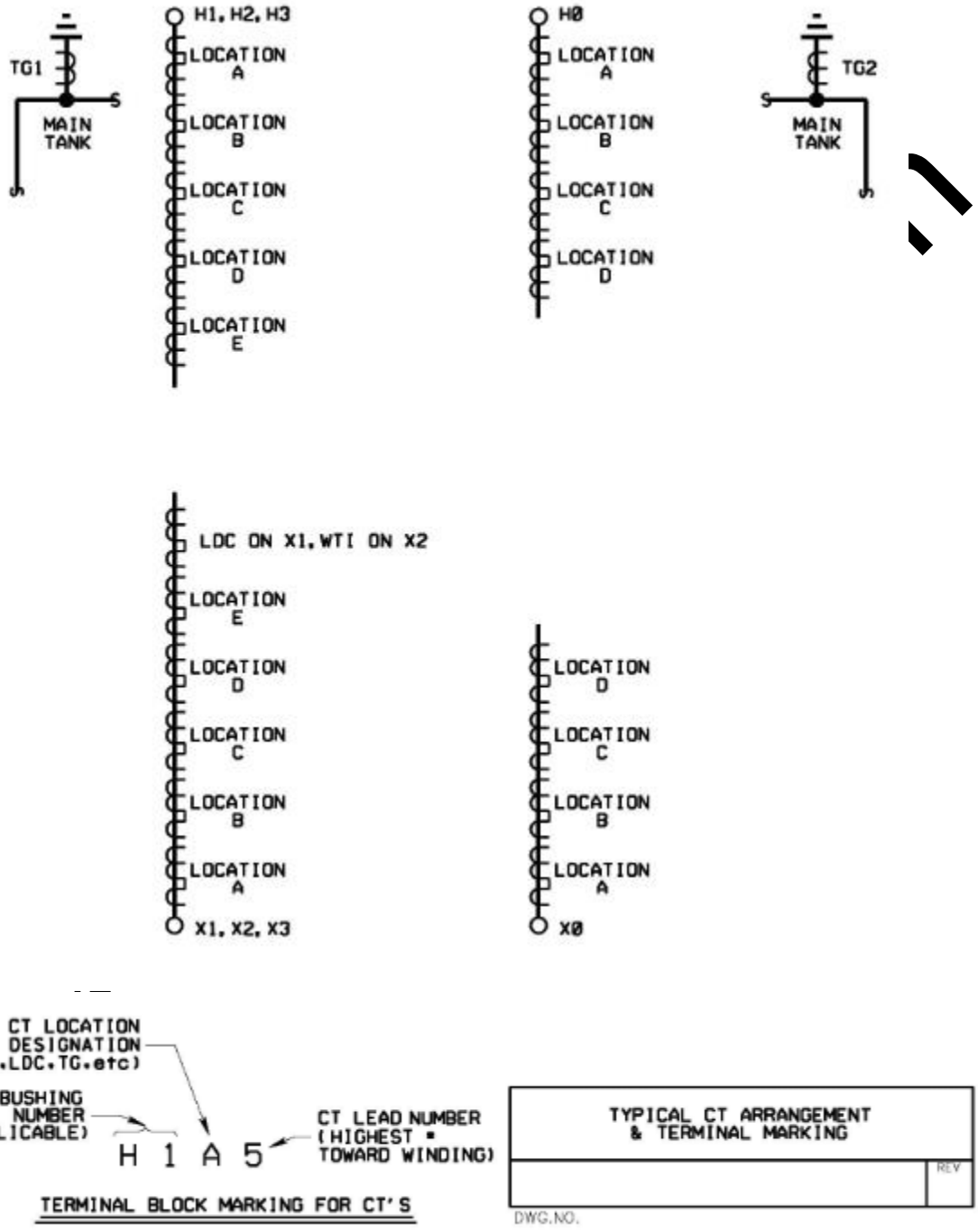


BASE TYPE 6 TRANSFORMER PAD

SCALE 1:20

APPENDIX 7

DRAWINGS



APPENDIX 8

AMENDMENTS FORM

To:	**Bidder's Distribution List**	**Project:**	**Summerside T7 Replacement**
		Specification No.:	**192617.00-SP-E01**
Attention:	Bidder's Distribution List	**Date:**	
Fax:	via e-mail	**Addendum No.:**	ADD-001

Tender Addendums are issued for the purposes of providing clarification, changes, or additions to the contents of the Technical Specification Document. These instructions are subject to the provisions of the technical specification documents and unless stated herein and specifically co-authorized by the Client, will not affect the contract. The Bidder is asked to indicate within the Quotation package any inclusions, removals, or exceptions that result from the Tender Addendum.

CORRECTION:

Per: _____

CBCL LIMITED
Consulting Engineers

APPENDIX 9

COMMERCIAL PRICE PROPOSAL SHEET

The proponent shall provide pricing for the equipment described in the scope of work and technical requirements above. Pricing should also be provided for the various optional sensors and monitoring hardware listed below that will form part of this bid submission.

Please fill out the table below. Costs not to include HST.

Deliverable	Description	Cost ($ CAD)
1A	12/16 MVA, 69-12.5 kV Power Transformer	
1B	15/20 MVA, 69-12.5 kV Power Transformer	
2	Transformer Monitor and Cooling System Control	
3	Direct Winding Temperature Sensors	
4	Bushing Monitor Sensors	
5	Partial Discharge Sensors	
6	Maintenance Free Breather (if required)	
7	Online Dissolved Gas Monitor (Single Gas)	
8	Online Dissolved Gas Monitor (Multi Gas) Indicate Number of Gases Monitored: #_____	

VENDOR (PRINT): _____

NAME (PRINT): _____

SIGNATURE: _____

TELEPHONE: _____

EMAIL: _____

DATE: _____