



Request for Tender

**Colborne Water Treatment Plant Electrical & SCADA System
Upgrades**

The Corporation of the Township of Cramahe

Contract No. 2025-01

Hard Copy Submission Only

TENDER GENERAL INFORMATION & REQUIREMENTS

Project: Tender for Contract No. 2025-01
Colborne Water Treatment Plant Electrical & SCADA System Upgrades

Owner: The Corporation of the Township of Cramahe

Bidder:

Contractor's Name

Contractor's Address

Contractor's Telephone Number

Contractor's Facsimile Number

Contractor's E-mail Address

Name of Person Signing for Contractor

Signature of Person Signing for Contractor

Position of Person Signing for Contractor

Tenders Received By: Tim Gilligan,
Assistant Manager & Compliance Coordinator
Tel: 905-355-2821 ext. 126
tgilligan@cramahe.ca

Office Location: The Corporation of the Township of Cramahe
1 Toronto Street,
Colborne, ON
K0K 1S0

To: Township of Cramahe

Re: Tender for Contract No. 2025-01

Colborne Water Treatment Plant Electrical & SCADA System Upgrades

The Contractor has carefully examined the Plans, Provisions, Specifications and Conditions described herein as part of the work to be done under this Contract. The Contractor understands and accepts the said Plans, Provisions, Specifications and Conditions, and, for the prices set forth in this Tender, hereby offers to furnish all machinery, tools, apparatus and other means of construction and furnish all materials, except as otherwise specified in the Contract, and to complete the work in strict accordance with the said Plans, Provisions, Specifications and Conditions. The Contractor understands and accepts that the quantities shown are approximate only, and are subject to increase, decrease, or deletion entirely if found not to be required.

The Contractor understands and accepts that the agreement for work to be done under this Contract will be between the Contractor and the Owner (The Corporation of the Township of Cramahe), with payments to the Contractor made by the Owner. The Contractor further understands and accepts that the work under this Contract involves upgrades to an existing municipal drinking water system (Colborne Drinking Water System) for which Lakefront Utility Services Inc. (LUSI) is the operating authority. The operating authority (LUSI or otherwise) will have final authority over works that may impact the ability to operate the system during construction.

The Bid Deposit submitted with this tender, made payable to the Owner, shall constitute a deposit which shall be forfeited to the Owner if the successful Contractor fails to file the required contract documentation with the Owner including the required certificate(s) of insurance, WSIB clearance certificate and 100% Performance Bond of a nature satisfactory to the Owner and execute the contract agreement within ten (10) days from the date of receipt of Notice of Acceptance of the Tender. Attached to this Tender is an agreement to bond, duly executed by the Contractor and the contractor's surety company to provide bonds as set out herein.

In submitting a tender, each bidder acknowledges, agrees, undertakes, represents and warrants to abide by the terms set out herein. This tender and prices entered herein shall remain open for acceptance for 90 days after the opening date for tenders.

The Contractor acknowledges and agrees that he is not entitled to any payment from the identified allowances or for any provisional work, except for additional work carried out by him in accordance with the Contract and only to the extent of such additional or provisional work as authorized by the Owner in writing.

The Contractor guarantees that said work shall remain in such condition as will meet the approval of the Owner for a period of twelve (12) months from the date of completion of the work. The Contractor shall remedy, in a permanent manner, any imperfections therein due to materials or workmanship used in the construction of the works. Where the Contractor fails to correct deficiencies within a reasonable time, the Owner may perform the necessary work, with the cost thereof borne by the Contractor or their Surety. Notification of acceptance of award may be given and delivery of the form of Agreement made by prepaid post, addressed to the Contractor at the address contained in this Tender.

STATEMENT "A" – BIDDER'S PROPOSED SUPERVISORY STAFF

The Bidder is required to supply the name, position, and experience of the Supervisory Staff to be assigned to this project, if successful.

NAME OF INDIVIDUAL	POSITION IN FIRM	QUALIFICATIONS AND EXPERIENCE

STATEMENT “B” – BIDDER’S PROPOSED SUB-CONTRACTORS

The Bidder is required to identify any proposed sub-contractors on this statement as part of the Tender. For convenience, a partial list of potential sub-trades has been provided, and the Contractor shall identify the proposed sub-contractor for each sub-trade or indicate “own forces” where related work will be completed by the Contractor. The Contractor shall also add to the list of sub-trades in order to identify proposed sub-contractors for sub-trades not listed.

The Bidder may be required to submit additional information with respect to the experience and qualifications of sub-contractors and the extent of work to be completed by each sub-contractor.

If the successful Contractor, after tender opening, wishes to substitute an alternate sub-contractor for a sub-contractor listed herein, the Contractor shall submit documentation to the Owner and/or Engineer with respect to the alternate sub-contractor’s experience and qualifications for review and approval of the substitution. Where approval for the substitution of a sub-contractor is not granted by the Owner and/or Engineer the Contractor shall arrange to have the proposed work completed by such other Sub-Contractor(s) acceptable to the Owner and/or Engineer without change in the Tender price.

SUB-TRADE	PROPOSED SUB-CONTRACTOR (Name & Address)
I&C / SCADA	

STATEMENT “C” – BIDDER’S PROPOSED ALTERNATIVES

The Bidder is required to identify any proposed alternatives, with respect to products or procedures, which are considered to be in the best interests of the Owner. The Bidder shall complete a statement for each substitute piece of equipment, material, product or procedure for which consideration is requested.

The Bidders base bid is to be based on products and procedures identified in the Contract specifications and requirements including conformance with all applicable standards. Cost increases or decreases associated with proposed alternatives are to be clearly identified herein. The Owner will make the final decision whether to proceed with any alternatives proposed by the Contractor. The Owner, at its discretion, may take into account the change (increase/decrease) in the tender price associated with alternates when comparing or awarding the Contract. The Bidder may be required to submit additional information on proposed products or procedures related to the alternatives.

The Contractor assumes full responsibility that identified alternatives will not exceed space or time requirements allocated under the Contract and shall be responsible for any additional installation costs resulting from the acceptance of a substitute piece of equipment, material, or product. Contractor to identify any and all deviations or exceptions to contract specifications or requirements resulting from any proposed alternatives.

Alternative No.		
Material or Product		
Manufacturer and Supplier		
Change in Price	Credit \$	Extra \$
Reason for Proposed Alternative		
Detailed Description of Proposed Alternate		
Deviations and/or Exceptions to Contract Specifications or Requirements		

Alternative No.		
Material or Product		
Manufacturer and Supplier		
Change in Price	Credit \$	Extra \$
Reason for Proposed Alternative		
Detailed Description of Proposed Alternate		
Deviations and/or Exceptions to Contract Specifications or Requirements		

Alternative No.		
Material or Product		
Manufacturer and Supplier		
Change in Price	Credit \$	Extra \$
Reason for Proposed Alternative		
Detailed Description of Proposed Alternate		
Deviations and/or Exceptions to Contract Specifications or Requirements		

Alternative No.		
Material or Product		
Manufacturer and Supplier		
Change in Price	Credit \$	Extra \$
Reason for Proposed Alternative		
Detailed Description of Proposed Alternate		
Deviations and/or Exceptions to Contract Specifications or Requirements		

Alternative No.		
Material or Product		
Manufacturer and Supplier		
Change in Price	Credit \$	Extra \$
Reason for Proposed Alternative		
Detailed Description of Proposed Alternate		
Deviations and/or Exceptions to Contract Specifications or Requirements		

Alternative No.		
Material or Product		
Manufacturer and Supplier		
Change in Price	Credit \$	Extra \$
Reason for Proposed Alternative		
Detailed Description of Proposed Alternate		
Deviations and/or Exceptions to Contract Specifications or Requirements		

SCHEDULE OF ITEMS AND TENDER PRICES**TOTAL LUMP SUM TENDER PRICE** (excluding HST)

Colborne Water Treatment Plant Electrical & SCADA System Upgrades \$ _____(1)

Total Lump Sum Tender Price in Words (Line 1)

Bidder's HST Registration No. _____

The Bidder agrees to have the works substantially performed within 36 weeks of receiving the Notice of Contract Award and authorization to proceed with the works.

Signature of Authorized Person
Signing for Contractor

(Company Seal)

Bidders are required to provide their breakdown of the lump sum tender price, on the table provided herein, as part of their tender submission.

The Bidder may be required to submit additional data or information to substantiate prices included in the breakdown of the lump sum tender price. In any event, the Owner reserves the right to adjust the breakdown to correct any unbalanced pricing.

The Bidder shall note that this is a lump sum contract, and the total tender price shall include contingencies, and provisional works identified in the following Breakdown of the Total Lump Sum Tender Price.

The Contractor is not entitled to payment from contingency or for provisional work items except for additional work which has been authorized and approved under the Contract.

BREAKDOWN OF THE TOTAL LUMP SUM TENDER PRICE

No.	Description	Amount
	General Requirements	
1	Bonds and Insurance	\$
2	Mobilization and Demobilization	\$
3	Testing & Commissioning	\$
4	System Demonstration & Operator Training	\$
6	As-Built Drawings and O&M Manual Updates	\$
7	Project Management and Coordination	\$
8	Lump Sum for All Other Requirements	\$
9	Contingency Allowance	\$
	Instrumentation & Control (I&C)	
10	PLC Equipment	\$
11	Other I&C Equipment	
	Electrical Works	
12	Motor Control Center (MCC)	\$
13	Variable Frequency Drive (VFD)	\$
14	Wires and Cables	\$
15	Other Electrical Equipment	\$
No.	Description	Amount
16	Provisional: Conduits	\$
	Total Lump Sum Tender Price	\$

(Transfer Total to Line 1) denoted as (1) on the first page of Schedule of Items and Tender Prices

(This form shall be completed and included as part of the tender submission)

AGREEMENT TO BOND

WE, the undersigned, **HEREBY AGREE** to become bound as Surety for

in a bond totaling ONE HUNDRED PERCENT (100%) of the CONTRACT amount, and conforming to the Instruments of Contract attached hereto, for the full and due performance of the works shown or described herein, if the Tender for Contract No. 2025-01 Colborne Water Treatment Plant Electrical & SCADA System Upgrades, is accepted by the Owner.

IT IS A CONDITION of this Agreement that if the above-mentioned Tender is accepted, application for a Performance and Maintenance Bond must be made to the undersigned within TEN (10) DAYS of Notice of Contract Award, otherwise the Agreement shall be null and void.

DATED AT _____ this _____ day of _____ 2025.

Name of Bonding Company:

Signature of Authorized Person
Signing for Bonding Company:

Position:

Name of Witness:

Signature of Witness:

(COMPANY SEAL)

(This form shall be completed and included as part of the tender submission)

SCHEDULE OF TENDER DATA

The work specified in the Contract shall be performed in strict accordance with the following Schedule:

A. ADDENDA

Numbers _____ to _____ Inclusive*

B. TENDER FORM

Tender General Information & Requirements (TF1-TF2)
Statement A – Bidder's Proposed Supervisory Staff (TF3)
Statement B – Bidder's Proposed Sub-Contractors (TF4)
Statement C – Bidder's Proposed Alternatives (TF5-TF6)
Schedule of Items and Tender Prices (TF7-TF8)
Agreement to Bond (TF9)
Schedule of Tender Data (TF10-TF11)

C. INFORMATION TO BIDDERS & SUPPLEMENTAL REQUIREMENTS**D. GENERAL CONDITIONS**

General Conditions of the Stipulated Price Contract, Canadian Standard Construction Document CCDC-2 2008 Edition, expect as amended under the Information to Bidders & Supplemental Requirements.

E. DRAWINGS**Electrical:**

- E-0001 – Legend
- E-0002 – Site Layout
- E-0003 – Single Line Diagram (SLD) & MCC Demolition
- E-0004 – Main Plant Demolition
- E-0005 – Well #2 Pumphouse Demolition
- E-0006 – Single Line Diagram (SLD) & MCC Modification
- E-0007 – Main Plant MCC-1 Installation
- E-0008 – Well #2 Pumphouse Installation
- E-0009 – Well #2 Pump VFD Schematic

Instrumentation & Control (I&C):

- Colborne WTP PLC Control Panel (CP01), Sheets 1-17
- Colborne Standpipe PLC Control Panel (CP02), Sheets 1-7

F. SPECIFICATIONS

- Division 1 – General Requirements
- Division 13 – Instrumentation and Control
- Division 16 – Electrical

G. REFERENCED DOCUMENTS

- Hydro One Design Drawing – 64678626
- Schedule B 64678626 – 2025-01-08 11,29,23
- Trenching Guidelines
- Hydro One Retail Metering Guide – 2024 Edition

*The Bidder (in the spaces provided above) shall insert the number of Addenda received and taken into account in preparing the tender.

The Contractor, by this Tender, offers to complete the work of this Contract in strict accordance with the terms contained herein with prices provided constituting full compensation for the work specified under Contract No. 2025-01.

The Contractor declares that this Contract is made without any connection, comparison of figures or arrangement with or knowledge of any other Corporation, Firm or Person making a Contract for the same work.

The Contractor declares that no member of the Council and no officer or employee of The Corporation of the Township of Cramahe is, will be, or has become interested, directly or indirectly, as a Contracting Party, Partner, Stockholder, Surety or otherwise in, or in the performance of, the Contract or in the supplies, work or business to which it relates, or in any portion of the profits thereof, or in any of the money to be derived there from.

The Contractor agrees that this contract will remain open for acceptance and the prices herein tendered will remain firm and unchanged for a period of 90 days after the opening of contracts and The Corporation of the Township of Cramahe may at any time within this period accept this contract whether any other contracts has been previously accepted or not.

By my signature hereunder, I hereby identify this as the Schedule of Tender Data, for Contract No. 2025-01, executed by me:

DATED this _____ day of _____, 2025.

SIGNATURE _____

NAME OF SIGNING OFFICER _____

NAME OF FIRM _____

This is the 11th and last page to be submitted as the tender submission for The Corporation of the Township of Cramahe, Contract No. 2025-01 Colborne Water Treatment Plant Electrical & SCADA System Upgrades.

(This form shall be completed and included as part of the tender submission)

**Township of Cramahe
Colborne Water Treatment Plant Electrical &
SCADA System Upgrades**

Contract No. 2025-01

Information to Bidders and Supplemental Requirements

TABLE OF CONTENTS

1.	General Description and Summary of Works.....	1
2.	Inquiries During Tender Period	3
3.	Bid Deposit.	3
4.	Time of Completion	4
5.	Liquidated Damages	4
6.	Delivery and Opening of Tenders	4
7.	Warranty.....	5
8.	Performance and Maintenance Bond.....	5
9.	Maintenance Security.....	5
10.	Insurance.....	6
11.	Examination of the Site and Facilities	6
12.	Site Visit.....	7
13.	Submission of Tender	7
14.	Omissions, Discrepancies, and Interpretations.....	8
15.	Disqualification of Tenders.....	8
16.	Withdrawal or Qualifying of Tenders	8
17.	Informal Tenders	8
18.	Clarification of Tenders	9
19.	Acceptance or Rejection of Tenders	9
20.	Definition of Owner and Engineer	10
21.	Permits & Approvals.....	10
22.	Operational Constraints.....	10
23.	Government Requirements	11
24.	Execution of Contract and Agreement	11
25.	Proof of Ability	11
26.	Sub-Contractors	11
27.	Workplace Safety Insurance Board.....	12
28.	Mobilization and Demobilization.....	12
29.	Lump Sum for Other Requirements	12
30.	Estimated Starting Date	13
31.	Harmonized Sales Tax.....	13
32.	Hours of Work	13
33.	Emergency and Maintenance Measures.....	13
34.	General Conditions (CCDC).....	13
35.	Revision to CCDC General Conditions	14
36.	Supplemental General Conditions.....	17
37.	Utilities and Existing Works	20
38.	Layout.....	20
39.	Order of Precedence	20
40.	Equivalents.....	20
41.	Shop Drawings	21
42.	Operation and Maintenance Manuals	22
43.	Operator Training	22
44.	Testing and Commissioning Plan.....	22
45.	Meetings.....	23
46.	Pre-Start Inspection.....	23
47.	Construction Staging	24
48.	Relevant Ontario Provincial Standards & Other Standards	24

1. General Description and Summary of Works

The following is a general, but not necessarily complete, description and summary of the works to be completed under this contract. The work under this Contract generally includes the supply of all material, equipment and labour necessary for upgrades to the existing Colborne Water Treatment Plant including but not limited to the following:

- Supply and installation of new underground power feed cable and conduit from Hydro One overhead transformer bank to main plant, as per Hydro One requirements, refer to Item G in Schedule of Tender Data, Referenced Documents for Hydro One requirements. (Coordinate with Hydro One for connection to transformer bank).
- Disconnecting the existing underground feeder cable between the existing transformer bank and existing Disconnect Switch from both ends. Underground cable and conduit to be marked and abandoned in place.
- Supply and installation of a new Fused Disconnect Switch (FDS) (600V system) and rigid metal conduit(s) outside the main plant entrance door. FDS to be equipped with an outdoor enclosure that is at minimum a NEMA Type 3R.
- Supply and installation of new power meter base, new rigid metal conduit(s), and NEMA Type 3R enclosure for the power meter, as per Hydro One requirements. Coordinate with Hydro One to install the new Hydro One supplied power meter.
- Removal and disposal of existing (old) power meter base, existing (old) FDS, and conduit(s) after commissioning of new power feed. Hydro One to remove the existing (old) power meter, coordinate accordingly.
- Supply and installation of a new Motor Control Center panel (MCC-1) and new lighting panel (LP-1) along with conduits as per Contract drawings.
- Supply and installation of a NEMA 14-50 outlet equipped with a lockable weatherproof enclosure, suitable for outdoor use (with a cover). Addition of a separate 50A circuit. The 80% rated type 60A 208V, 2-pole CB to be included in the new lighting panel LP-1, and to be equipped with ground fault protection.
- Supply and installation of a new standalone 60HP Variable Frequency Drive (VFD) and Passive Harmonic Filter for Well #2 Pump in Well #2 Pumphouse along with conduits and cables as per Contract drawings.
- Removal and disposal of existing MCC including the 60HP VFD and relevant cables/conduits.
- Removal and disposal of electrical components in Well #2 Pumphouse and installation of new similar equipment in the same location as per Contract drawings. The 100A FDS for the 60HP motor in Well #2 Pumphouse to be permanently removed and no new installation is required for this FDS. The new 60HP VFD to include a disconnect switch.
- Supply and installation of a new Instrumentation Control Panel in main plant (CP01 – Colborne WTP Main Control Panel) on a backplate in new MCC (rightmost section) as per Contract drawings.
- Removal of existing Instrumentation Control Panel in the main plant including the existing Pribusin hardware.
- Replacement of existing Pribusin hardware in existing Standpipe control panel (CP02) with new CompactLogix PLC at the Colborne Standpipe.
- Coordination of the installation of wireless radio equipment installed by others in both main plant and Colborne Standpipe.
- Re-routing of relevant cables and conduit for all affected equipment. Supply and install new cable / conduit as per drawings, specifications, and as required.
- Equipment testing and commissioning.
- Coordination with the Electrical Safety Authority (ESA) for all electrical installations, as needed.
- Refer to Specifications Division 1, Section 01010 Summary of Work and to Contract Drawings for more details on scope of work.

The Owner and/or operating authority retains the right to direct the Contractor to stop work at any time where the Contractor's work interferes with the operation of the existing water supply system or where an operational emergency occurs. Under such circumstances the Owner will consider an application from the Contractor for an extension of time although no additional payment will be made with respect to delays associated with a maximum of two (2) requests to stop work (for operational emergencies) for a maximum of two (2) days each.

Contractor to consider and treat all contract documents including specifications and drawings as one contract and fully coordinate the work of all trades. Any item or aspect of the work identified in one part of the contract documents is considered adequately and sufficiently specified whether omitted from other parts of the contract documents. Misinterpretation of requirements of either drawings or specifications will not relieve the Contractor of the responsibility to provide complete systems and components.

Equipment and systems indicated on contract drawings shall be installed complete with all accessories required for a complete functional and warranted installation in accordance with industry standards, in compliance with applicable codes and to the satisfaction of the Engineer. Furnish at no additional cost, any appurtenant fittings, materials or accessories, not herein or elsewhere mentioned specifically, but necessary for the operation of the equipment and system. Provide all materials, labour and equipment to make adjustments to the installation as required by the equipment manufacturer or the Engineer to effect correct performance of systems or equipment. Contractor and appointed sub-contractors to be fully acquainted with and qualified to complete the work including the installation of all equipment. At no time will any claim be considered as to a misunderstanding in the amount or nature of work involved.

Contractor to pay all Electrical Safety Authority (ESA) review, permit and inspection costs. The Contractor is to provide a copy of ESA Certification of works prior to start-up and commissioning.

Electrical power (hydro) necessary for construction of the works, coordinating all stages of Works with the Operating Authority for the provision of temporary and permanent power supply as required. All costs resulting from this requirement are to be paid by the Contractor. This includes any fuel used for temporary power supply.

2. Inquiries During Tender Period

Tenderers are advised that inquiries regarding the interpretation of the plans or specifications shall be directed in writing via email to Tim Gilligan, Assistant Manager & Compliance Coordinator, Township of Cramahe – e-mail: tgilligan@cramahe.ca

Inquires will be accepted until **2:00 PM local time, Friday April 4th, 2025**. There shall be guarantee that a response will be provided for inquires received after the above stated deadline.

3. Bid Deposit

Each tender shall be accompanied by a bid deposit in the form of a bid bond made payable to the Township of Cramahe in the amount of **\$15,000.00**.

Bid bonds must be from a recognized and approved surety company submitted using CCDC Form 220 or equivalent. Bid bonds to be valid for 90 days from tender opening.

The bid deposits of all but the two (2) lowest bidders will be returned within 10 days of the tender closing. The bid deposits of the two (2) lowest bidders will be retained until a tender has been accepted, an agreement executed and all required documentation to formalize the Contract have been furnished to the satisfaction of the Owner and their representatives.

Without prejudicing the validity of the tender, the Owner may at its discretion:

- cash a bid deposit and deposit the proceeds to their account without prejudice to the ultimate disposition of such bid deposit as provided herein; or
- return a bid deposit to a bidder at an earlier time than provided herein, or
- return a bid deposit to a bidder upon receipt (from the said bidder) of an alternative security acceptable to the Owner in lieu of the bid deposit.

Except as otherwise herein provided, the Bidder guarantees that upon notification that their tender has been accepted by the Owner, within the identified period of validity, the Bidder shall provide all documentation required herein, within ten (10) days, including the Agreement executed by the Bidder, the Performance Bond executed by the Bidder and the Surety Company and other documents as identified herein.

Except as otherwise herein provided, the Tenderer guarantees that if their tender is withdrawn before the Owner shall have considered the tenders or before or after they have been notified that their tender has been recommended to the Owner for acceptance or that the Owner does not for any reason receive within the said period of ten (10) days as stipulated and as required herein, the Agreement executed by the bidder and other documents required herein, the Owner may retain the tender deposit for the use of the Owner and may accept any tender, negotiate a contract or not accept any tender as the Owner may deem advisable.

4. Time of Completion

Time shall be the essence of this contract. The Bidder's attention is drawn to the completion requirements identified herein and in the Tender Form.

The Contractor will be required to have the work on this Contract completed within the number of calendar weeks identified in the Bidder's Tender Form or a completion date subsequently agreed upon by both contracting parties.

5. Liquidated Damages

In accordance with the General Conditions of the Contract and as specified herein, should the Contractor fail to complete the works to the satisfaction of the and in accordance with the Time of Completion specified in the Contract or the written extension of contract time in accordance with the General Conditions of the Contract, it is agreed by the parties to this Contract that:

- Liquidated damages, payable to the Township of Cramahe by the Contractor, will be assessed at the rate of \$2,000 (Two Thousand Dollars) per calendar day for each and every day's delay in finishing this Contract beyond said completion dates.
- The Owner may deduct any amount due as liquidated damages, from any monies that may be due or payable to the Contractor under the contract whatsoever. Monies payable on this account are in addition to and without prejudice to any other remedy, action or other alternative that may be available to the Owner.
- The Contractor shall not be assessed for any delay caused by Acts of God or of the Public Enemy, Acts of the Province of any Foreign State, Fire, Flood, Epidemics, Quarantine Restrictions or Embargoes.

6. Delivery and Opening of Tenders

Sealed Tenders clearly marked "Colborne Water Treatment Plant Electrical & SCADA System Upgrades, Contract No. 2025-01" will be received until:

12:00 P.M. noon (local time) Thursday, April 10th, 2025

Tenders shall be addressed to: Tim Gilligan
Assistant Manager & Compliance Coordinator
Township of Cramahe
1 Toronto Street
Colborne, ON K0K 1S0

Tenders shall be submitted in hard copy format only. The method of hard copy tender delivery shall be entirely the responsibility of the Bidder. The Township shall not be responsible for delivery delays resultant from any issues that may arise including those related to the use of postal or courier services.

Bidders making submissions are invited to the in person tender opening held at the Municipal Office (1 Toronto Street, Colborne Ontario) at the following date and time:

12:00 P.M. (local time) Thursday, April 10th, 2025

7. Warranty

The warranty period, for the upgraded portion of the water supply system, shall extend twelve (12) months from the date of written acceptance of the works by the Owner and turnover of operation of the upgraded system to the Township and its operating authority. The upgraded water supply system must be fully tested and commissioned to the satisfaction of the Engineer, representatives of the Township, operating authority and MECP as required, and all relevant documentation submitted prior to acceptance.

Acceptance of the works shall not relieve the Contractor of the responsibility for faulty materials or workmanship that may appear in the work during the warranty period. The Contractor will be responsible for rectifying defective work in a timely manner both during construction and the warranty period.

Where defective work must be rectified by the Township or its representatives, due to the Contractor's failure to remedy such work in a timely manner or where emergency remediation is deemed necessary, the cost of defective work rectified by the Township or its representative shall be borne by the Contractor or its Surety.

8. Performance and Maintenance Bond

The Contractor, together with a Surety Company approved by the Owner and authorized by law to carry on business in the Province of Ontario shall, unless otherwise directed, furnish to the Owner a Performance and Maintenance Bond, in an appropriate and agreeable form, in the amount of 100% of the Total Lump Sum Tender Price to guarantee the contractors faithful performance of this Contract. The Bidder shall include the cost of the bond(s) in the item provided for that purpose in the Tender Form.

The Bidder shall include with their tender, the Agreement to Bond in the form enclosed herewith executed under the corporate seal of the surety company from which they propose to obtain the required bonds.

The successful Bidder will be required to furnish the Performance and Maintenance Bond in triplicate as required herein and in the form include herein, within ten (10) days after notification of the execution of the Agreement by the Owner has been mailed to him. One copy of the said bonds shall be bound into each of the three (3) executed sets of the Contract.

9. Maintenance Security

The Contractor shall provide to the Owner, for the duration of the period of maintenance (12 months from completion of the works) a maintenance security the value of which shall be 4% of the contract price.

The maintenance security, which at no time is to be part of the statutory holdback, shall be retained by the Owner from monies that would otherwise be payable to the Contractor, commencing during the latter part of the construction period such that by the date of substantial performance of the contract the full value of the maintenance security has been retained.

Except as otherwise provided hereunder, the maintenance security, less any deductions made there from as provided for in the Contract, shall be paid to the Contractor following the issuance of the Final Acceptance Certificate at the end of the period of maintenance.

The Contractor may apply in writing to the Owner at the time of substantial performance to substitute for the monies retained as the maintenance security an alternative maintenance security of equivalent or greater value comprised of one or more irrevocable letters of credit, or another readily negotiable security. Acceptance of any such alternative shall be at the discretion of the Owner.

10. Insurance

The Contractor will be required to carry General Liability Insurance and Automobile Liability Insurance as specified in GC 11.1.1 of the CCDC General Conditions identified for the Contract. The Liability Insurance shall be Comprehensive Liability Insurance covering all operations and liability assumed under the Contract with the Owner, with limit of liability not less than \$5,000,000 per occurrence.

The Automobile Insurance shall include insurance against liability for bodily injury and property damage caused by vehicles owned by the Contractor and used on the work, and in addition, shall include insurance against liability for bodily injury and property damage caused by vehicles not owned by the Contractor and used on the work, with limit of liability not less than \$5,000,000 per occurrence.

The Contractor shall be required to pay any deductible amounts in connection with all insurance policies. Insurance policies shall be endorsed to provide that the policy or policies will not be altered, cancelled, or allowed to lapse without thirty (30) days prior written notice to the Owner and Owner.

Insurance policies shall be endorsed to include the Owner (Township of Cramahe), the Operating Authority (Lakefront Utility Services Inc.) and the Engineer (WSP Canada Inc.) as additional insureds.

The need for any additional insurance, as may be deemed necessary by the Owner prior to commencing work, will be at additional cost to the Owner.

11. Examination of the Site and Facilities

The Bidder shall visit the site of the work before submitting their tender and shall satisfy themselves by personal examination as to the local conditions to be met with during the construction and carrying out of the work. The bidder shall make their own estimate of the facilities and difficulties to be encountered including the nature and condition of existing facilities and site conditions, including the proximity of adjacent properties and structures. The Contractor shall not claim at any time after submission of their tender that there was any misunderstanding of the terms and conditions of the Contract relating to site conditions.

Bidders must satisfy themselves by personal examination of the site and by such other means as they may prefer as to the actual conditions and requirements of the work.

The Bidder shall carefully examine all plans and profiles so that the prices provided in the tender are commensurate with the nature of the work taking into account restrictions with respect to the site.

It shall be the Contractor's responsibility to thoroughly inspect the site of the proposed works, determine the location of any obstructing services and make satisfactory arrangements for interference with such service with the proper jurisdictional agency.

12. Site Visit

There will be a Mandatory Site Meeting for all bidders at the Colborne Water Treatment Plant (321 Purdy Road, Colborne, Ontario) at **1:00 P.M. (local Time) Tuesday April 1st, 2025.**

13. Submission of Tender

Each tender shall be submitted in accordance with the conditions set out in the Contract Documents and shall include a completed Tender Form, all Addenda, Statements A to C, an Agreement to Bond, all as bound herein and a bid deposit as required herein, together with any further forms or sheets which bidders are instructed elsewhere herein, or in any addendum hereto, to submit with their tender. The Bidder may retain the rest of the tender documents issued to him.

Persons or firms submitting tenders shall be actively engaged in the type of work required by the specifications and shall be able to refer to work of a similar character satisfactorily performed by him. The Owner reserves the right to reject any tenders not meeting these requirements.

All tenders for the execution of the work herein set forth or referred to must be made on the printed forms supplied for that purpose, no others will be considered. Such tenders must be made without any knowledge, comparison of figures or arrangements with any other person making any tender or estimate for the same purpose, and that such tenders are in all respect fair and without collusion or fraud, and that no officer of the Owner and/or operating authority is, shall be, or shall become interested, directly or indirectly, as contracting party, partner, surety or otherwise in the performance of, the Contract, or in the supplies, work or business to which it relates, or in any of the monies to be derived therefrom.

If required in the Tender Form, a Statutory Declaration must be submitted by the party or parties submitting the tender stating that the several matters referred to herein are in all respects true. Bidders must cover the cost of completion of the Contract in every respect, in accordance with the Contract, including all labour, products, materials and services.

The Bidder shall give the Total Lump Sum Tender Price both in words and in figures and, except as is otherwise specifically permitted in the Tender Form, shall fill in all blank spaces for unit prices, item prices, lump sums, Time of Completion and other information in the Tender Form.

All Bidders are required to submit the Breakdown of the Total Lump Sum Tender Price on the pages included in the Tender Form, as part of their tender submission.

If in the opinion of the Owner or its representatives the breakdown contains prices which are unbalanced, the Bidder will be required to submit data to substantiate the price. In any event, the Owner reserves the right to adjust the breakdown and correct any unbalanced prices.

Each item in the Tender Form shall be a reasonable price for such item. Under no circumstances will an unbalanced tender be considered. The Owner and its representatives will be the sole judge of such matters, and where any Tender is considered to be unbalanced, it may be rejected.

14. Omissions, Discrepancies and Interpretations

Should a Bidder find omissions from or discrepancies in any of the tender documents or is in doubt as to the meaning of any part of such documents, the Engineer (WSP Canada Inc.) shall be notified in writing and not later than seven (7) calendar days before the closing date for tenders. If the Owner or its representatives consider that a correction, explanation or interpretation is necessary or desirable, an addendum will be issued to all who have registered as takers of the tender.

No oral explanation or interpretation shall modify any of the requirements or provisions of the tender documents.

The entire scope of work is required to be completed by the Contractor in accordance with the Specifications or as indicated on the Drawings (Contract Documents). The Contract Documents are complementary, and work outlined in the Specifications and/or Drawings shall be required as part of the Contract. Claims for extras, on the basis that work as noted in one or more parts of the Contract Documents and not shown or noted in another, shall not be entertained.

15. Disqualification of Tenders

Under no circumstances will tenders be considered which:

- are received after the identified closing time on the identified or advertised closing date for tenders; or
- are not accompanied by a Bid Deposit in the amount specified (where required).

16. Withdrawal or Qualifying of Tenders

A Bidder who has already submitted a tender may submit a further tender at any time up to the official closing time. The last tender received shall supersede and invalidate all tenders previously submitted by that bidder for this contract.

A bidder may withdraw or qualify their tender at any time up to the official closing time by submitting a letter bearing their signature and seal as in their tender to the designated representative of the Township. Such a submission at the location stated previously for the receipt of tenders must be received in sufficient time to be marked with the time and date of receipt on the date for closing of tenders. The bidder shall show their name, the name of the project and the contract number(s) on the envelope. No telegrams or telephone calls will be considered.

17. Informal Tenders

Tenders which are incomplete, conditional, illegible or obscure, or that contain additions not called for, reservations, erasures, alterations (unless properly and clearly made and initialed by the Contractors signing officer) or irregularities of any kind, may be rejected as informal.

If the Bidder shall neglect to insert a price for an item in the Tender Form, they shall, unless they have specifically stated otherwise in the Tender Form, be deemed to have allowed elsewhere in the Tender Form for the cost of carrying out said item of work and, unless otherwise agreed to by the Owner, no increase shall be made in Lump Sum Tender Price on account of such omission.

Tenders that are based upon an unreasonable Time of Completion of the Works may be rejected.

The Owner reserves the right to waive formalities as the interests of the Owner may require without stating reasons therefor. Bidders who have submitted tenders which have been rejected by the Owner because of informalities will normally be notified of the reasons for the rejection within ten (10) days after the closing date for tenders.

18. Clarification of Tenders

The Owner may, at any time following the Bid closing time, request that any Bidder clarify its Bid. Bidders shall provide a written response to any such request for clarification within two (2) working days following receipt of such a request, or within such shorter time as the Owner may require. The Owner may require any Bidder to submit additional information clarifying any matters contained in its Bid and require the relevant Bidder's acknowledgement of the accuracy of that interpretation.

The additional information accepted by the Owner and written interpretations which have been acknowledged by Bidders shall be considered to form part of the Bids of those Bidders.

The right to request clarification of Bids by the Owner as provided herein is within the sole, complete and unfettered discretion of the Owner and is for the Owner's sole benefit and may or may not be exercised by the Owner at any time and in respect to any or all Bids.

The Owner's right to request clarification of Bids as provided herein shall not in any way impose upon the Owner a requirement to clarify with a Bidder any part of a Bid, and where in the opinion of the Owner the Bid is ambiguous, incomplete, deficient, or otherwise not acceptable in any aspect, the Owner may reject a Bid either before or after seeking a clarification under this section.

The seeking of a clarification of a Bid by the Owner as provided herein shall not in any way oblige the Owner to enter into a Contract with that Bidder and shall not constitute an acceptance of that Bid or any other Bid.

All Bid clarifications submitted by a Bidder shall be in writing in a form satisfactory to the Owner.

19. Acceptance or Rejection of Tenders

The Owner will not be bound to accept the lowest or any tender they may receive.

Subject to the General Conditions, except as provided hereunder, neither the Consulting Engineer nor any officer or employee of the Owner or operating authority has authority to make or accept an offer or to enter into a contract on behalf of the Owner or to create any rights against or to impose any obligations on the Owner. The recommendation of a tender to the Owner for acceptance does not constitute acceptance of the tender by the Owner.

A tender is accepted by the Owner when an agreement in the form bound herein (or other approved form of agreement) is executed by the Owner and by the Contractor, when a written order to commence work to the successful Bidder has been issued, the Owner and anyone acting on their behalf has requested to execute the Agreement and return it to the Owner. The acceptance of a tender and the execution of an Agreement is subject to the express condition that the Owner receive contract bond(s), as required herein and in a form satisfactory to the Solicitor for the Owner, within ten (10) days after notification of the execution of the Agreement by the Owner has been mailed to the Bidder whose tender has been accepted as aforesaid.

The Owner or Engineer shall not be responsible for any liabilities, costs, expenses, loss or damage incurred, sustained or suffered by any bidder prior or subsequent to or by reason of the acceptance or the non-acceptance by the Owner of any tender or by reason of any delay in the acceptance of a tender save as provided in the Contract. Tenders are subject to a formal Contract being prepared and executed. If an insufficient number of tenders are received, tenders may be returned unopened.

The selection of the preferred bid will be subject to budgetary and technical evaluation of tender submissions including review of alternative design features (where permitted under the Contract). The Owner reserves the right to accept the bid which it considers to provide the best value to the Owner and the Township based on its evaluation without stating or documenting reasons.

Tenders will be called, received, evaluated, accepted, and processed in accordance with The Corporation of the Township of Cramahe Purchasing By-Law No. 2020-77 (copy available upon request). By submitting a Tender each Bidder agrees to be bound by the terms and conditions of that By-law and those procedures and any amendments to them, as fully as if it were reproduced and attached to this document.

20. Definition of Owner and Engineer

Wherever the word "Owner" appears in this Contract, it shall be interpreted as meaning the Township of Cramahe.

Wherever the word "Engineer" or "Contract Administrator" appears in the Contract, it shall be deemed to mean the Consulting Engineer, WSP Canada Inc. or other firm which may be retained by the Owner to administer the Contract.

21. Permits & Approvals

The ability to proceed with the works under this contract may be subject to the Township receiving the following approvals from the Ministry of Environment, Conservation & Parks (MECP):

- Amendment to current Permit-To-Take-Water
- Amendment to current Drinking Water Works Permit

22. Operational Constraints

The Colborne Drinking Water System provides water treatment, treated water storage and distribution within the community of Colborne.

At this time the drinking water system includes (2) groundwater production wells (Well #1A and Well #2). Well #1A is the primary production well with Well #2 providing emergency standby capacity. Treatment involves addition of sodium silicate and sodium hypochlorite.

Bidders are advised that the implementation of upgrades under this contract, is to be carried out with the existing water supply system remaining in service to maintain the required treated water storage volumes and water distribution system pressures for the existing community.

Use only those areas designated by the Owner for Contractor access except in so far as is necessary for the execution of the Works, and in so doing the Contractor shall not unnecessarily obstruct the normal traffic of, to, from or about the Site; and they shall not unreasonably allow any vehicles or materials to stand in front of or near to any buildings on the Site or any access thereto.

The Contractor shall so arrange the timing of, and the method by which they carry out the works as not to affect the operation of the existing water supply system which shall continue operation throughout the Contract.

The existing water supply and distribution system will remain in operation during construction and commissioning of the new or modified works and all diversions will take place with minimum disruption to the operation of the facility.

The Owner retains the right to direct the Contractor to stop work at any time where the Contractor's work interferes with the operation of the facility or where an operational emergency occurs. In such an event, the Owner will consider an application for extension of time from the Contract in full and final settlement thereof. No additional payment will be made in respect of any delays associated with a maximum of two (2) requests to stop work (for operational emergencies) for a maximum of two (2) days each.

23. Government Requirements

The Contractor shall obey all Federal, Provincial and Municipal Laws, Acts, Ordinances, Regulations, Orders-in-Council and By-laws which could in any way pertain to the work outlined in the Contract or to the employees of the Contractor.

24. Execution of Contract and Agreement

Tenders shall be open for acceptance and irrevocable for a period of ninety (90) days after the closing date. After this time, the Tender may only be accepted with the consent of the successful Bidder. Any extension in the period of validity of Tenders may be subject to negotiation between the Owner and the respective bidders.

The successful Bidder shall execute the Contract Documents and furnish the required bond within ten (10) calendar days of receipt of notification of acceptance of their Tender.

Failure by the successful Bidder to meet the above requirements will entitle the Owner to cancel the award of the Contract and to retain the bid deposit as compensation for damages sustained due to the successful Bidder's default. The Owner may then award the Contract to one of the other Bidders or take such other action as they choose.

The Bidder agrees that, if requested to do so by the Owner or anyone acting on its behalf within ninety (90) days after the date of opening tenders, they will execute in triplicate and return to the Owner the Agreement in the form bound herein within ten (10) days after being so requested. If the Bidder has not been so requested within the said ninety (90) days or the written order to commence work has not been mailed or delivered to the Bidder or their office or postal address within the said ninety (90) days, the Bidder may, unless they have otherwise agreed or offered and except as otherwise provided herein, withdraw their tender.

25. Proof of Ability

The Owner reserves the right to reject the Tender of any Bidder who does not furnish satisfactory evidence of sufficient capital, manpower, plant and experience to successfully execute and complete the work in the specified time.

In order to aid the Owner in determining the responsibility of each Bidder, the Bidder shall complete Statement "A" of the Tender Form.

Statement "A" requires the Bidder to provide the name, position and experience of the Supervisory Staff to be assigned to this project. The Bidder may be requested to provide references and/or detailed resumes for identified staff. The Owner and Owner's approval will be required for the successful Bidder to substitute identified supervisory staff for the project.

26. Sub-Contractors

The Bidder shall provide in Statement "B" of the Tender Form, the name and address of each proposed Sub-Contractor used in making up their tender and shall state the portion of the work allotted to each. Only one Sub-contractor shall be named for each part of the work to be sublet.

If the successful Contractor, after tender opening, wishes to substitute an alternate sub-contractor for a sub-contractor listed herein, the Contractor shall submit documentation to the Owner and/or Engineer with respect to the alternate sub-contractor's experience and qualifications for review and approval of the substitution. Where approval for the substitution of a sub-contractor is not granted by the Owner and/or Engineer the Contractor shall arrange to have the proposed work completed by such other Sub-Contractor(s) acceptable to the Owner and/or Engineer without change in the Tender price.

27. Workplace Safety Insurance Board

The Contractor shall at the time of entering into any contract with the Owner, make a statutory declaration or furnish a satisfactory clearance letter from the Workplace Safety Insurance Board that all assessments or compensation payable to the Workplace Safety Insurance Board have been paid.

The successful Bidder shall submit such statutory declaration or clearance letter in triplicate to the Owner together with the Agreement. One copy of the statutory declaration or clearance letter shall be bound into each of the three executed sets of the Contract.

The Contractor shall also at any time during the performance, when requested by the Owner, and upon completion of such contract furnish said satisfactory certificate from the Workplace Safety Insurance Board.

28. Mobilization and Demobilization

This item under the Breakdown of the Lump Sum Tender Price included under General Requirements is to cover the Contractor's cost of mobilization at the beginning of the construction period and demobilization at the close of the construction period. The price entered for this item shall be consistent with costs involved but shall not, in any event, exceed four percent (4%) of the total Tender Price.

If the bidder has entered against this item in their Tender a price in excess of four percent (4%) of the total price, the Owner shall, in preparing contract documents based upon the Tender, reduce the price for the said item to an amount not exceeding four percent (4%) of the total Tender price and shall add the amount of the reduction to the price for the "Lump Sum for Other Requirements" item so that the total Tender price shall not be affected.

Sixty percent (60%) of the price for the Mobilization and Demobilization item shall be considered as relating to mobilization and the balance to demobilization.

The payment for mobilization shall be included in the first payment certificate issued for the Contract subject to the Engineer being satisfied that full mobilization has been carried out. If the Engineer is not so satisfied, they shall allow a payment which, in their opinion, reflects the degree of mobilization effected to date.

The payment for demobilization shall become due following Substantial Performance of the works and subject to the Engineer being satisfied that full demobilization has been carried out. The Engineer may, at their discretion, allow partial payment for demobilization before full demobilization has been affected.

29. Lump Sum for Other Requirements

In this item of the Breakdown of the Lump Sum Tender Price included under General Requirements, the Bidder shall enter their Tender price for providing items such as watchpersons, permits and approvals (other than those to be paid by the Owner), items required by the Drawings or Specifications but which have been omitted from the Schedule and other items required by the Contract but not specifically covered by or related to the other items in the Schedule.

Each Progress Payment Certificate will include a percentage of the Tender Price for this item in proportion to the percentage of the permanent works completed.

The price entered for this item shall be consistent with costs involved but shall not, in any event, exceed ten percent (10%) of the total Tender Price.

30. Estimated Starting Date

The estimated starting (award) date for the project is **April 22nd, 2025**.

The schedule for all remaining work will be negotiated between the Owner and the successful bidder.

31. Harmonized Sales Tax

The Contractor shall quote the items in this Contract excluding the Harmonizing Sales Tax (H.S.T.). The H.S.T. will be added to each invoice at the time of payment for the work completed.

32. Hours of Work

The Contractor may normally execute the work during “normal” working hours (7:00 AM to 5:00 PM) Monday to Thursday from April 1st to November 1st or as otherwise approved by the Township on any weekday, providing that they conduct their operations as not to create a nuisance or disturb the peace unnecessarily and providing such hours meet with the approval of the Township of Cramahe.

Whenever the Contractor desires to depart from their normal working hours as established by their past performance, they shall obtain the written approval of the Owner, at least 72 hours prior to the contemplated change in operations.

The Contractor shall refrain from working on-site on Saturday's, Sunday's or statutory holidays recognized in Ontario unless otherwise approved by the Owner and arrangements are made in advance to have representatives of the Owner (including independent inspection agencies) on-site to provide necessary inspections.

33. Emergency and Maintenance Measures

Whenever the construction site is unattended by the general superintendent, the name, address and telephone number of a responsible official of the contracting firm, shall be given to the Contract Administrator. This official shall be available at all times and have the necessary authority to mobilize workmen and machinery and to take any action as directed by the Contract Administrator in case emergency or maintenance measures are required regardless of whether the emergency or requirement for maintenance was caused by the Contractor's negligence, act of God, or any cause whatsoever.

Should the Contractor be unable to carry out immediate remedial measures required, the Owner and/or its representative will carry out the necessary repairs, the costs for which shall be charged to the Contractor.

34. General Conditions (CCDC)

Work to be performed under Contract, in the form of the Agreement, Articles, Definitions and General Conditions of the Stipulated Price Contract, Canadian Standard Construction Document CCDC-2 2008 Edition, except as amended herein.

Wherever in the Contract Documents, reference is made to the General Conditions, it shall be interpreted as meaning the above identified General Conditions. A copy of the General Conditions has not been included as part of the tender document. It will be the Contractors responsibility to secure a copy of the edition of the General Conditions identified herein.

35. Revision to CCDC General Conditions

The following supplementary (revised) conditions are intended to supplement and govern over the General Conditions of CCDC-2 2008.

Add the following to GC 1.1.8 (under Contract Documents):

The Consultant will issue the Contractor, one (1) set of executed Contract Documents upon which the contract is based. Additional copies of the executed Contract Documents will be issued at the Contractor's expense.

Add the following after GC 1.1.10 (under Contract Documents):

1.1.11 The Owner reserves the right to delete items from the Contract, prior to award of the Contract.

1.1.12 The Contractor shall notify the Engineer of any discrepancies, omissions, or errors and request clarification and/or instruction. Where identified during construction, work on affected areas shall stop until clarification and/or instruction to proceed has been obtained from the Engineer.

Add the following after GC 1.4.1 (under Assignment):

1.4.2 The Owner's consent to permit assignment of all or part of this Contract shall not relieve the Contractor of the obligations and responsibilities for proper execution and completion of the works according to the terms of the Contract.

Add the following after GC 3.5.1.3 (under Construction Schedule):

3.5.1.4 Time shall be of the essence in the performance of the work.

Add the following after GC 5.2.7 (under Applications for Progress Payments):

5.2.8 The first payment application shall not be submitted until 30 days after the award of the Contract.

5.2.9 Second and subsequent applications for payment shall be accompanied by a duly signed Statutory Declaration on CCDC Form 9A.

5.2.9 All applications for payment shall be accompanied by a Workplace Safety Insurance Board Clearance Certificate.

GC 5.3.1.2 to be modified as follows:

Change "ten (10) calendar days" to "fourteen (14) calendar days"

GC 5.3.1.3 to be modified as follows:

Change "twenty (20) calendar days" to "thirty (30) calendar days"

Delete GC 5.5.3

Add the following after GC 5.6.3 (under Progressive Release of Holdback):

5.6.4 Holdback monies will not be released until 46 days after substantial performance of the contract excluding any monies held in relation to the above.

GC 5.7.4 (under Final Payment) to be modified as follows:

Change “five (5) calendar days” to “twenty (20) calendar days”

Add the following after GC 5.8.1 (under Withholding of Payment):

5.8.2 The Owner, with documented justification, may withhold sufficient funds as protection against loss on account of the following:

- Damaged work/ property caused by Contractor, Sub-Contractors or Suppliers
- Defective work not remedied
- Delay in performance of work
- Delay in submission of documentation, certificates, reports, shop drawings or record drawings
- Claims filed or reasonable evidence indicating probable filing of claims
- Overpayment for completed work

5.8.3 When the condition for which funds were withheld has been remedied to the Owner’s satisfaction, the Contract Administrator will authorize payment for the amount withheld, within five (5) calendar days, for payment by the Owner within the payment requirements of the Contract.

Add the following after GC 6.2.2 (under Change Order):

6.2.3 For extra work on a negotiated price or time and material basis, the Contractor shall prepare and present to the Engineer a detailed estimate of the Contractors and/or Sub-Contractors cost for labour and material, statutory charges, overhead and fees all shown separately.

6.2.4 In the valuation of labour costs in connection with changes and the amount to be charged for labour burden and materials, they shall be limited to such amounts as can be directly substantiated by current market value.

6.2.5 Allowance for overhead and profit shall be limited to the following:

- When work is performed by the Contractor’s own work force, the Contractor shall be entitled to an overhead and profit not exceeding fifteen percent (15%) in total.
- When work is performed by a sub-contractor, that sub-contractor shall be entitled to an overhead and profit not exceeding ten percent (10%). The Contractor shall be entitled to an overhead and profit not exceeding five percent (5%) of the sub-contractor’s total cost.

6.2.6 Contractors and sub-contractors will not be entitled to charge a fee or charge for overhead and profit on credits to the Contract. Where a change involves extras and credits on the work of a trade, the sub-contractor will only be entitled to allowances for overhead and profit on the total net extra for the change.

6.2.7 Allowances for overhead and profit shall cover all the Contractor's and/or sub-contractor's administrative, and incidental costs relating to a change, including, without limitation, costs relating to site superintendence and supervision, shop drawing production, Site Office and Home Office expenses, worker's tools, temporary facilities, and controls.

6.2.8 Considerations of additional costs for site supervision (including site supervisor vehicles costs and office trailer rentals) will only be considered when change orders have resulting in more than a 20-working day extension of the project completion date and where detailed justification is provided.

Add the following after 6.5.5 (under Delays):

6.5.6 Where the Contractor fails to complete the Works to the satisfaction of the Owner and/or Contract Administrator within the Time for Completion specified in the Contract or the extended time allowed in writing, the Contractor shall pay to the Owner as liquidated damages the sum of \$2,000.00 for each calendar day that the Works remain uncompleted after the time specified or allowed.

Add the following after 7.2.5 (under Contractors Right to Suspend the Work or Terminate the Contract):

7.2.6 Clause 7.2.3.3 shall not apply to the proper withholding of payments due to the Contractors failure to pay all just claims promptly or where there is a registration or notice of lien(s) against the Township's property, until such time as the claim or lien is appropriately discharged.

Add the following after 9.2.9 (under Toxic and Hazardous Substances and Materials):

9.2.10 Prior to commencing work on-site, the Contractor shall provide the Contract Administrator with a list of products controlled under WHMIS which the Contractor expects to use in performing the work under this Contract. Related Materials Safety Data Sheets shall be submitted with the list. All products shall be handled and stored in accordance with WHMIS standards including appropriate labelling. The Contractor shall notify the Contract Administrator of any changes to the list in writing and provide relevant documentation.

Add the following after 11.1.1.7 (under Insurance):

11.1.1.8 Contractor shall be required to pay any deductible amounts in connection with all insurance policies carried by the Contractor.

11.1.1.9 Contractor shall be required to pay any deductible amounts for claims under the Township's insurance, where the claim was caused by the Contractors work or actions.

Add the following after 12.3.6 (under Warranty):

12.3.7 The Contractor shall provide to the Owner, for the duration of the period of maintenance (warranty), a maintenance security the value of which shall be 4% of the final contract price. The maintenance security, which is not to be considered part of the statutory holdback, shall be retained by the Owner in increments from money otherwise payable to the Contractor, commencing during the latter part of the period of construction, such that the full value of the maintenance security has been retained by the date of substantial performance.

12.3.8 The Contractor may apply in writing to the Contract Administrator, at the time of substantial performance, to substitute an alternate means of maintenance security in the form of an irrevocable letter of credit or other readily negotiable security of equivalent or greater value. Acceptance of such alternate means of security and release of monies retained as the maintenance security shall be at the discretion of the Owner.

12.3.9 During the month prior to the end of the one (1) year warranty period, the Contractor shall request a review of the project and Works completed, to identify and list any outstanding defects or deficiencies to be corrected by the Contractor at no cost to the Owner. This review inspection will be carried out by the Owner representatives with the Contractor invited to attend.

12.3.10 At the end of the one (1) year warranty period, the maintenance security will be released, less any monies expended by the Owner on behalf of the Contractor.

36. Supplemental General Conditions**F1 Interpretation:**

In the contract "Work" means the whole of the work, services and materials required to be done, furnished and or performed by the Contractor in order to carry out the Contract.

F2 Status of the Contractor:

The Contractor is engaged as an independent contractor for the sole purpose of performing the Work. Neither the Contractor nor any of its personnel is engaged as an employee, servant, or agent of the Township.

F3 Amendments:

No amendment to the Contract shall be binding unless it is incorporated into the Contract by written amendment executed by the authorized representatives of the Township and of the Contractor.

F5 Compliance with Applicable Laws:

The Contractor shall comply with all laws applicable to the performance of the Work.

F7 Subcontracting:

Unless otherwise provided in the Contract, the Contractor shall obtain the consent of the Township in writing prior to subcontracting or permitting the subcontracting of any portion of the Work at any tier.

Notwithstanding the above, the Contractor may, without prior consent of the Township, subcontract such portions of the Work as is customary in the carrying out of similar contracts. In any Subcontract, the Contractor shall, unless the Township otherwise

consents in writing, ensure that the subcontractor is bound by terms and conditions of the Contract.

F8 Time of the Essence:

Time is of the essence of the Contract.

F9 Inspection of the Work:

The Work and any and all parts thereof shall be subject to inspection and acceptance by the Township.

F10 Infringement:

The Contractor warrants that no Work furnished in accordance with this contract shall infringe upon any patent, registered industrial design, trademark, trade secret, copyrighted work, or other intellectual property right. The Contractor at its sole cost and expense shall defend and hold harmless the Township, its agents, employees, and customers against any and all suits, actions and claims arising out of any and every charge of infringement.

F11 Indemnification:

The Contractor shall indemnify and save harmless the Township from any and all claims, demands, causes of action, loss, costs or damages that the Township may suffer, incur or be liable for resulting from the performance or non-performance of the Contractor of their obligations under any resulting contract.

F12 Packing: Price(s) quoted shall include all costs for crating and packing as required, for safe delivery of goods and should be of recycled materials where feasible.

F13 Payment:

Payment by the Township for the Work shall be made following delivery, inspection, and acceptance of the Work, and following presentation of an invoice which correctly corresponds with the work provided. Unless otherwise stated, the period for payments will be within thirty (30) days, calculated from the date the invoice is received, or delivery and acceptance of the work, whichever date is later.

F14 Conflict of Interest:

All firms are required to disclose to the Township prior to accepting the assignment any potential conflict of interest. If a conflict of interest does exist, the Township may, at its discretion, withhold the assignment from the Contractor until the matter is resolved to the satisfaction of the Township. If, during the contract, a contractor is retained by another client giving rise to a potential conflict of interest, then the Contractor shall so inform the Township and if a significant conflict of interest is deemed to exist by the Township, then the Contractor shall:

1. Refuse the new assignment, OR
2. Take such steps as are necessary to remove the conflict of interest.

F15 Fraud or Bribery:

Should the Contractor, any of their agents give or offer any gratuity to, or attempt to bribe any member of the awarding body, officer, or servant of the Township, or to commit fraud against the Township, the Township shall be at liberty to declare the tender void

forthwith, or the Township to take the whole or any part of the contract out of the hands of the Contractor, and to invoke the provisions of termination.

F16 Environmental Purchasing:

The Township is committed to the principles of sustainable development and will apply environmentally sound practices in fulfilling its mandate in the planning and provision of materials, services, and programs. Contractors are encouraged to adopt and promote environmentally sound practices and introduce environmentally sound goods, materials and services when dealing with the Township.

F17 Municipal Freedom of Information and Protection of Privacy Act:

The Corporation of the Township of Cramahe is subject to the *Municipal Freedom of Information and Protection of Privacy Act*, R.S.O. 1990, c.M.56, as amended ("MFIPPA") with respect to, and protection of, information under its custody and control. Accordingly, all documents provided to the Township in response to this Request for Tender may be available to the public unless the party submitting the information requests that it be treated as confidential. All information is subject to MFIPPA and may be subject to release under the Act, notwithstanding your request to keep the information confidential.

F18 Entire Agreement:

The Contract constitutes the entire and sole agreement between the parties with respect to the subject matter of the Contract and supersedes all previous negotiations, communications, and other agreements, whether written or oral, relating to it, unless they are incorporated by reference in the Contract. There are no terms, covenants, representations, statements, or conditions binding on the parties other than those contained in the Contract.

F19 Applicable Laws:

This Contract shall be interpreted and governed, and the relations between the Parties, determined by the laws in force in Ontario.

F20 Accessibility for Ontarians with Disabilities Act, 2005 (AODA):

The Corporation of the Township of Cramahe is committed to providing equal treatment to people with disabilities with respect to the use and benefit of Township services, programs, and goods in a manner that respects their dignity and that is equitable in relation to the broader public. All contractors with the Township must comply with all laws applicable to the performance of the work.

Effective 1 January 2010, third party Contractors who deal with the public or other third parties on behalf of the Township, as well as contractors who participate in developing Township policies, practices or procedures governing the provision of goods and services to members of the public or other third parties, must conform with the Accessibility Standards for Customer Service, O. Reg. 429/07 (Appendix A), under *The Accessibility for Ontarians With Disabilities Act, 2005 (AODA)*.

Contractors shall ensure that training records are maintained, including dates when training is provided, the number of employees who received training and individual training records. Contractors are required to ensure that this information will be made available, if requested by the Township.

37. Utilities and Existing Works

The Contractor shall be responsible for the protection of all utilities and existing works at the job site during the time of construction. It is not intended that any utilities (overhead or underground) will be relocated or taken out of service to accommodate the work under this contract unless specifically indicated.

The Contractor is responsible for verification of the location and type of all utilities and existing works within the Contract limits and which may be encountered during construction.

38. Layout

The Contractor shall be responsible for all layout required to accommodate construction under this Contract.

39. Order of Precedence

In the event of any inconsistency or conflict in the contents of the following documents, such documents shall take precedence and govern in the following order:

- Contract Agreement
- Addenda
- Information to Bidders and Supplemental Requirements
- Tender Form
- Drawings
- Specifications
- General Conditions
- Supplemental General Conditions

Later dates shall govern within each of the above categories of documents.

Should reference standards and standard specifications conflict with the detailed specifications pertaining to the Works, the detailed specifications pertaining to the Works shall govern. Should the reference standards and standard specifications conflict with each other, the more stringent shall apply.

Figured dimensions shall govern over scaled dimensions, in general scaled dimensions should not be used.

Neither party to the Contract shall take advantage of any apparent error or omission in the drawings or specifications. The Contract Administrator shall be permitted to make such corrections and interpretations as may be necessary for fulfillment of the intent of the drawings and specifications. The Contract Administrator shall not unfairly refuse compensation for such corrections and interpretations; however, the Contract Administrator shall be the sole judge of the value of such compensation, if any.

40. Equivalents

Design and approval of the upgrades has been based on the identified and specified equipment. Contractor pricing shall be based on supplying the specified equipment not alternates that the Contractor may consider equivalent. Requests for any proposed substitutions shall be made in writing to the Engineer and will include sufficient supporting documentation with respect to the

suitability of the proposed alternate equipment or material. Contractor will also be required to provide supporting documentation to the Engineer and Township to show that the alternate equipment complies with the current MECP approvals. Approval or rejection of the proposed substitution shall be at the sole discretion of the Engineer and/or Township. Contractor will assume all responsibility that the alternate equipment or material will “fit” in the available space and with ancillary components and be responsible for any additional installation costs resulting from the equipment or material substitutions.

41. Shop Drawings

Contractor to submit two (2) sets of shop drawings for all equipment and system components to be incorporated in the work. The shop drawing submission shall include drawings, diagrams, illustrations, schedules, performance data/charts, brochures, or other relevant data to adequately illustrate the relevant portion of the works. Shop drawings to be reviewed and approved by the Engineer. Only shop drawings reviewed by the Engineer and marked “Reviewed – No Comment” or “Reviewed – As Noted” shall be considered approved.

Where the required shop drawing information can be easily interpreted on 8.5” x 11” or 11” x 17” standard black and white printouts, shop drawings may be submitted to the Engineer for review, in digital (pdf) form via e-mail. The Engineer reserves the right to request hard copy submissions from the contractor, at no additional cost, where the material is not considered fully legible, colour copies are deemed necessary for review, or the submission exceeds twenty (20) pages (single sided).

Metric units shall be used throughout shop drawings. Where manufacturer’s literature includes several models or options, the applicable information shall be clearly indicated.

The Contractor shall submit shop drawings to the Engineer for review with reasonable promptness and with sufficient time to allow review without causing delay in the work. The Engineer will endeavour to review and return shops drawings within fifteen (15) working days of receiving the submission.

All shop drawings shall be submitted to the Engineer by the General Contractor. Sub-Contractors shall not submit shop drawings directly to the Engineer. The General Contractor shall review all shop drawings prior to submission to the Engineer. By submitting shop drawings to the Engineer for review, the General Contractor represents that they have reviewed the drawings and verified all dimensions to ensure proper installation within the available space and without interference with other equipment or the work of other trades and have thereby checked and coordinated each shop drawing with the requirements of the work and contract documents.

The Engineer’s review of shop drawings will be for conformity with the design concept and for the general arrangement of works only and does not relieve the Contractor of the responsibility for errors or omissions of the shop drawings or to meet the overall requirements of the work and contract documents. Engineer’s comments on shop drawings do not constitute approval for extra costs associated with making any changes noted.

Work which relates to shop drawings shall not be carried out without approved shop drawings. The Contractor assumes all responsibility for ordering or accepting delivery of equipment with or without approved shop drawings.

Shop drawings for items of a structural nature including, grating and support systems, ladders, access hatches, and piping supports/restraints to be stamped/signed by a Professional Engineer registered in Ontario, unless otherwise approved.

42. Operation and Maintenance Manuals

The Contractor will prepare two (2) copies of documentation, to update the Township's existing operations and maintenance manuals, including sufficient information to instruct staff in the operation and maintenance of each piece of equipment and system as supplied and installed. The information is to be assembled by the Contractor, in a well-organized manner, complete with an updated table of contents, section tabs and dividers. Each copy of the operations and maintenance information is to be placed in the existing Operation and Maintenance manuals only after approval by the Township. Operations and maintenance manual to include project information sheet identifying the project and providing the name and detailed contact information for the consultant, general contractor, major sub-contractors, and major equipment suppliers.

Where new information does not "fit easily" in existing binders (manuals), Contractor to provide additional (new) binders matching existing.

The operations and maintenance information for each system and piece of equipment shall include relevant manufacturers printed materials providing description of system components, technical data, maintenance and operating instructions, troubleshooting data, preventative maintenance requirements/schedules and warranty information. Operations and maintenance manuals also to include copies of approved shop drawings and all relevant testing and commissioning reports and data.

Operations and maintenance manual updates to be submitted to the Engineer for review and approval with the Contractor responsible for revising the manuals as required. Complete and approved operations and maintenance manuals and as-built drawings must be submitted prior to the system being accepted by the Township.

43. Operator Training

The Contractor is responsible for providing on-site training for the Township and/or operating authority operations staff in the operation and maintenance of equipment and system components. Training sessions are to be conducted by qualified factory-trained representatives of the equipment supplier or manufacturer. Training sessions to be coordinated and scheduled in as few sessions as possible for the benefit and convenience of operations staff not the individual equipment suppliers. It will be the decision of the Township as to which equipment and system components for which training is to be provided. Training sessions will only be scheduled after equipment/instrument has been appropriately tested and commissioned and a representative of the equipment manufacturer and/or supplier has provided a written report as to the proper operation of such.

44. Testing and Commissioning Plan

The Contractor is responsible for developing a comprehensive testing and commissioning plan for review and approval as well as updating the plan to the satisfaction of the Engineer, representatives of the Township, operating authority and MECP as required.

The Contractor's testing and commissioning team shall be on-site during testing and commissioning operations with qualified individuals equipped and ready to make emergency repairs, corrections or adjustments to equipment and systems.

The Contractor shall submit a testing and commissioning plan to the Engineer, for review and approval by the Engineer and representatives of the Township, a minimum of two (2) weeks prior to any proposed testing and commissioning operations. No testing or commissioning of the works

will be scheduled or witnessed by the Engineer or representatives of the Township until the testing and commissioning plan has been approved by the Engineer and Township.

All equipment functional testing shall be carried out under conditions as near as possible to those under which the equipment is to normally operate and over the full range of expected operation.

All system control functions and alarms, including operation under emergency power conditions, to be tested and proven to the satisfaction of the Engineer and Township.

The Contractor shall submit a fully coordinated testing and commissioning plan complete with proposed test procedures and protocols detailing the sequential testing of each item, component and system installed under the Contract. The test plan shall be specific to each item, component and system to be tested. Test plan to identify each device and control function to be tested and the specific result to be observed/obtained and outline the procedure to be used, including what setting or set point will be manipulated, to prove the system functionality.

Testing and commissioning plan to clearly define the expected test procedure duration and identify which sub-contractors are required to be on-site during the testing.

All meters, sensors, instrument, and gauges shall be calibrated and appropriate calibration certificates provided. Calibration of instruments, meters, sensors, and gauges installed under the Contract shall proceed on a system-by-system basis. No equipment or system performance tests shall be performed until instruments, sensors, meters, and gauges relevant to that particular system have been calibrated to the satisfaction of the Engineer. Instruments, meters, sensors, and gauges shall be recalibrated as necessary and as directed by the Engineer following performance testing to ensure all devices are accurate and measuring as required at the time of turnover to the Township.

Contractor to include all costs for qualified representatives of equipment manufactures and/or suppliers to visit the site to ensure the equipment installation is acceptable (prior to equipment start-up), to start-up and commission equipment, and to provide training in the operation and maintenance of equipment. The Contractor shall have no expectation that the above will be combined on a single site visit by representatives of the equipment manufacturer or supplier.

45. Meetings

Contractor will attend meetings at the site, online, or at Township offices, during the construction period, as may be required.

Meetings to include but not be limited to pre-construction meeting, progress meetings, pre-commissioning meeting and other coordination meetings as may be required. Contractor to provide updated overall construction schedule and short-term (minimum 2 week) detailed work schedule at each progress meeting.

46. Pre-Start Inspection

Prior to commencing work on-site, representatives of the Owner and Contractor will carry out a pre-start inspection to document the condition of the existing facility and equipment. The inspection should document any noticeable damage or deficiencies including but not limited to cracks, dents, leaks, or corrosion.

A copy of all photographs taken during the inspection will be provided to all parties.

47. Construction Staging

Upgrades to the Colborne Water Treatment Plant Electrical & SCADA System must be staged and coordinated to minimize interruptions in service (operation) of the water treatment plant and to ensure no interruptions in the supply of water to the distribution system.

Interruptions in treatment plant operation must be fully coordinated and approved by the Township and operating authority.

48. Relevant Ontario Provincial Standards & Other Standards

Portions of work to be performed under this Contract, are based on the requirements identified in published Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD). A copy of relevant OPSS's and OPSD's have not been included as part of the tender document. It will be the Contractor's responsibility to secure a copy of specific OPSS's identified herein.

The following list is not comprehensive of all standards required for the project.

- Environment Canada
- Transport Canada
- National Building Code
- Occupational Health and Safety Act
- Municipal by-laws and servicing standards
- Municipal Utilities
- Ontario Safe Drinking Water Act (SDWA)
- Ontario Building Code
- Technical Standards & Safety Authority (TSSA)
- The Energy Act – Provincial Hydro Electrical Safety Codes and Bulletins, CSA Certification Standards and Electrical Bulletins.
- Ontario Regulation made pursuant to the Power Corporation Act regarding the Electrical Safety Code.
- Environmental Protection Act
- Codes and Standards of the National Fire Protection Association
- Ontario Electrical Safety Code
- National Fire Protection Association (NFPA)
- National Sanitation Foundation (NSF)

Reference to the above OPSS's or OPSD's herein or on the Contract Drawings is considered to fully specify materials and construction methods for the identified items.

Reference to the above OPSS's or OPSD's should be understood to extend to the requirements for other relevant standards referenced therein.

**Township of Cramahe
Colborne Water Treatment Plant Electrical &
SCADA System Upgrades**

Contract No. 2025-01

General Conditions

General Conditions of the Stipulated Price Contract, Canadian Standard Construction Document CCDC-2 2008 Edition, except as amended under the Information to Bidders & Supplemental Requirements shall apply.

The above noted document is not included in these Tender Documents. It is the Bidder's responsibility to obtain a copy of the above the noted document (Canadian Standard Construction Document CCDC-2 2008 Edition)

Township of Cramahe
Colborne Water Treatment Plant Electrical & SCADA
System Upgrades
Contract No. 2025-01

Drawings

The following drawings shall constitute the Contract Drawings:

Electrical:

- E-0001 – Legend
- E-0002 – Site Layout
- E-0003 – Single Line Diagram (SLD) & MCC Demolition
- E-0004 – Main Plant Demolition
- E-0005 – Well #2 Pumphouse Demolition
- E-0006 – Single Line Diagram (SLD) & MCC Modification
- E-0007 – Main Plant MCC-1 Installation
- E-0008 – Well #2 Pumphouse Installation
- E-0009 – Well #2 Pump VFD Schematic

Instrumentation & Control (I&C):

- Colborne WTP PLC Control Panel (CP01), Sheets 1-17
- Colborne Standpipe PLC Control Panel (CP02), Sheets 1-7

STANDARD ABBREVIATIONS

A	AMPERES (CONTINUOUS)	L/S	LITRE PER SECOND
AC	ALTERNATING CURRENT	LS	LIMIT/LEVEL SWITCH
AF	AMPERE FRAME	MAN	MANUAL
ANF	DRY TYPE TRANSFORMER – FAN COOLED	MCC	MOTOR CONTROL CENTRE
ANN	DRY TYPE TRANSFORMER – NATURALLY COOLED OR ANNUNCIATOR	MCP	MOTOR CIRCUIT PROTECTOR
AS	AIR SUPPLY	mm	MILLIMETER
ASYM	ASYMMETRICAL	M.O.	MANUALLY OPERATED
AT	AMPERE TRIP	M/O/A	MANUAL–OFF–AUTOMATIC
ATS	AUTOTRANSFORMER REDUCED VOLTAGE STARTING OR AUTO TRANSFER SWITCH	MOT	MOTOR
AUTO	AUTOMATIC	MTD	MOUNTED
AWG	AMERICAN WIRE GAUGE	MTG	MOUNTING
BLDG	BUILDING	MTS	MANUAL TRANSFER SWITCH
BKR	BREAKER	N	NORTH OR NEUTRAL
°C	DEGREE CELSIUS	N/A	NON AUTOMATIC
C	CONDUCTOR	N.O.	NORMALLY OPEN/NUMBER
CCT	CIRCUIT	N.C.	NORMALLY CLOSED
CL	CENTERLINE	NP	NAMEPLATE
C/W	COMPLETE WITH	NPT	NATIONAL PIPE THREAD
CPT	CONTROL POWER TRANSFORMER	NTS	NOT TO SCALE
CR	CONTROL RELAY/CORROSION RESISTANT	OC	OVERCURRENT
CS	CONTROL SWITCH	OH	ONTARIO HYDRO OR OVERHEAT
CSA	CANADIAN STANDARDS ASSOCIATION	OL	OVERLOAD
CT	CURRENT TRANSFORMER	O/O/A	ON/OFF/AUTO
CTL	CONTROL	P	POLE
CTD	CURRENT TEST DEVICE	PB	PUSHBUTTON
CU	COPPER	PC	PHOTOCELL CONTROL
DC	DIRECT CURRENT	PCV	PRESSURE/PUMP CONTROL VALVE
D.O.	DRAW OUT	PH OR Ø	PHASE OR DIAMETER
DISC	DISCONNECT	P/I	PNEUMATIC–TO–CURRENT
DPDT	DOUBLE POLE DOUBLE THROW	PID	PROPORTIONAL–INTEGRAL–(RESET) DERIVATIVE (RATE)
DPST	DOUBLE POLE SINGLE THROW	P & ID	PROCESS AND INSTRUMENTATION DIAGRAM
EEMAC	ELECTRICAL AND ELECTRONIC MANUFACTURERS ASSOCIATION OF CANADA	PLC	PROGRAMMABLE LOGIC CONTROLLER
ELEC	ELECTRIC, ELECTRICAL	REM	REMOTE
ELR	END OF LINE RESISTOR	PNL	PANEL
ELU	EMERGENCY LIGHTING UNIT	RES	RESISTOR
EM	ENCLOSURE	RTD	RESISTANCE TEMPERATURE DETECTOR
ENCL	EARLY MAKE (CONTACTS)	RTU	REMOTE TERMINAL UNIT(PLC)
EO	ELECTRICALLY OPERATED	SEL	SELECTOR
EP	EXPLOSION PROOF	SV	SOLENOID VALVE
ESTOP	EMERGENCY STOP	S/C	SHORT CIRCUIT
ETM	ELAPSED TIME METER	SHLD	SHIELDED
FRE	FIBREGLASS REINF.EPOXY	SN	SOLID NEUTRAL
FVR	FULL VOLTAGE REVERSING	SPDT	SINGLE POLE DOUBLE THROW
FVNR	FULL VOLTAGE, NON–REVERSING	SPST	SINGLE POLE SINGLE THROW
GFI	GROUND FAULT INTERRUPTER	SS	SELECTOR SWITCH
GFR	GROUND FAULT CCT INTERRUPTING RECEPTACLE	SV	SOLENOID OPERATED VALVE (DIRECT OPERATED)
GND	GROUND	SW	SWITCH
H/O/A	HAND–OFF–AUTOMATIC	SYM	SYMMETRICAL
HP	HORSEPOWER	TC	SHUNT TRIP COIL or THERMOCOUPLE
HTR	HEATER	TDC	TIME DELAY ON CLOSING
Hz	HERTZ	TDDO	TIME DELAY ON DROP–OUT
IEEE	INSTITUTE OF ELECTRICAL & ELECTRONIC ENGINEERS	TDO	TIME DELAY ON OPENING
IND	INDICATION	TDPU	TIME DELAY ON PICK–UP
INST	INSTANTANEOUS	TEMP	TEMPERATURE
I/O	INPUT/OUTPUT	TERM	TERMINAL
I/P	CURRENT TO PNEUMATIC	TR	TIME RELAY
ISA	INSTRUMENT SOCIETY OF AMERICA	TYP	TYPICAL
JB	JUNCTION BOX	V	VOLT
KAIC	KILO–AMP INTERRUPTING CAPACITY	VA	VOLT–AMPERE
kVA	KILOVOLTAMPERE	VAC	VOLTS ALTERNATING CURRENT
kHz	KILOHERTZ	VDC	VOLTS DIRECT CURRENT
kW	KILOWATT	VFD	VARIABLE FREQUENCY DRIVE
kWh	KILOWATT HOUR	VT	VOLTAGE TRANSFORMER (FORMER PT)
LA	LIGHTNING ARRESTOR	VTD	VOLTAGE TEST DEVICE
LB	LATE BREAK (CONTACTS)	W	WIRE OR WATT
LOS	LOCK OUT STOP	WP	WEATHERPROOF
L/R	LOCAL–REMOTE	2S1W	TWO SPEED–ONE WINDING
		2S2W	TWO SPEED–TWO WINDING
		XFMR	TRANSFORMER

ELECTRICAL SYMBOLS LIGHTING & POWER LAYOUTS

	FIRE ALARM PULL STATION
	HUMIDISTAT
	THERMOSTAT
	ADJUSTABLE SPEED CONTROLLER
	SINGLE PHASE MOTOR STARTER WITH OVERLOAD
	SINGLE PHASE MOTOR STARTER WITH OVERLOAD AND PILOT LIGHT
	SELECTOR SWITCH
	DISCONNECT SWITCH ('X' DENOTES No. OF POLES)
	CONTROL PANEL (OR 'LP'–LOCAL PANEL)
	SINGLE POLE SWITCH (LETTER + NUMBER DENOTES CONNECTED TO PNL 'A' + CCT NUMBER '10')
	3 WAY SWITCH (3 WIRE)
	INTERMEDIATE SWITCH (4 WIRE)
	OCCUPANCY SENSOR (INFRARED MOTION)
	PHOTOCELL CONTROL
	SINGLE RECEPTACLE
	DUPLEX RECEPTACLE
	DUPLEX RECEPTACLE WEATHER PROTECTED
	DUPLEX RECEPTACLE (WEATHER AND CORROSION PROTECTED)
	THREE PHASE RECEPTACLE (FEMALE CONFIGURATION)
	DIRECT CONNECTION TO PACKAGE EQUIPMENT OR DEVICE
	CLOCK OUTLET
	20A–1P DUPLEX RECEPTACLE
	SPECIAL OUTLET AS NOTED
	COUNTER–TOP OR WORKBENCH HEIGHT DUPLEX RECEPTACLE
	COUNTER–TOP OR WORKBENCH HEIGHT SPLIT DUPLEX RECEPTACLE
	JUNCTION BOX (OR 'PB'–PULL BOX)
	HEAT DETECTOR ('X' DENOTES TAG No.)
	SMOKE DETECTOR ('X' DENOTES TAG No.)
	ELECTRICAL MOTOR
	SOLENOID
	MOTORIZED (EO) VALVE
	DIESEL–GENERATOR
	FIRE ALARM BELL
	PAGING LOUDSPEAKER
	CEILING MTD PAGING LOUDSPEAKER
	TELEPHONE OUTLET
	EMERGENCY LIGHTING UNIT,
	REMOTE ELU LAMPS (TWO LAMPS)
	REMOTE ELU LAMP (1 LAMP)
	CEILING OR WALL MOUNTED EXIT SIGN
	LIGHT FIXTURE TYPE 'F1' (TYPICAL) CONNECTED TO PNL 'A', CCT '10'
	LIGHT FIXTURE TYPE H1 (TYPICAL) CONNECTED TO PNL 'A', CCT '10'
	UNIT HEATER
	LIGHTING CONTROL PANEL
	TIME SURFACE PRIMER
	POWER MONITOR

ELECTRICAL SYMBOLS SINGLE LINE/ELEMENTARY CONTROL DIAGRAMS

	AMMETER SWITCH		TERMINAL BLOCK TO PLC
	VOLTMETER SWITCH		HVAC TERMINAL
	KEY INTERLOCK		TERMINAL BLOCK TO FIELD
	600V DRAWOUT AIR CIRCUIT BREAKER		TERMINAL BLOCK INSIDE MCC OR CONTROL PANEL
	CIRCUIT BREAKER, MOULDED CASE WITH THERMAL & MAGNETIC TRIPS		PLC INPUT/OUTPUT, 'di' DENOTES DISCRETE INPUT
	CIRCUIT BREAKER, MCP, MOULDED CASE WITH ADJUSTABLE 'MAGNETIC ONLY' TRIPS		CONTROL/SELECTOR SWITCH, 3 POSITION, TOP
	DRAWOUT CONNECTION		CONTROL/SELECTOR SWITCH, 2 POSITION, TOP
	CAPACITOR		CONTROL/SELECTOR SWITCH, 2 OR 3 POSITION, BOTTOM
	RESISTOR OR HEATER		PUSHBUTTON, N.O., MOMENTARY CONTACT
	FUSE		PUSHBUTTON, N.C., MOMENTARY CONTACT
	FUSED DISCONNECT SWITCH		PUSHBUTTON, MOMENTARY CONTACT, WITH N.O. & N.C. CONTACTS
	DISCONNECTING (ISOLATING) SWITCH		THERMOSTAT, NORMALLY OPENED, CLOSSES ABOVE 22°C
	LIGHTNING ARRESTER		THERMOSTAT, NORMALLY CLOSED, OPENS ABOVE 22°C
	SOLENOID		LEVEL SWITCH, CLOSSES ON HIGH LEVEL
	THERMAL OVERLOAD TRIP		LEVEL SWITCH, OPENS ON HIGH LEVEL
	BATTERY		PRESSURE SWITCH, OPENS ON HIGH PRESSURE
	CURRENT TRANSFORMER		PRESSURE SWITCH, CLOSSES ON HIGH PRESSURE
	ZERO SEQUENCE (GROUND) CURRENT TRANSFORMER		FLOW SWITCH, CLOSSES ON HIGH FLOW
	VOLTAGE TRANSFORMER		FLOW SWITCH, OPENS ON HIGH FLOW
	AUTOTRANSFORMER WITH TAPS		TIME DELAY ENABLE (TDE) CONTACT NORMALLY OPEN
	POWER OR DISTRIBUTION TRANSFORMER		TIME DELAY ENABLE (TDE) CONTACT NORMALLY CLOSE
	CONTROL POWER TRANSFORMER		TIME DELAY DISENABLE (TDDE) CONTACT NORMALLY OPEN
	REACTOR		TIME DELAY DISENABLE (TDDE) CONTACT NORMALLY CLOSE
	DUAL AMMETER, THERMAL DEMAND & INSTANTANEOUS		LIMIT/POSITION SWITCH, NORMALLY CLOSE
	VOLTMETER		LIMIT/POSITION SWITCH, NORMALLY OPEN
	POWER FACTOR METER		CONTACT NORMALLY OPENED
	KILOWATT METER		CONTACT NORMALLY CLOSED
	WATTMETER		INDICATING LIGHT, LETTER DENOTES LENS COLOUR
	POWER GENERATOR, OR DG–DIESEL GENERATOR, OR MG–MOBILE GENERATOR		PUSH TO TEST (P.T.T.) INDICATING LIGHT, LETTER DENOTES LENS COLOUR
	DELTA CONNECTION		CONTACTOR, CONTROL OR TIMING RELAY: MS – MOTOR STARTER/CONTACTOR CR – CONTROL RELAY TR – TIME DELAY RELAY (ON OR OFF TYPE AS INDICATED), No. – SEE 'DEVICE FUNCTION NUMBERS' FOR DESCRIPTION * – RELAY NUMBER
	STAR CONNECTED, GROUNDED		SURGE SUPPRESSOR
	SOLENOID		
	MOTOR		

GENERAL NOTES

1. THIS IS A GENERAL ELECTRICAL LEGEND SHEET. SOME DEVICES, SYMBOLS OR ABBREVIATIONS MAY NOT BE USED ON THIS PROJECT.

ELECTRICAL GROUNDING SYMBOLS

	GROUNDING ROD DIRECT BURIED
	GROUND ROD WITH INSPECTION BOX OR WELL
	GROUNDING CONDUCTOR CONCEALED, EMBEDED OR DIRECT BURIED
	SPLICE TO TAP CONNECTION
	GRADIENT CONTROL MAT
	CONDUIT TRADE SIZE
	CONDUCTOR SIZE AWG OR MCM
	NUMBER OF CONDUCTORS

SEAL:



For Revision 1 Only



150 COMMERCE VALLEY DR. W. THORNHILL, ONTARIO, L3T 7Z3
PHONE: 905-882-1100 EMERGENCY ON-CALL: 416-332-9600
WWW.WSP.COM

NO	REVISION	DRAWN	CHECKED	APPROVED	DATE
0	95% DESIGN DRAFT	W.M.	F.J.	E.S.	FEB. 2025
1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025



TOWNSHIP OF CRAMAHE

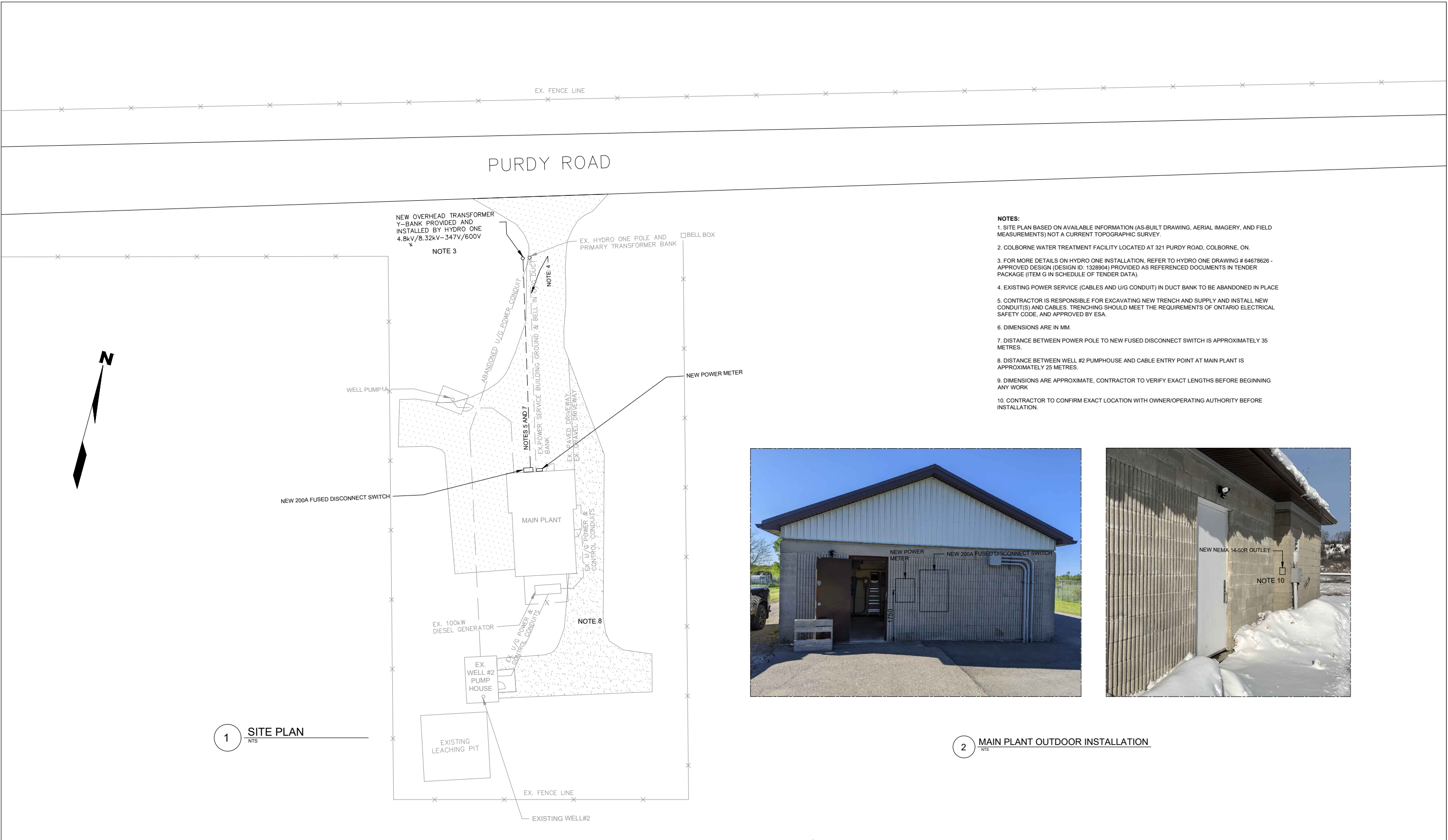
PROJECT:
TOWN OF COLBORNE WTP
MCC AND SCADA SYSTEM
UPGRADES

PROJECT NUMBER:
CA0042058.3870

COLBORNE WTP

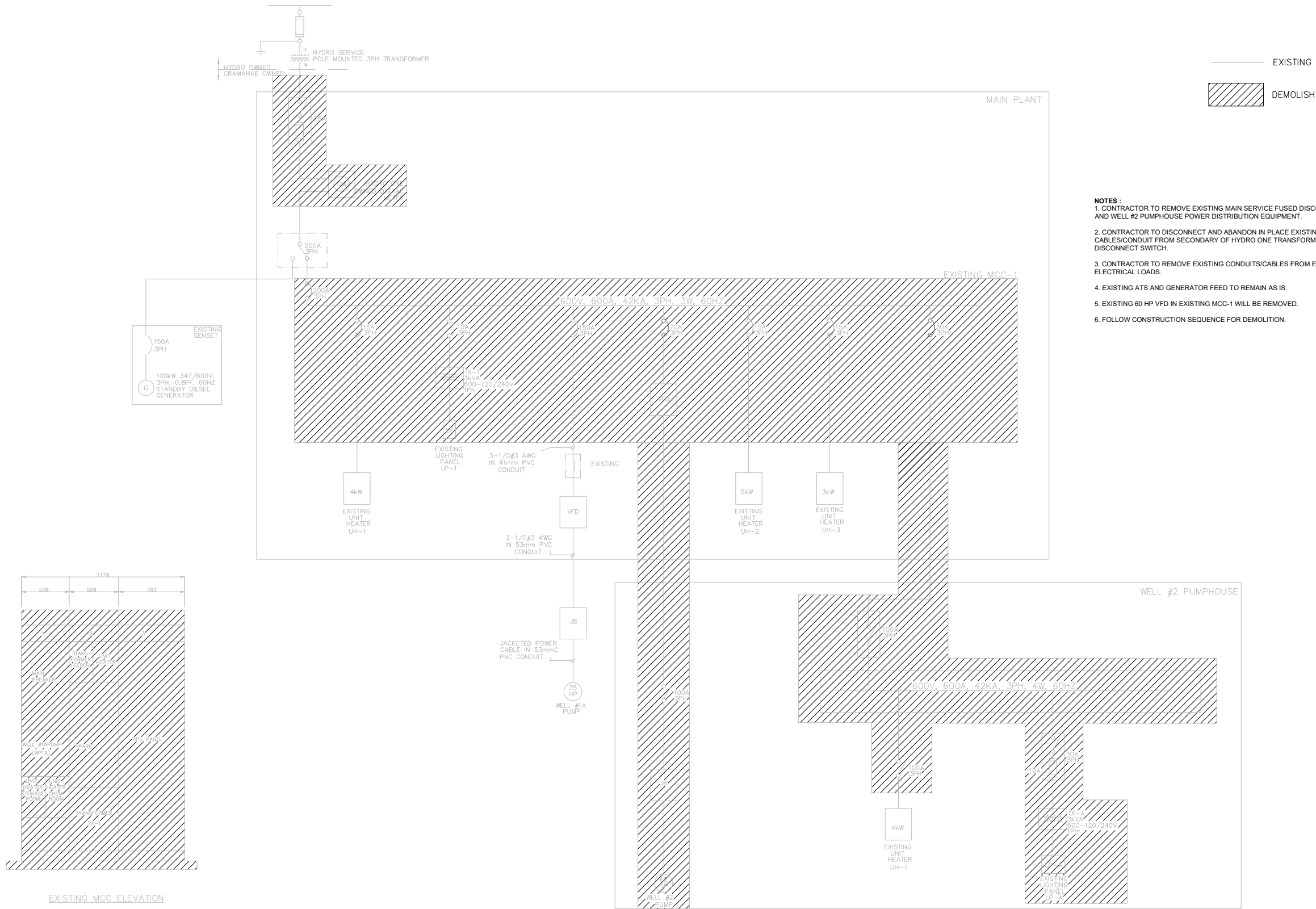
LEGEND

DISCIPLINE:	DWG NUMBER:	REV
ELECTRICAL	E-0001	1



- NOTES:**
1. SITE PLAN BASED ON AVAILABLE INFORMATION (AS-BUILT DRAWING, AERIAL IMAGERY, AND FIELD MEASUREMENTS) NOT A CURRENT TOPOGRAPHIC SURVEY.
 2. COLBORNE WATER TREATMENT FACILITY LOCATED AT 321 PURDY ROAD, COLBORNE, ON.
 3. FOR MORE DETAILS ON HYDRO ONE INSTALLATION, REFER TO HYDRO ONE DRAWING # 64678626 - APPROVED DESIGN (DESIGN ID: 1328904) PROVIDED AS REFERENCED DOCUMENTS IN TENDER PACKAGE (ITEM G IN SCHEDULE OF TENDER DATA).
 4. EXISTING POWER SERVICE (CABLES AND U/G CONDUIT) IN DUCT BANK TO BE ABANDONED IN PLACE
 5. CONTRACTOR IS RESPONSIBLE FOR EXCAVATING NEW TRENCH AND SUPPLY AND INSTALL NEW CONDUIT(S) AND CABLES. TRENCHING SHOULD MEET THE REQUIREMENTS OF ONTARIO ELECTRICAL SAFETY CODE, AND APPROVED BY ESA.
 6. DIMENSIONS ARE IN MM.
 7. DISTANCE BETWEEN POWER POLE TO NEW FUSED DISCONNECT SWITCH IS APPROXIMATELY 35 METRES.
 8. DISTANCE BETWEEN WELL #2 PUMPHOUSE AND CABLE ENTRY POINT AT MAIN PLANT IS APPROXIMATELY 25 METRES.
 9. DIMENSIONS ARE APPROXIMATE, CONTRACTOR TO VERIFY EXACT LENGTHS BEFORE BEGINNING ANY WORK
 10. CONTRACTOR TO CONFIRM EXACT LOCATION WITH OWNER/OPERATING AUTHORITY BEFORE INSTALLATION.

SEAL:	 150 COMMERCE VALLEY DR. W, THORNHILL, ONTARIO, L3T 7Z3 PHONE: 905-882-1100 EMERGENCY ON-CALL: 416-332-9600 WWW.WSP.COM	NO	REVISION	DRAWN	CHECKED	APPROVED	DATE	CLIENT:  TOWNSHIP OF CRAMAHE	PROJECT: TOWN OF COLBORNE WTP MCC AND SCADA SYSTEM UPGRADES PROJECT NUMBER: CA0042058.3870	COLBORNE WTP		
		0	95% DESIGN DRAFT	W.M.	F.J.	E.S.	FEB. 2025			SITE LAYOUT		
		1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025			DISCIPLINE:	DWG NUMBER:	REV
										ELECTRICAL	E-0002	1



SEAL:

LICENSED PROFESSIONAL ENGINEER
F. JAMSHIDI NAGHANI
100650187
PROVINCE OF ONTARIO

2025-03-12

For Revision 1 Only

wsp

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NO	REVISION	DRAWN	CHECKED	APPROVED	DATE
0	95% DESIGN DRAFT	W.M.	F.J.	E.S.	FEB. 2025
1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025

CLIENT:

CRAMAHE

TOWNSHIP OF CRAMAHE

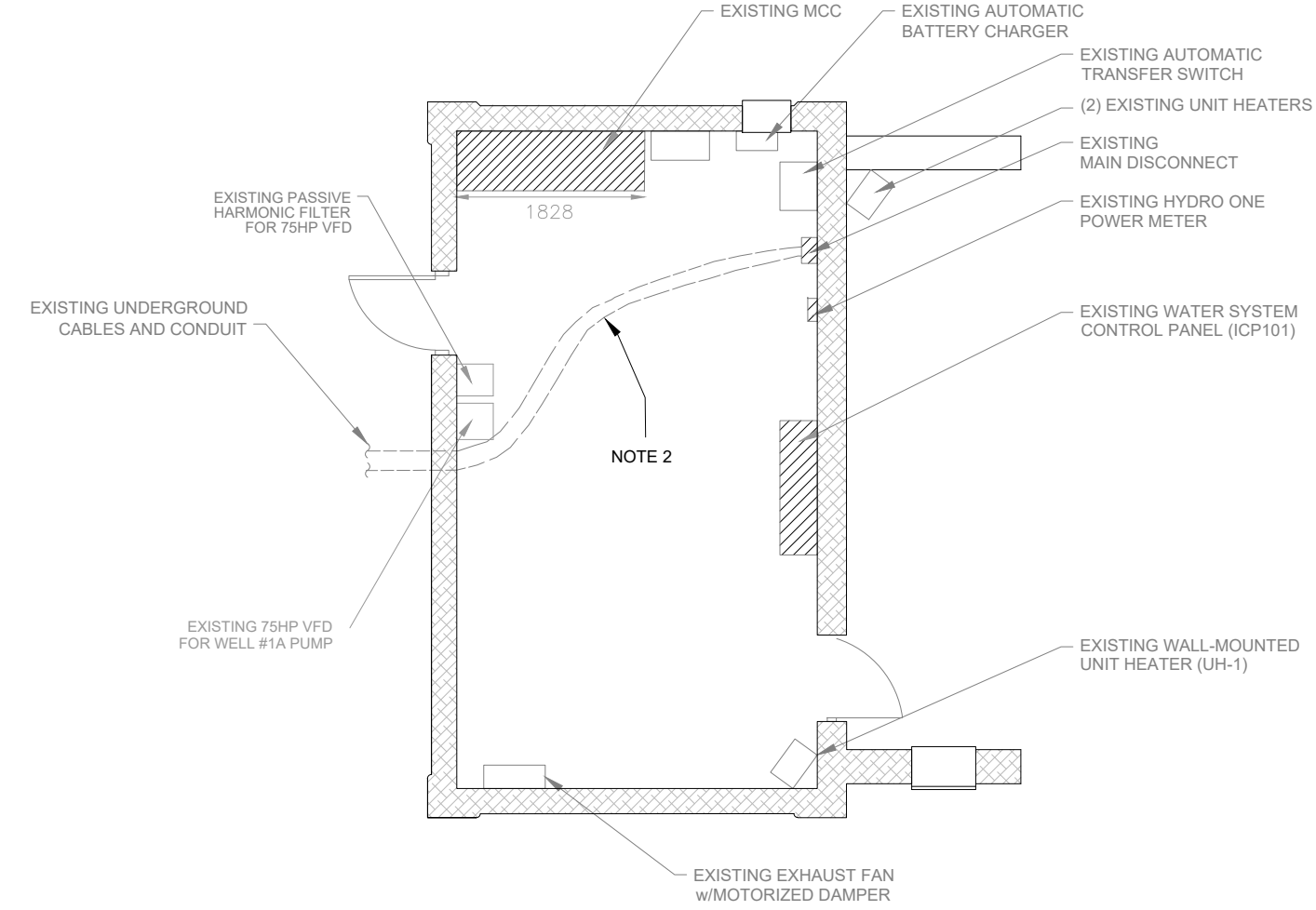
PROJECT:

TOWN OF COLBORNE WTP
MCC AND SCADA SYSTEM
UPGRADES

PROJECT NUMBER:
CA0042058.3870

COLBORNE WTP		
SINGLE LINE DIAGRAM (SLD) & MCC DEMOLITION		
DISCIPLINE:	DWG NUMBER:	REV
ELECTRICAL	E-0003	1

- NOTES:**
- 1. EXISTING MCC, EXISTING FUSED DISCONNECT SWITCH, AND EXISTING CONTROL PANEL TO BE DEMOLISHED. EXISTING POWER METER TO BE REMOVED BY HYDRO ONE.
 - 2. CONTRACTOR TO DISCONNECT MAIN FEEDER CABLE FROM BOTH ENDS AND ABANDON CABLES AND CONDUIT IN PLACE.
 - 3. CONTRACTOR TO REMOVE WATER SYSTEM CONTROL PANEL. WATER SYSTEM CONTROL PANEL SHOULD REMAIN IN SERVICE UNTIL NEW PLC CONTROL PANEL HAS BEEN INSTALLED AND COMMISSIONED IN SECTION 3F OF NEW MCC-1.
 - 4. CONTRACTOR TO RELOCATE TO A SPOT TEMPORARILY TO ACCOMMODATE MCC INSTALLATION, AND TO BE RELOCATED TO NEW PLC CONTROL PANEL SECTION 3F IN THE NEW MCC-1 PANEL.
 - 5. DIMENSIONS ARE IN MM.
 - 6. DIMENSIONS ARE AN ESTIMATE, CONTRACTOR TO VERIFY ALL DIMENSIONS IN THE FIELD.



1 GROUND FLOOR PLAN - DEMOLITION
NTS



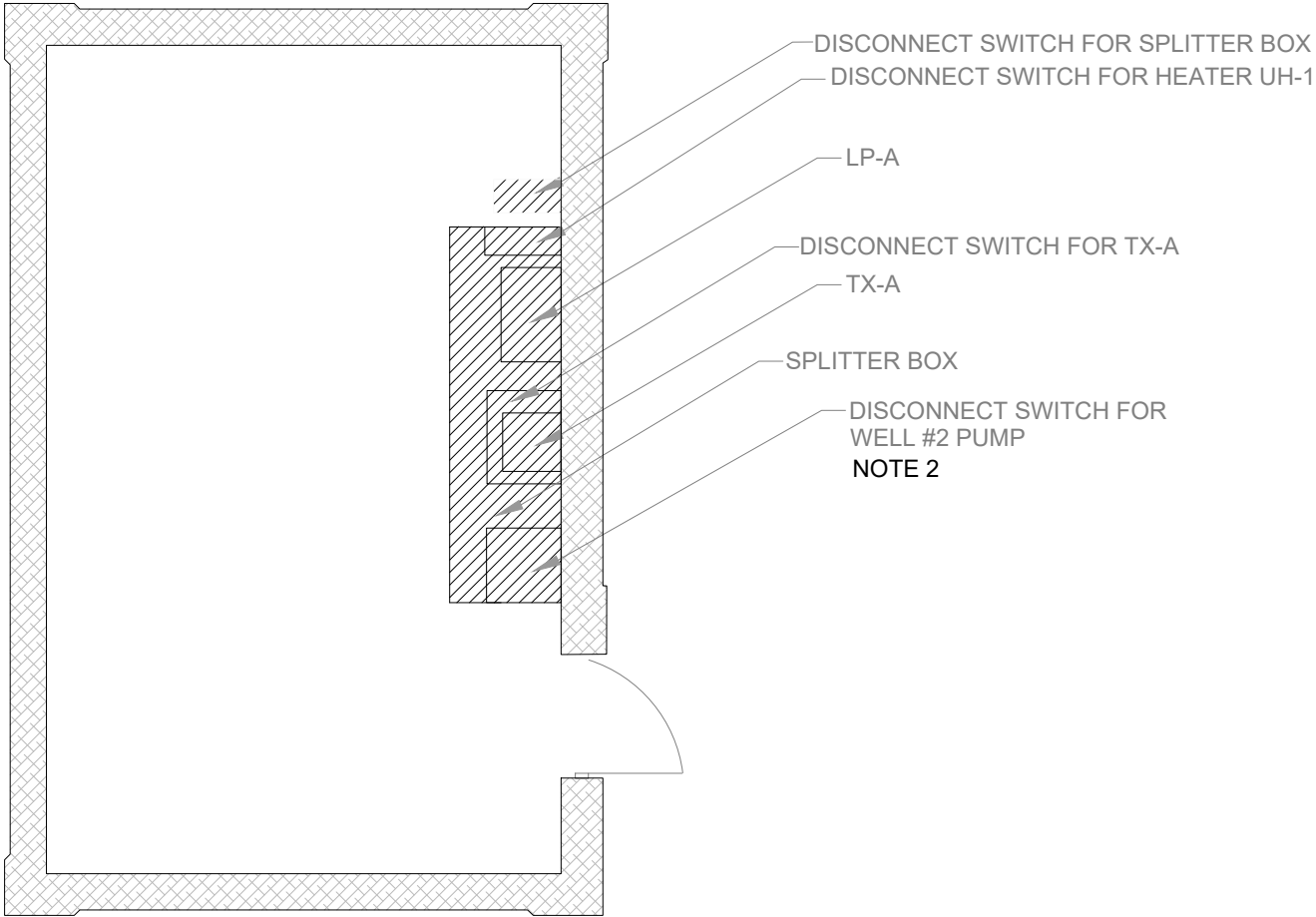
2 FRONT VIEW OF EXISTING DISCONNECT SWITCH AND POWER METER DEMOLITION



3 FRONT VIEW OF EXISTING MCC - DEMOLITION

SEAL:	 For Revision 1 Only	 150 COMMERCE VALLEY DR. W. THORNHILL, ONTARIO, L3T 7Z3 PHONE: 905-882-1100 EMERGENCY ON-CALL: 416-332-9600 WWW.WSP.COM	NO	REVISION	DRAWN	CHECKED	APPROVED	DATE	CLIENT:  TOWNSHIP OF CRAMAHE	PROJECT: TOWN OF COLBORNE WTP MCC AND SCADA SYSTEM UPGRADES PROJECT NUMBER: CA0042058.3870	COLBORNE WTP		
			0	95% DESIGN DRAFT	W.M.	F.J.	E.S.	FEB. 2025			MAIN PLANT DEMOLITION		
			1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025			DISCIPLINE:	DWG NUMBER:	REV
											ELECTRICAL	E-0004	1

NOTES:
1. CONTRACTOR TO REMOVE EXISTING EQUIPMENT AS INDICATED; KEEP CONDUIT/CABLES FOR NEW LIKE-FOR-LIKE INSTALLATIONS.
2. CONTRACTOR TO DEMOLISH 100A FUSED DISCONNECT SWITCH AND ASSOCIATED CONDUITS PERMANENTLY.



1 GROUND FLOOR PLAN - DEMOLITION
NTS
NOTE 1



2 FRONT VIEW OF EQUIPMENT DEMOLITION

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ONTARIO, L3T 7Z3
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NO	REVISION	DRAWN	CHECKED	APPROVED	DATE
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1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025

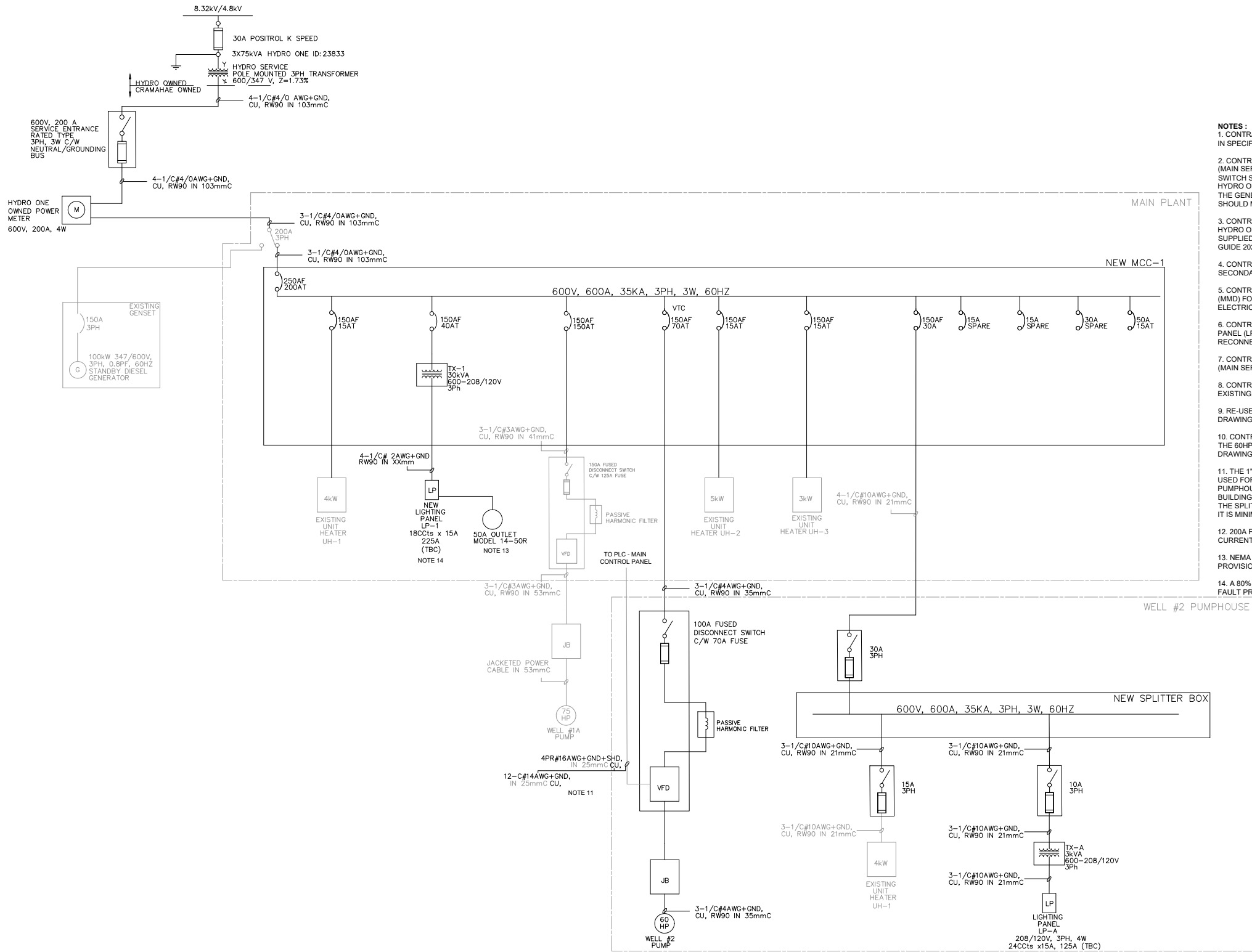
CLIENT:

CRAMAHE
TOWNSHIP OF CRAMAHE

PROJECT:
TOWN OF COLBORNE WTP
MCC AND SCADA SYSTEM
UPGRADES

PROJECT NUMBER:
CA0042058.3870

COLBORNE WTP		
WELL #2 PUMPHOUSE DEMOLITION		
DISCIPLINE: ELECTRICAL	DWG NUMBER: E-0005	REV 1



- NOTES :**
1. CONTRACTOR TO DEVELOP SEQUENCE OF CONSTRUCTION FOLLOWING THE GUIDELINE PROVIDED IN SPECIFICATION SECTION 01010.
 2. CONTRACTOR TO SUPPLY AND INSTALL NEW 600V, 200A, 4W FUSED DISCONNECT SWITCH (FDS) (MAIN SERVICE) BESIDE THE NEW OUTDOOR METERING ENCLOSURE. THE NEW FUSED DISCONNECT SWITCH SHOULD COMPLY WITH THE REQUIREMENTS OF OESC/ESA SECTION 84 AND ADDITIONAL HYDRO ONE REQUIREMENTS TO ENSURE A SAFE AND RELIABLE MEANS OF ELECTRICALLY ISOLATING THE GENERATION OR LOAD FACILITY FROM HYDRO ONE'S DISTRIBUTION SYSTEM. THE INSTALLATION SHOULD MEET THE REQUIREMENTS OF ONTARIO ELECTRICAL SAFETY CODE, AND APPROVED BY ESA.
 3. CONTRACTOR TO SUPPLY AND INSTALL THE NEMA 3R 16S METER BASE PER THE REQUIREMENTS OF HYDRO ONE AND INSTALL OUTDOOR BESIDE THE MAIN BUILDING DOOR. NEW POWER METER TO BE SUPPLIED BY HYDRO ONE. FOR MORE DETAILS, PLEASE REFER TO "HYDRO ONE RETAIL METERING GUIDE 2024 - PAGE 25 FOR OUTDOOR ENCLOSURE".
 4. CONTRACTOR TO SUPPLY AND INSTALL NEW UNDERGROUND INCOMING FEEDER CABLE FROM SECONDARY POLE MOUNT HYDRO TRANSFORMERS TO NEW MAIN FUSED DISCONNECT SWITCH.
 5. CONTRACTOR IS RESPONSIBLE FOR SUPPLYING AND INSTALLING MAIN METERING DISTRIBUTION (MMD) FOR THE POWER METER. THE INSTALLATION SHOULD MEET THE REQUIREMENTS OF ONTARIO ELECTRICAL SAFETY CODE, AND APPROVED BY ESA.
 6. CONTRACTOR TO SUPPLY AND INSTALL NEW 600V, 600A, 3PH, 3W MCC (MCC-1) AND NEW LIGHTING PANEL (LP-1) AS SHOWN IN THIS DRAWING IN MAIN PLANT. CONTRACTOR TO REROUTE AND RECONNECT EXISTING LOAD FEEDERS TO NEW MCC-1 AND LIGHTING PANEL LP-1.
 7. CONTRACTOR TO SUPPLY AND INSTALL NEW CABLE(S)/CONDUIT(S) FROM NEW DISCONNECT SWITCH (MAIN SERVICE) TO THE NEW POWER METER, AND MCC-1 TO EXISTING ATS.
 8. CONTRACTOR TO SUPPLY AND INSTALL ALL REQUIRED CONDUITS AND CABLES FROM NEW MCC-1 TO EXISTING ELECTRICAL LOADS.
 9. RE-USE THE EXISTING CONDUITS WHERE THEIR SIZES MEET OR EXCEED THE SIZES SHOWN IN THIS DRAWING.
 10. CONTRACTOR TO SUPPLY AND INSTALL A NEW 60HP VFD, A NEW PASSIVE HARMONIC FILTER (FOR THE 60HP VFD), A NEW LIGHTING PANEL (LP-A), AND A NEW TRANSFORMER (TX-A) AS SHOWN IN DRAWING IN WELL #2 PUMPHOUSE.
 11. THE 1" POWER CONDUIT (CURRENTLY USED FOR THE VFD POWER CABLE) WILL BE RELEASED AND USED FOR THE CONTROL CABLES BETWEEN THE MAIN PLANT BUILDING AND NEW VFD IN WELL #2 PUMPHOUSE. CONTRACTOR TO USE THE EXISTING POWER CONDUIT BETWEEN THE MAIN PLANT BUILDING AND WELL #2 PUMPHOUSE (THAT HAS 1 X 10AWG CABLE, CURRENTLY USED FOR FEEDING THE SPLITTER BOX) FOR THE NEW POWER CONDUCTORS FOR THE VFD AND SPLITTER BOX PROVIDED IT IS MINIMUM 1 1/4" (35MM) DIA TO MEET CEC.
 12. 200A FUSED DISCONNECT SWITCH IS NOT INTENDED TO BE MANUALLY OPERATED UNDER LOAD CURRENT.
 13. NEMA 14-50R 240V AC RECEPTACLE SUITABLE FOR OUTDOOR INSTALLATION COMES WITH PROVISION FOR PADLOCK.
 14. A 80% RATED TYPE 60A CB IN THE LIGHTING PANEL (LP-1) SHOULD BE EQUIPPED WITH GROUND FAULT PROTECTION.

SEAL:



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1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025

CLIENT:



TOWNSHIP OF CRAMAHE

PROJECT:

TOWN OF COLBORNE WTP
MCC AND SCADA SYSTEM
UPGRADES

PROJECT NUMBER:

CA0042058.3870

COLBORNE WTP

SINGLE LINE DIAGRAM AND MCC - MODIFICATION

DISCIPLINE:

ELECTRICAL

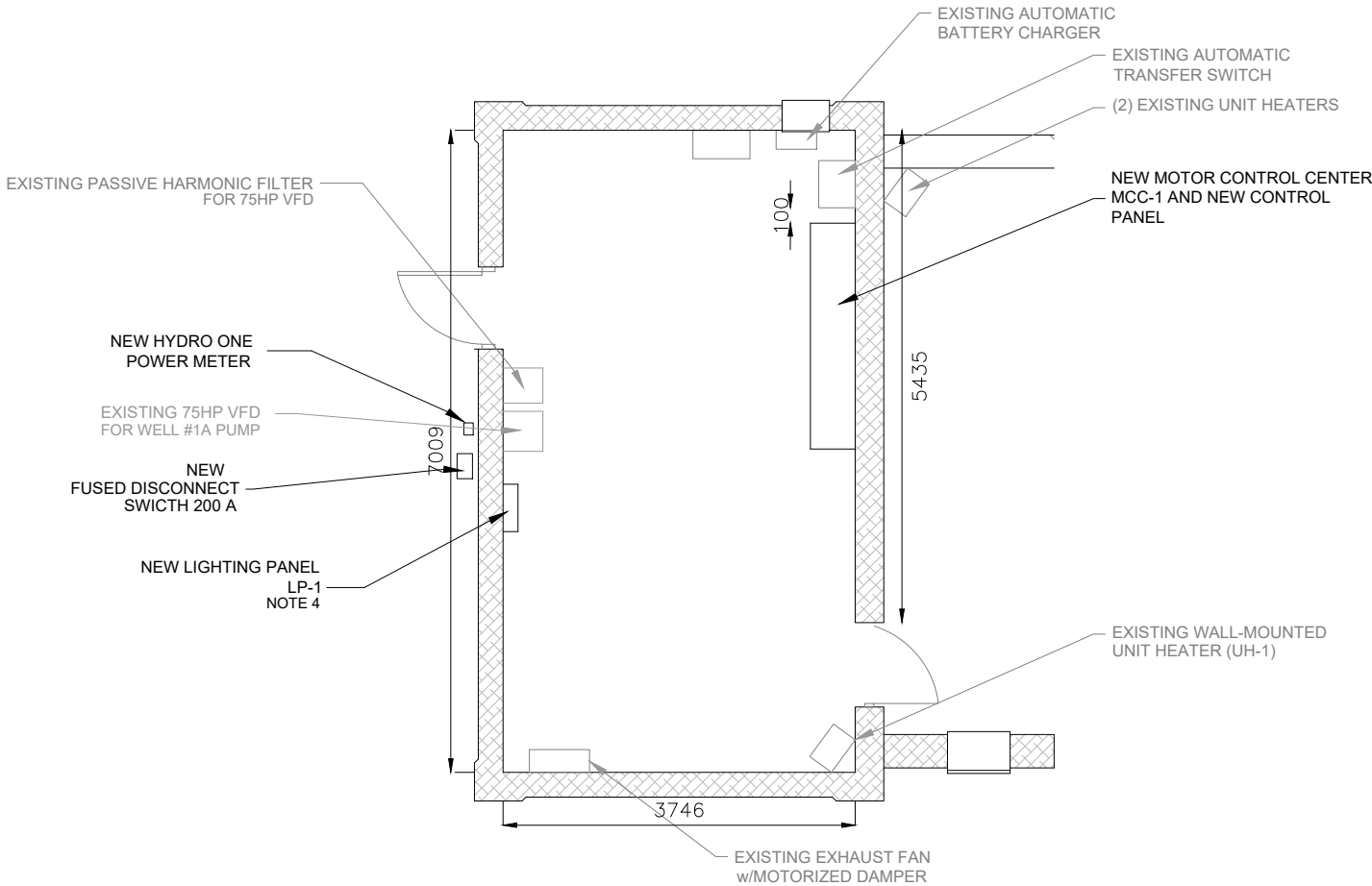
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E-0006

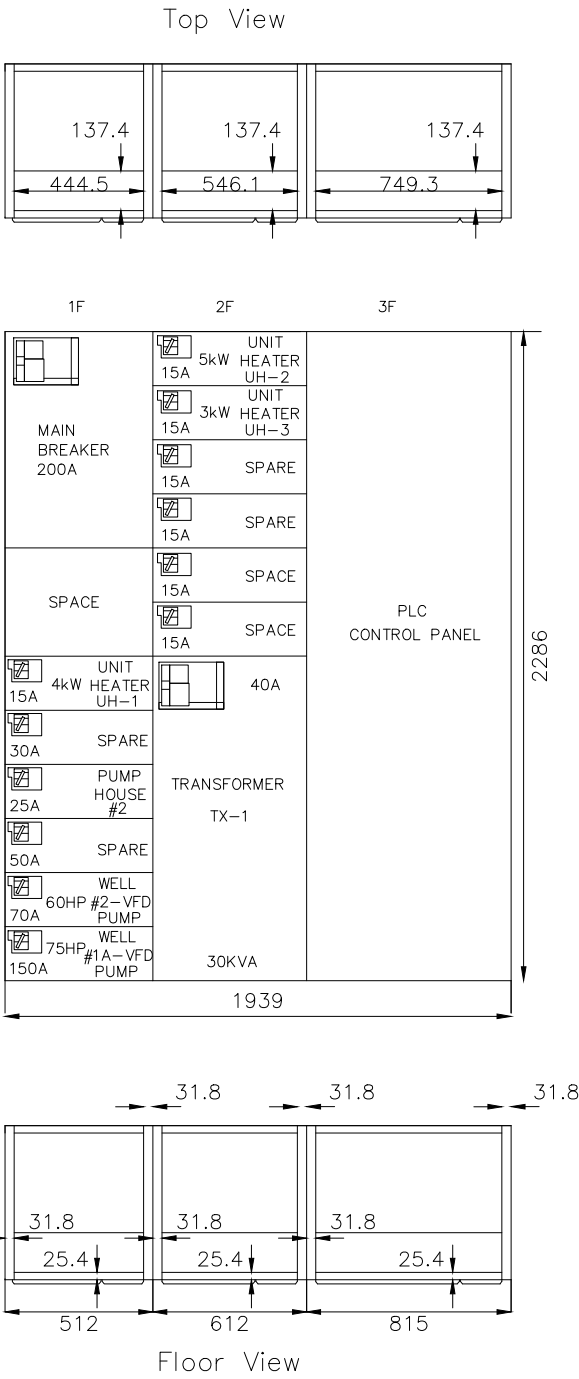
REV

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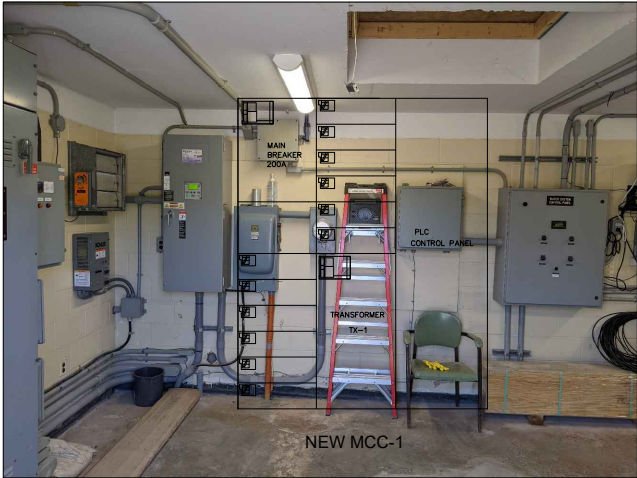
- NOTES:**
1. DIMENSIONS ARE IN MM. APPROXIMATE ROOM HEIGHT IS 2413 MM.
 2. DIMENSIONS ARE AN ESTIMATE, CONTRACTOR TO VERIFY ALL DIMENSIONS IN THE FIELD.
 3. NEW MCC-1 WILL BE INSTALLED IN THE LOCATION OF THE EXISTING FDS, AND POWER METER ONCE REMOVED.
 4. DIMENSIONS FOR LP-1 APPROXIMATELY 915H X 508W X 150D. FOR MORE DETAILS, PLEASE REFER TO SINGLE LINE DRAWING E-0006.
 5. THE LOCATION OF THE ELECTRICAL EQUIPMENT ARE APPROXIMATE, CONTRACTOR TO FIND BEST LOCATION.



1 **GROUND FLOOR PLAN**
NTS



2 **MCC ELEVATION**
NTS



3 **FRONT VIEW OF MCC-1 INSTALLATION LOCATION**
NTS
NOTE 4



4 **FRONT VIEW OF LP-1 INSTALLATION LOCATION**
NTS

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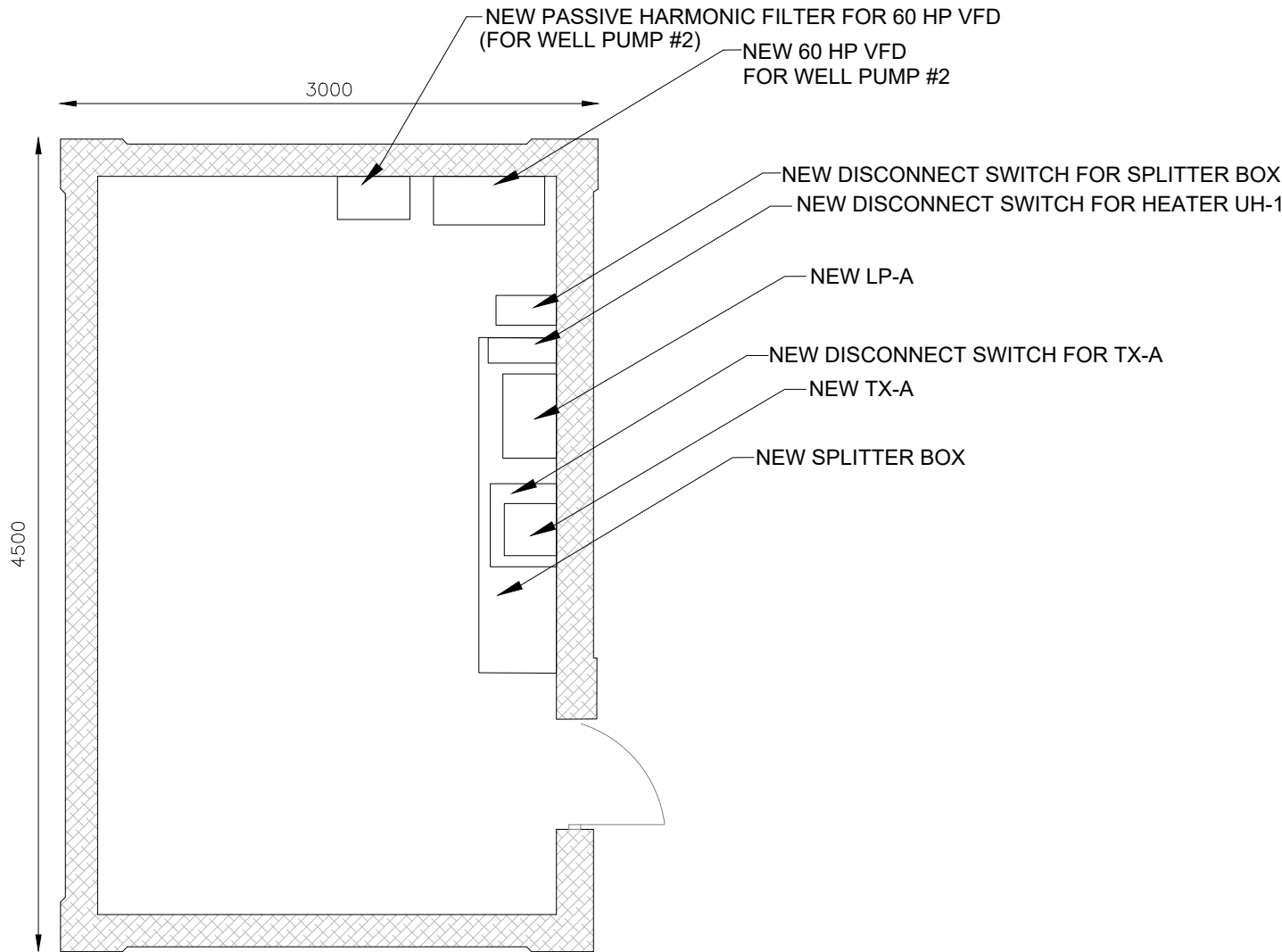
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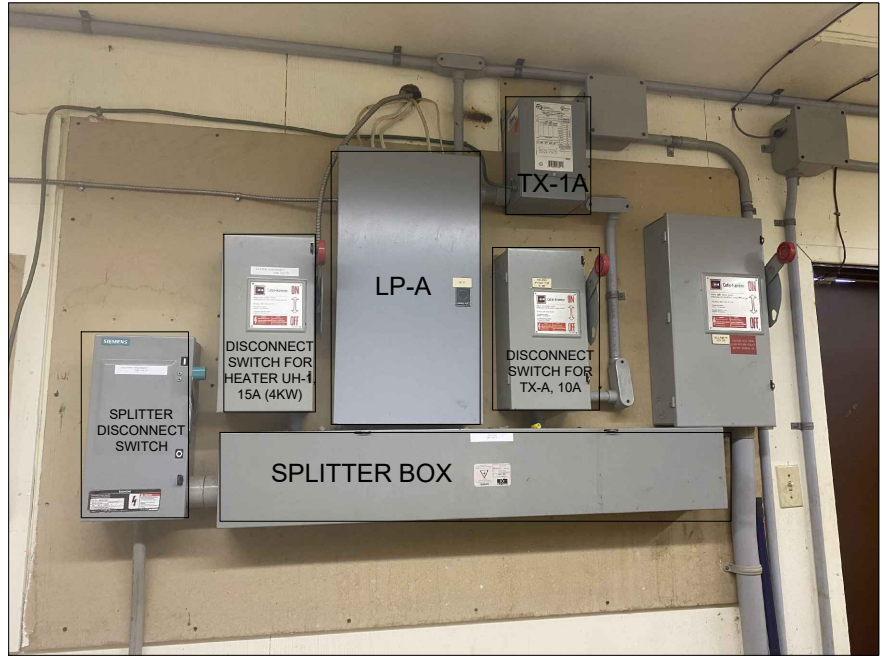
PROJECT: TOWN OF COLBORNE WTP
MCC AND SCADA SYSTEM
UPGRADES
PROJECT NUMBER: CA0042058.3870

COLBORNE WTP		
MAIN PLANT MCC-1 INSTALLATION		
DISCIPLINE:	DWG NUMBER:	REV
ELECTRICAL	E-0007	1

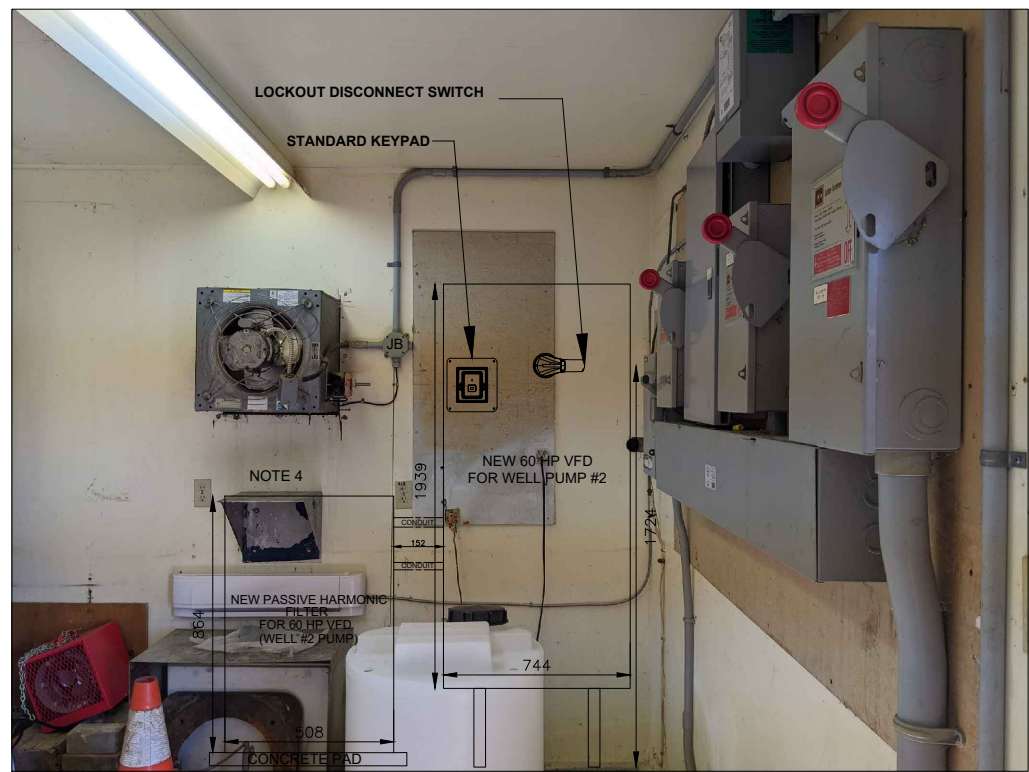
- NOTES:**
- 1. DIMENSIONS ARE IN MM.
 - 2. DIMENSIONS ARE AN ESTIMATE, CONTRACTOR TO VERIFY ALL DIMENSIONS IN THE FIELD.
 - 3. ELECTRICAL EQUIPMENT SHOULD BE REPLACED LIKE-FOR-LIKE, EXCEPT FOR TX-A AND LP-A WHICH WILL BE CHANGED. REFER TO DRAWING E-0006 FOR MORE DETAILS.
 - 4. CONTRACTOR TO RELOCATE IRRELEVANT EQUIPMENT OUT OF THE WAY FOR INSTALLATION OF THE 60 HP VFD FOR WELL PUMP #2 AND THE PASSIVE HARMONIC FILTER FOR 60 HP VFD (WELL PUMP #2).



1 GROUND FLOOR PLAN - INSTALLATION

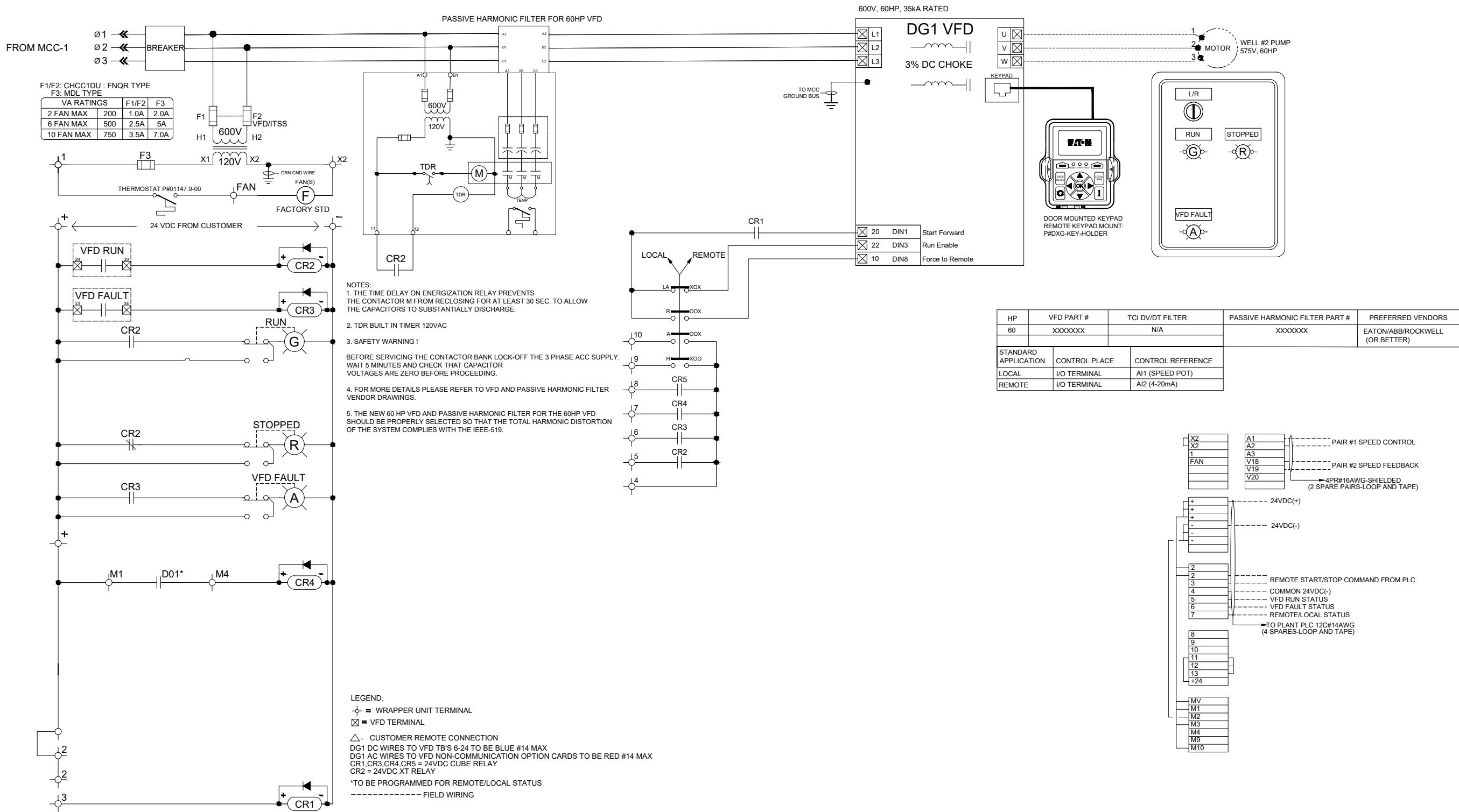


2 FRONT VIEW OF EQUIPMENT INSTALLATION



3 FRONT VIEW OF VFD INSTALLATION

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		0	95% DESIGN DRAFT	W.M.	F.J.	E.S.	FEB. 2025			WELL #2 PUMPHOUSE INSTALLATION		
		1	ISSUED FOR TENDER	W.M.	F.J.	E.S.	MAR. 2025			DISCIPLINE:	DWG NUMBER:	REV
										ELECTRICAL	E-0008	1



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TOWNSHIP OF CRAMAHE

PROJECT:

TOWN OF COLBORNE WTP
MCC AND SCADA SYSTEM
UPGRADES

PROJECT NUMBER:

CA0042058.3870

COLBORNE WTP

WELL #2 PUMP VFD SCHEMATIC

DISCIPLINE:

ELECTRICAL

DWG NUMBER:

E-0009

REV

1

TOWN OF COLBORNE	
WATER TREATMENT PLANT PLC CONTROL PANEL	
DRAWING NUMBER	DESCRIPTION
CP01–INDEX	DRAWING INDEX
CP01–B01	BILL OF MATERIALS
CP01–A01	PANEL LAYOUT
CP01–A02	PANEL BACKPLATE LAYOUT
CP01–C01	COMMUNICATION
CP01–E01	POWER SCHEMATICS 1
CP01–E02	POWER SCHEMATICS 2
CP01–E03	SLOT 05 DIGITAL INPUTS MODULE
CP01–E04	SLOT 06 DIGITAL INPUTS MODULE
CP01–E05	SLOT 07 DIGITAL INPUTS MODULE
CP01–E06	SLOT 08 DIGITAL INPUTS MODULE
CP01–E07	SLOT 09 DIGITAL OUTPUTS MODULE
CP01–E08	SLOT 10 DIGITAL OUTPUTS MODULE
CP01–E09	SLOT 01 ANALOG INPUTS MODULE
CP01–E10	SLOT 02 ANALOG INPUTS MODULE
CP01–E11	SLOT 03 ANALOG OUTPUTS MODULE
CP01–E12	SLOT 04 ANALOG OUTPUTS MODULE

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3					
4					



CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne WTP PLC Control Panel

DRAWING INDEX

SHEET 1 of 17	DWG CP01-INDEX	REV 2

Item	Qty.	Manufacturer	Part No.	Description
1	1			72" X 29" BACKPLATE
2				
3				
4A	1	EATON	PSX1500	1500VA, 5-15P INPUT, OUTPUT 6, 120V
4B	1	EATON	RELAY-MS	EATON UPS RELAY CARD
5	1	HONEYWELL	T498B	HEAT THERMOSTAT, 120/208/240V
6	4	ALLEN BRADLEY	1769-IA16	INPUT MODULE, COMPACTLOGIX, AC DIGITAL, 16 POINT, 79-132VAC
7	2	ALLEN BRADLEY	1769-OW16	OUTPUT MODULE, COMPACTLOGIX, RELAY DIGITAL, 16 CONTACTS AT 2.5 A RELAY OUTPUT, 16 POINT
8	2	ALLEN BRADLEY	1769-IF8	INPUT MODULE, COMPACTLOGIX, ANALOG, 8 POINT, 8 SINGLE-ENDED POINT INPUT
9	2	ALLEN BRADLEY	1769-OF8C	OUTPUT MODULE, COMPACTLOGIX, ANALOG, 8 POINT, CURRENT ONLY
10	1	ALLEN BRADLEY	1769-L33ER	CONTROLLER, COMPACTLOGIX, 2MB MEMORY
11	1	ALLEN BRADLEY	1769-PA4	POWER SUPPLY, COMPACTLOGIX,AC,85-132VAC
12	1	ALLEN BRADLEY	1769-ECR	COMPACTLOGIX END CAP
13	3	SCHNEIDER	M9F42115	MINIATURE CIRCUIT BREAKER, 1P, 15A, C CURVE, 14kA(UL489)
14	2	SCHNEIDER	M9F22101	MINIATURE CIRCUIT BREAKER, 1P, 1A, C CURVE, 14kA(UL1077)
15	1	SCHNEIDER	M9F22115	MINIATURE CIRCUIT BREAKER, 1P, 15A, C CURVE, 14kA(UL1077)
16	2	SCHNEIDER	M9F42110	MINIATURE CIRCUIT BREAKER, 1P, 10A, C CURVE, 14kA(UL489)
17	1	SCHNEIDER	M9F22102	MINIATURE CIRCUIT BREAKER, 1P, 2A, C CURVE, 14kA(UL1077)
18	1	SCHNEIDER	M9F22104	MINIATURE CIRCUIT BREAKER, 1P, 4A, C CURVE, 14kA(UL1077)
19	1	ALLEN BRADLEY	1606-XLS240E	POWER SUPPLY, 240W, 24VDC
20	16	PHOENIX CONTACT	3046032	FUSED TERMIANL BLOCK, 500V, 6.3A SCREW CONNECTION
21	1	TPS	TK-LT120-15ADIN2	SURGE PROTECTIVE DEVICE, 20kA PER PHASE, 15A, 120VAC, C/W COMPONENT LEVEL FUSING.
22	88	PHOENIX CONTACT	3044636	DOUBLE-LEVEL TERMINAL BLOCK, 500V, 24A, SCREW CONNECTION
23	5	PHOENIX CONTACT	3044102	FEED-THROUGH TERMINAL BLOCK, 1000V, 32A, SCREW CONNECTION
24	1	HAMMOND	FLK10LED	LED LIGHT KIT 26" 9.8 WATTS, 525 LUMENS LIGHT LED
25	1	HAMMOND	FLKDS	REMOTE DOOR SWITCH DOOR
27A	1	ALLEN BRADLEY	700-HRV52TA17	DIN RAIL MOUNT TIMING RELAY
27B	1	ALLEN BRADLEY	700-HN100	RELAY SOCKET,8-PIN, RELAY BASE
28	1	ALLEN BRADLEY	100-C23D200	100-C CONTACTOR, 4-POLE CONTACTOR 23AMPS, 110VAC 50Hz, 120VAC 60Hz LINE SIDE, 2 NO 2 NC
29A	16	ALLEN BRADLEY	700-HK32Z24-3-4	GENERAL PURPOSE SLIM RELAY, 8A, 24VDC
29B	16	ALLEN BRADLEY	700-HN222	SCREW RELAY SOCKET, 8-BLADE SOCKET
30	2	PHOENIX CONTACT	3044131	1000V, 41A FEED-THROUGH, SCREW CONNECTION
31	1	PHOENIX CONTACT	3044157	GROUND TERMINAL
32	AR	PANADUIT	F2X4LG6	2" WIRING DUCT
33	AR	PANADUIT	C2LG6	2" DUCT COVER
34	AR	PANADUIT	F3X4LG6	3" WIRING DUCT
35	AR	PANADUIT	C3LG6	3" DUCT COVER
36	1			RADIO RECEIVER SUPPLIED BY OTHERS
37	32	PHOENIX CONTACT	3214259	MUTLI-LEVEL TERMINAL BLOCK, 19A
38	32	PHOENIX CONTACT	3214301	UT 2,5-PE/L/L MULTI-LEVEL TERMINAL BLOCK WITH GROUND
39	1	ILSCO	N-174AS	GROUND BAR
40	2	HUBBELL	5352W	RECEPTACLE, DUPLEX 20A
41	3	IBERVILLE	BC1110	UTILITY BOX
42	1	HUBBELL	CR5252IG	ORANGE, DUPLEX RECEPTACLE, 15A
43	1	RACO	C10-S-020-1450ET	RACO CATALYST ETHERNET I/P AUTODIALER WITH ADAPTER
44	22	PHOENIX CONTACT	3022218	END BRCKT RAIL GRY
45	2	WEIDMULLER	1335150000	DIN RAIL/POWER RAIL
46	1	SCHNEIDER	M9F22105	MINIATURE CIRCUIT BREAKER, 1P, 5A, C CURVE, 14kA(UL1077)

SEAL



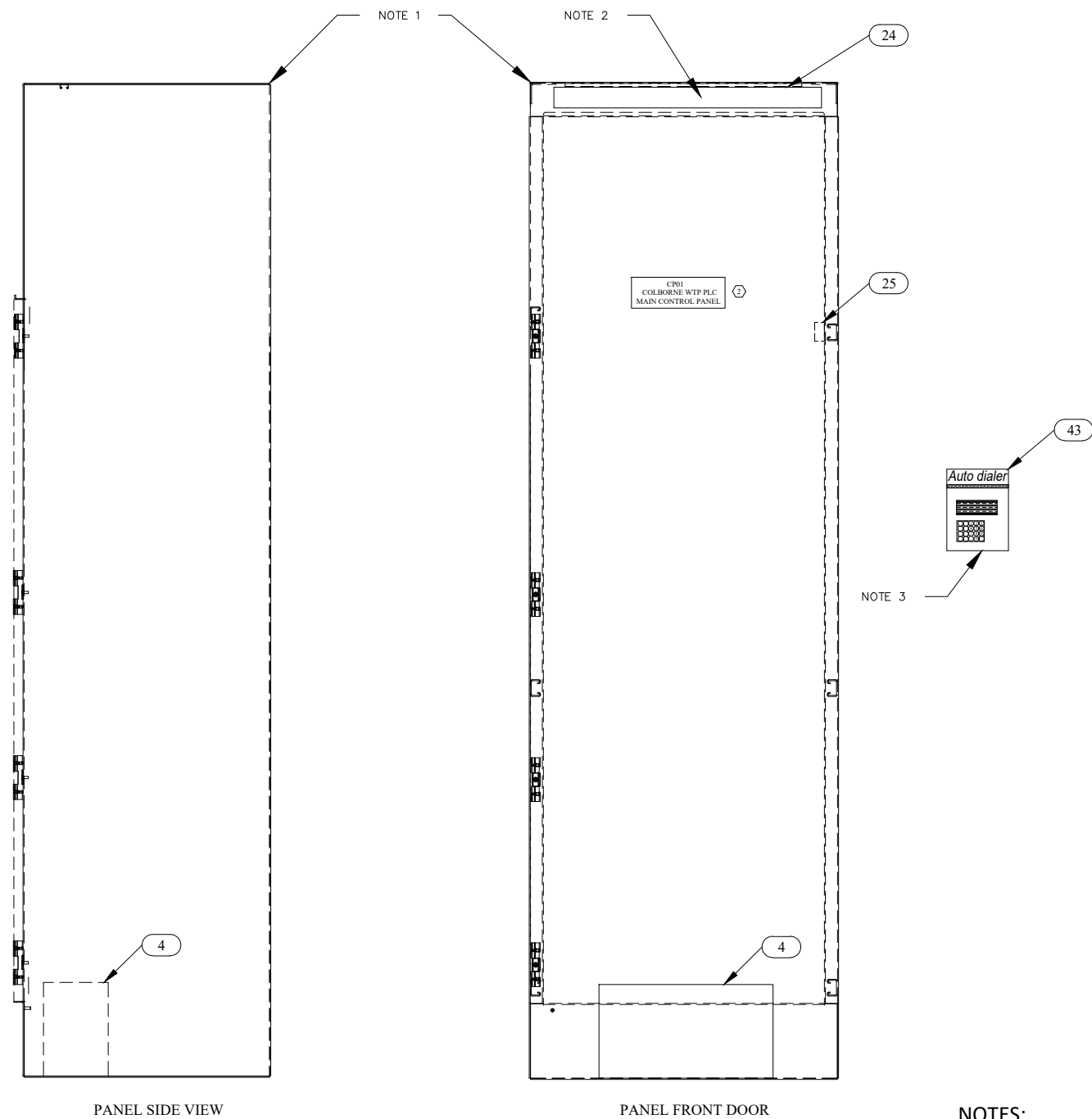
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3					
4					



CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne WTP PLC Control Panel

BILL OF MATERIAL

SHEET 2 of 17	DWG CP01-B01	REV 2



- NOTES:
- 1. PANEL SUPPLIED BY MCC VENDOR.
 - 2. PANEL LIGHT AND DOOR SWITCHES TO BE FIELD INSTALLED BY CONTRACTOR.
 - 3. CONTRACTOR TO MOUNT AUTODIALER ON THE WALL. EXACT LOCATION TO BE CONFIRMED CONTRACT ADMINISTRATOR/OPERATING AUTHORITY BEFORE INSTALLATION.

SEAL



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3					
4					



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Township of Cramahe

CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne WTP PLC Control Panel

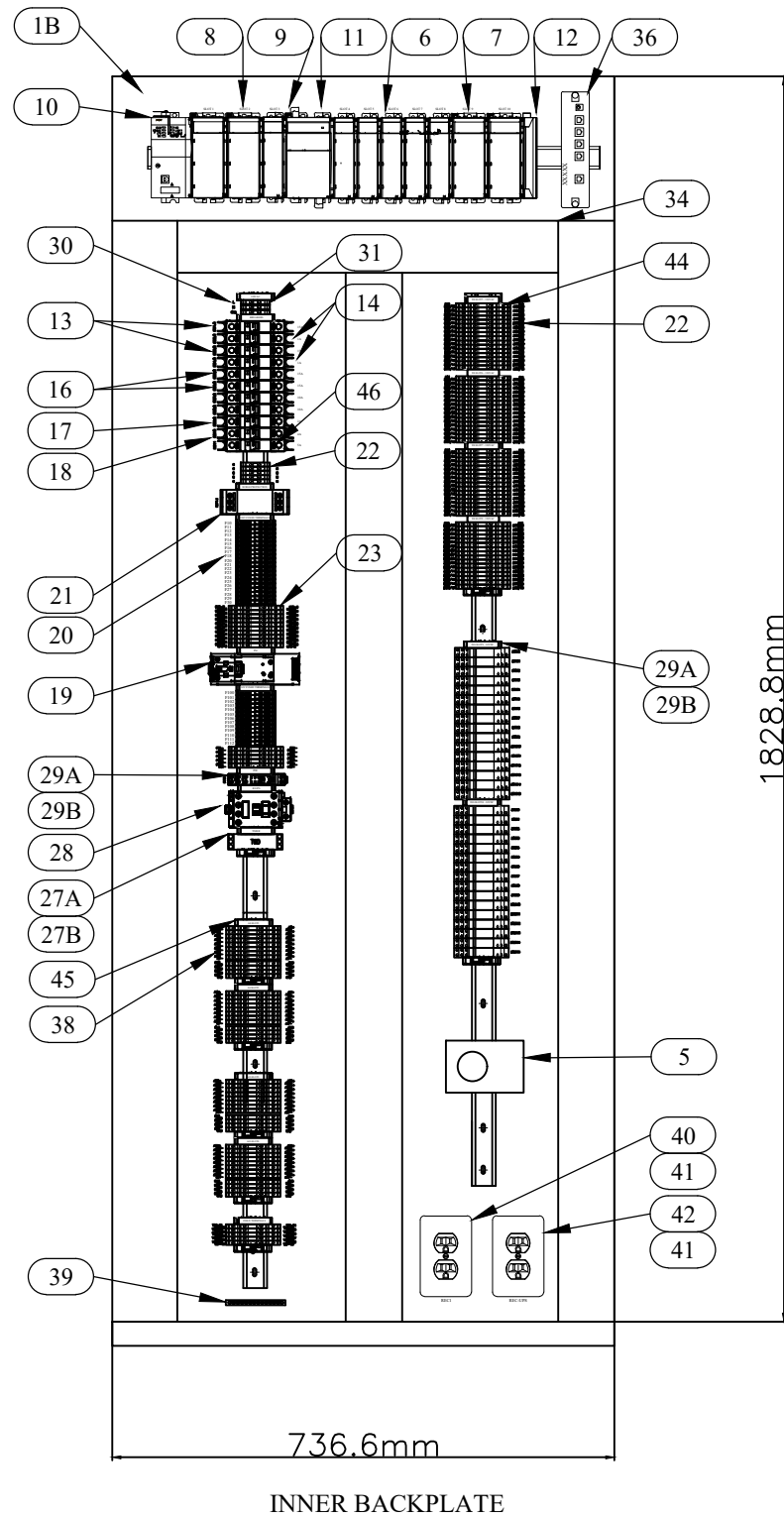
MAIN CONTROL PANEL

SHEET
3 of 17

DWG

CP01-A01

REV
2



- NOTES:
- BACKPLATE TO BE MOUNTED IN MCC RIGHTMOST SECTION AS PER ELECTRICAL DRAWING E-0007, MAIN PLANT MCC-1 INSTALLATION.

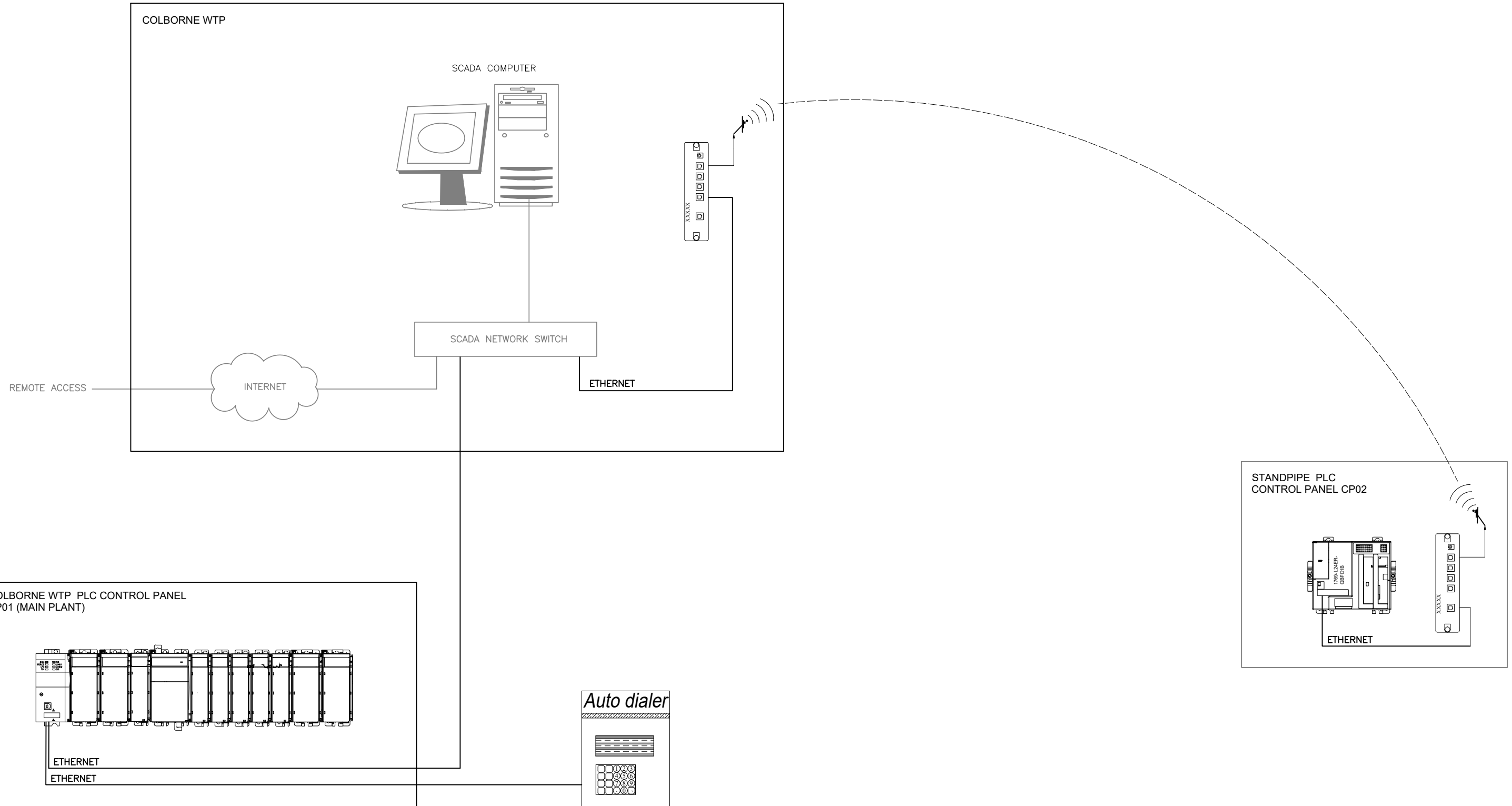
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3					
4					



CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades Colborne WTP PLC Control Panel		
MAIN PANEL BACKPLATE LAYOUT		
SHEET 4 of 17	DWG CP01-A02	REV 2

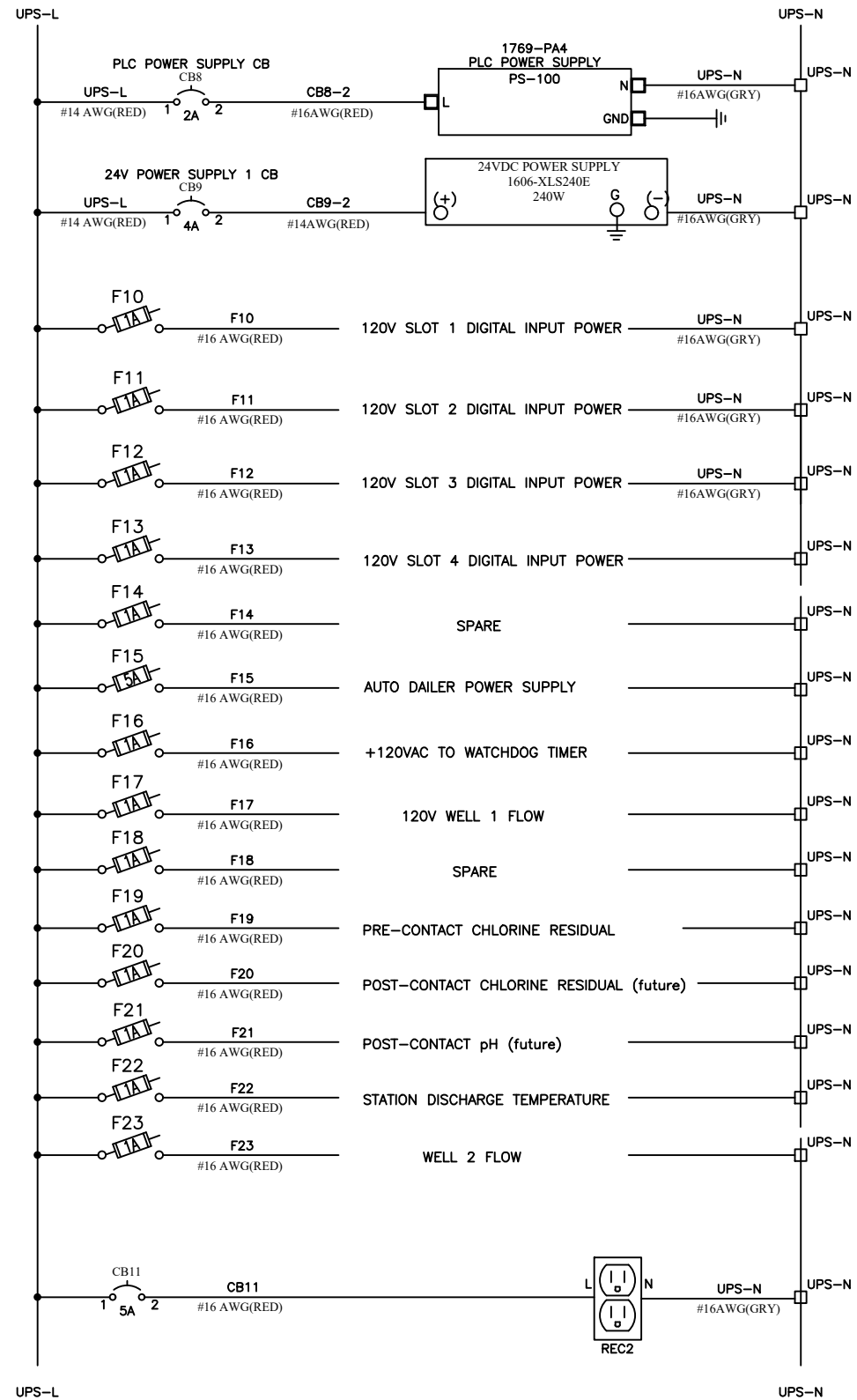
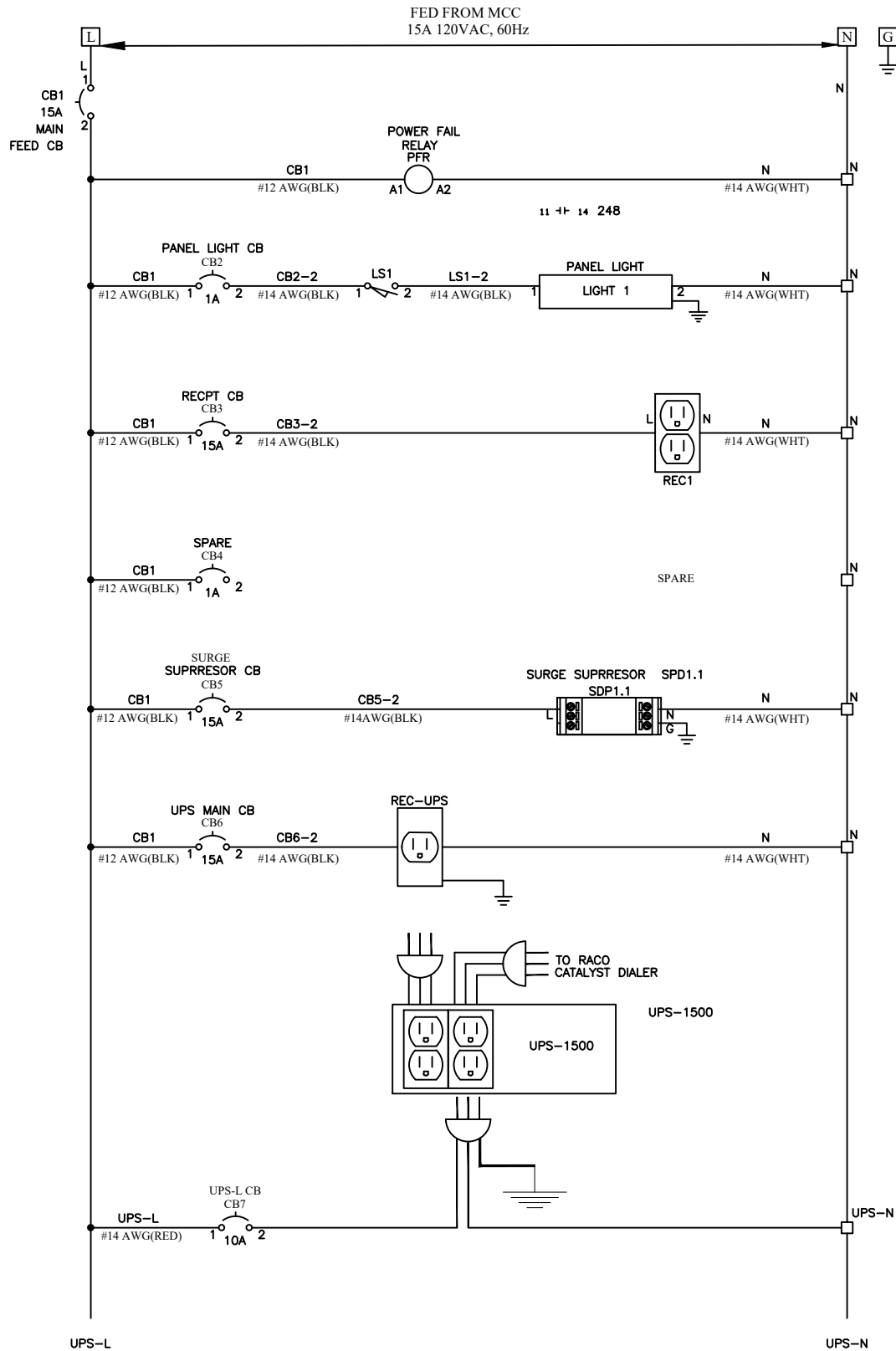


LEGEND:

NEW _____

EXISTING _____

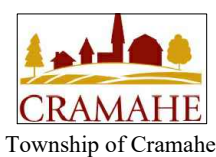
- NOTES:
- 1. CONTRACTOR TO CONFIRM ANTENNA LOCATIONS WITH CONTRACT ADMINISTRATOR BEFORE INSTALLATION.
 - 2. CONTRACTOR TO CONFIRM CONNECTIONS TO WTP NETWORK SWITCH WITH CONTRACT ADMINISTRATOR.



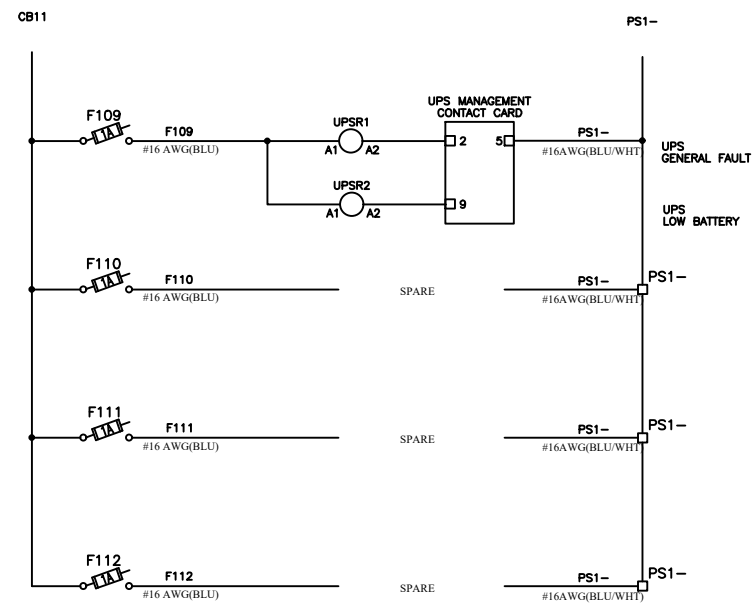
SEAL

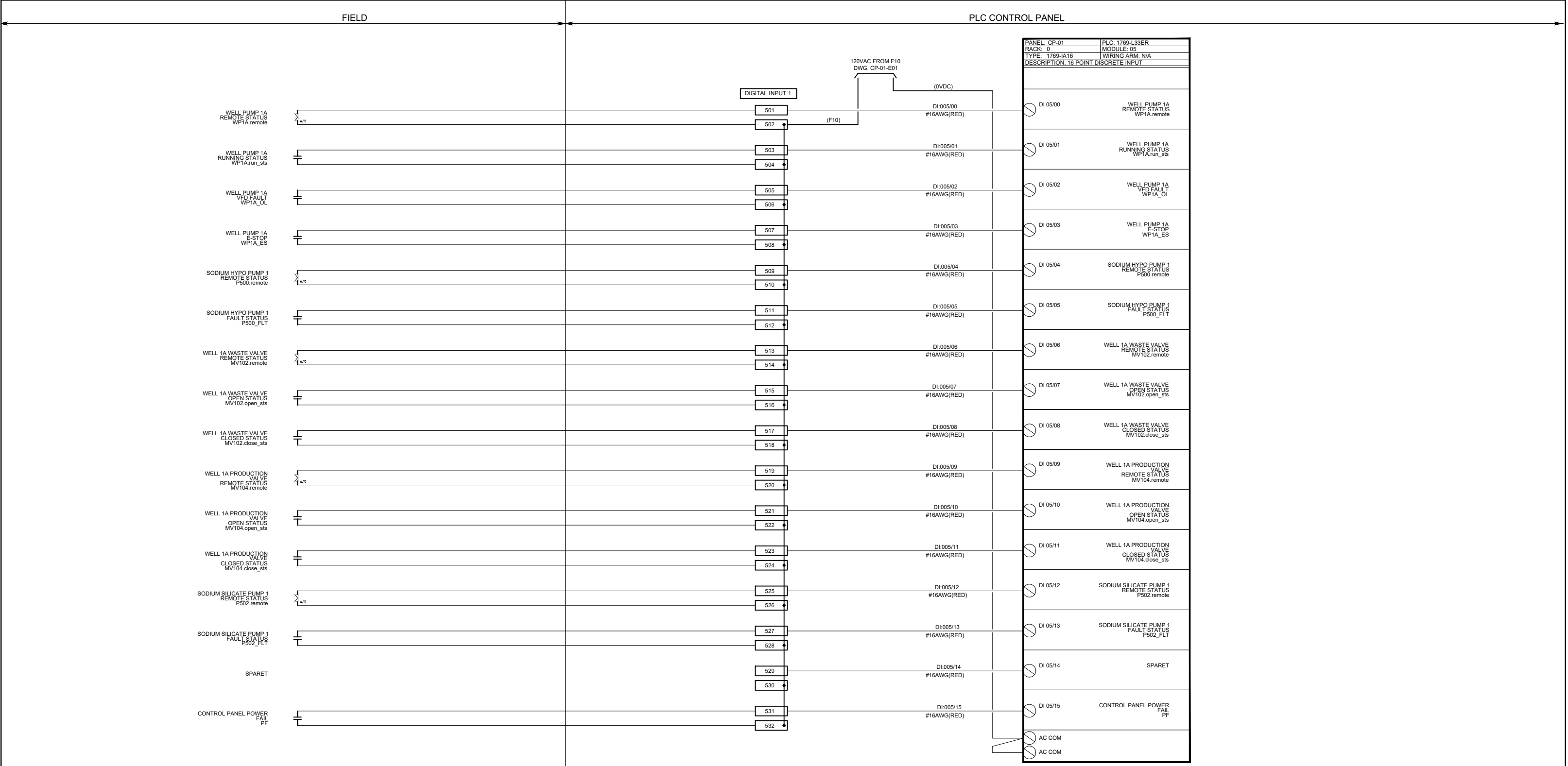


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CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades Colborne WTP PLC Control Panel			
POWER SCHEMATICS 1			
SHEET 6 of 17	DWG CP01-E01	REV 2	





SEAL



NO	REVISION	DRAWN	CHECKED	APPROVED	DATE
0	60% DESIGN DRAFT	S.M.	M.S.	E.S.	JAN. 2025
1	95% DESIGN DRAFT	S.M.	M.S.	E.S.	FEB. 2025
2	ISSUED FOR TENDER	S.M.	M.S.	E.S.	MAR. 2025
3					
4					



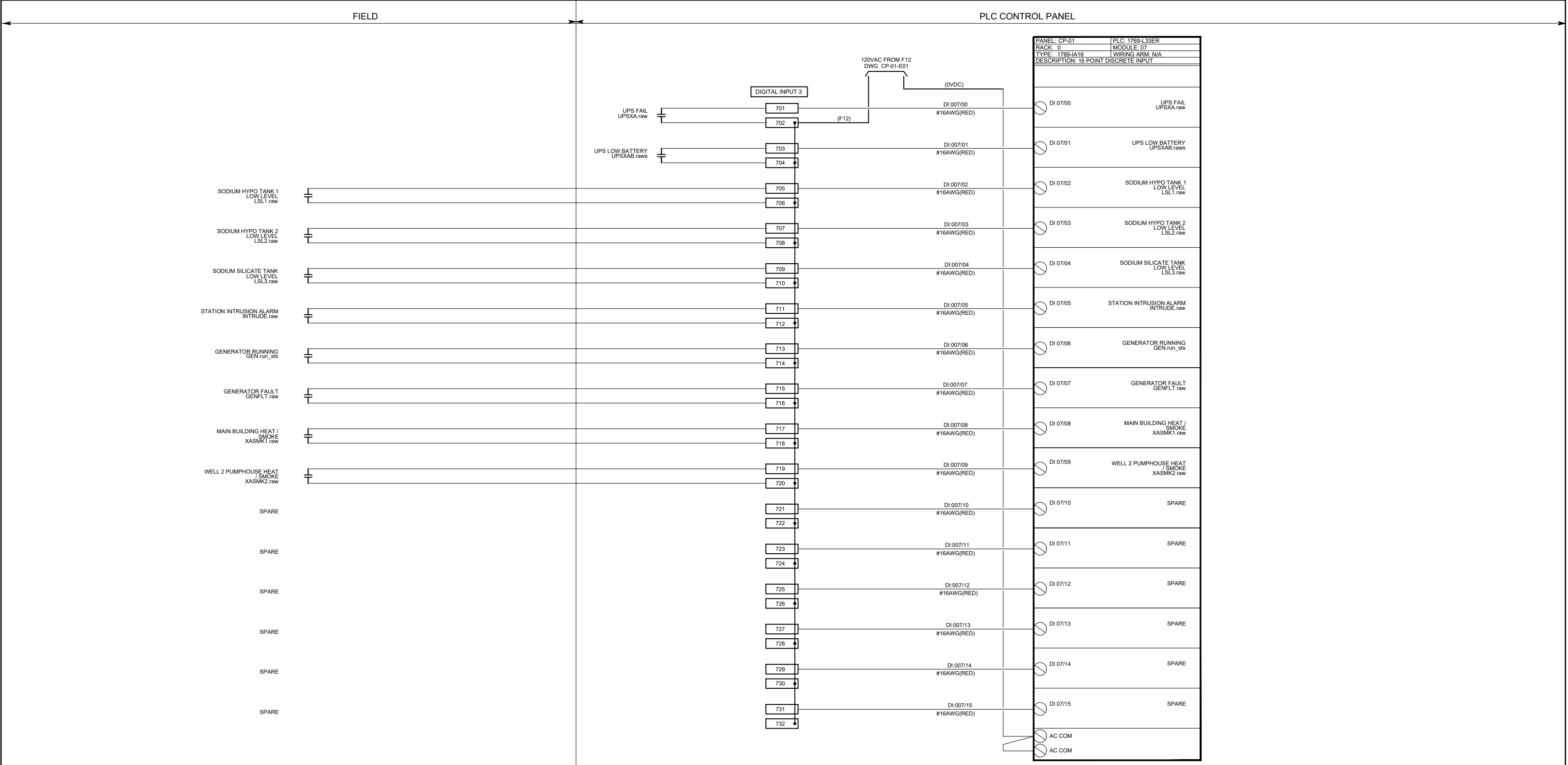
CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne WTP PLC Control Panel

SLOT 05 DIGITAL INPUT MODULE

SHEET
8 of 17

DWG
CP01-E03

REV
2



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Township of Cramahe

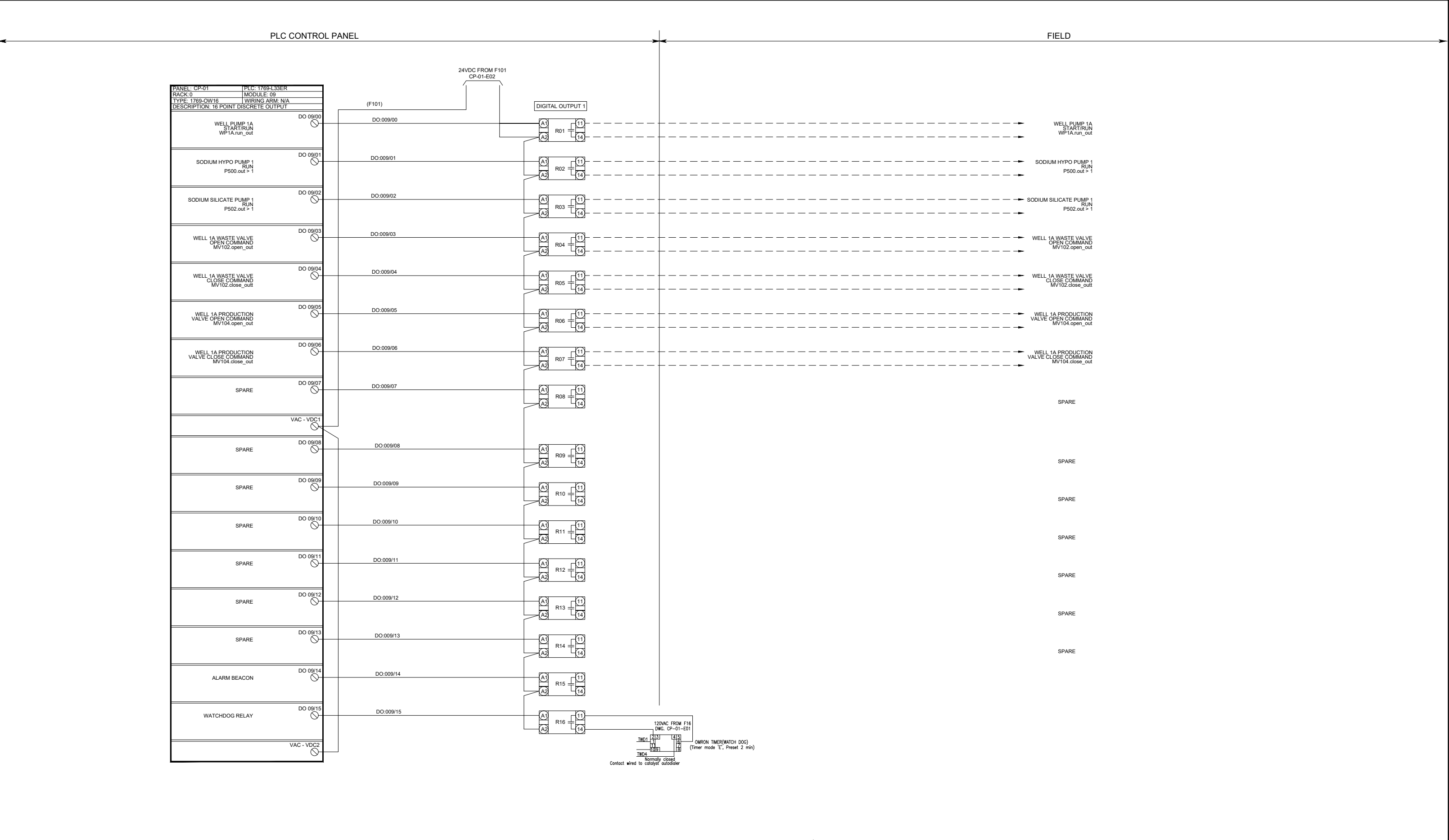
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Colborne WTP PLC Control Panel

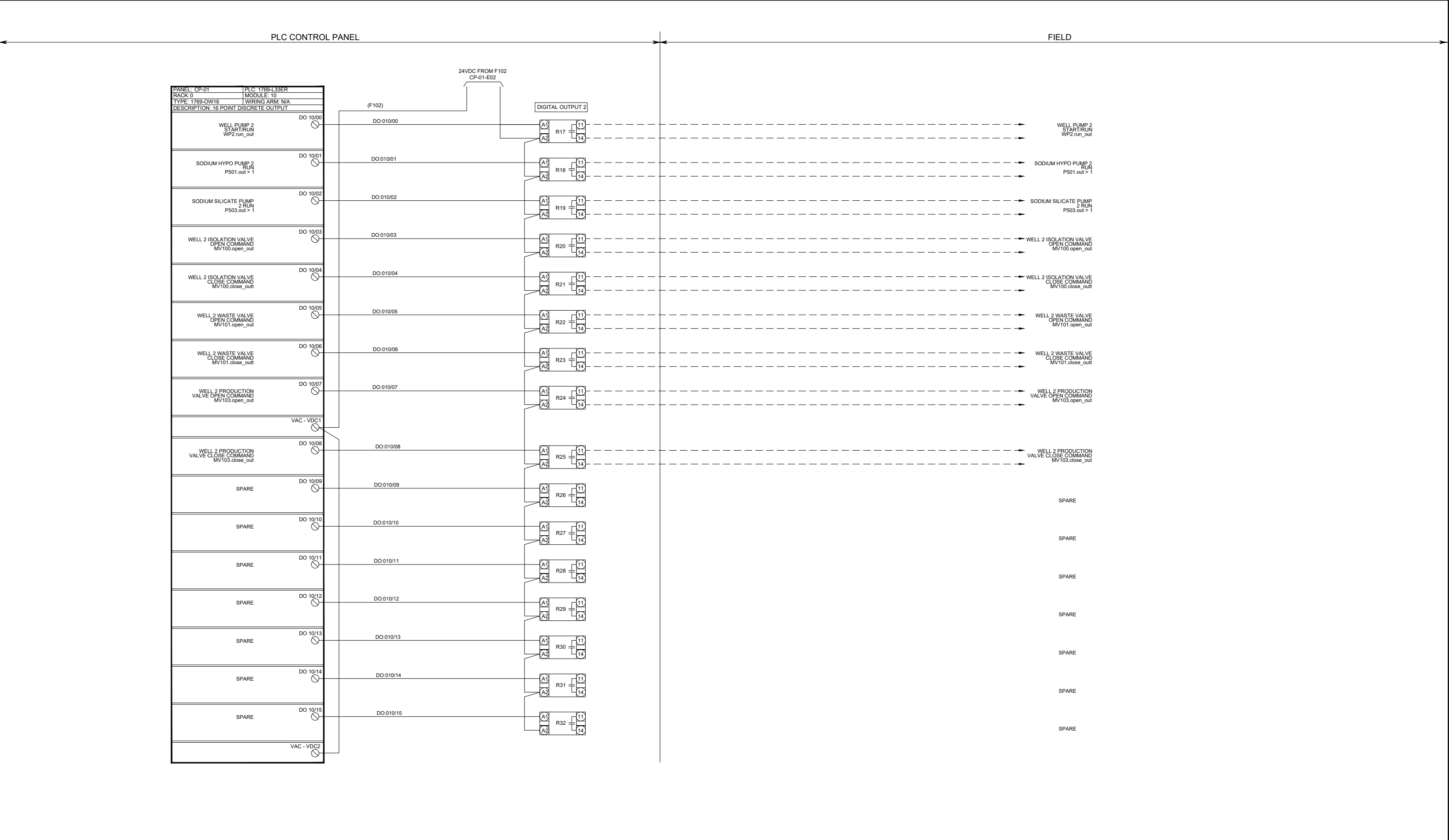
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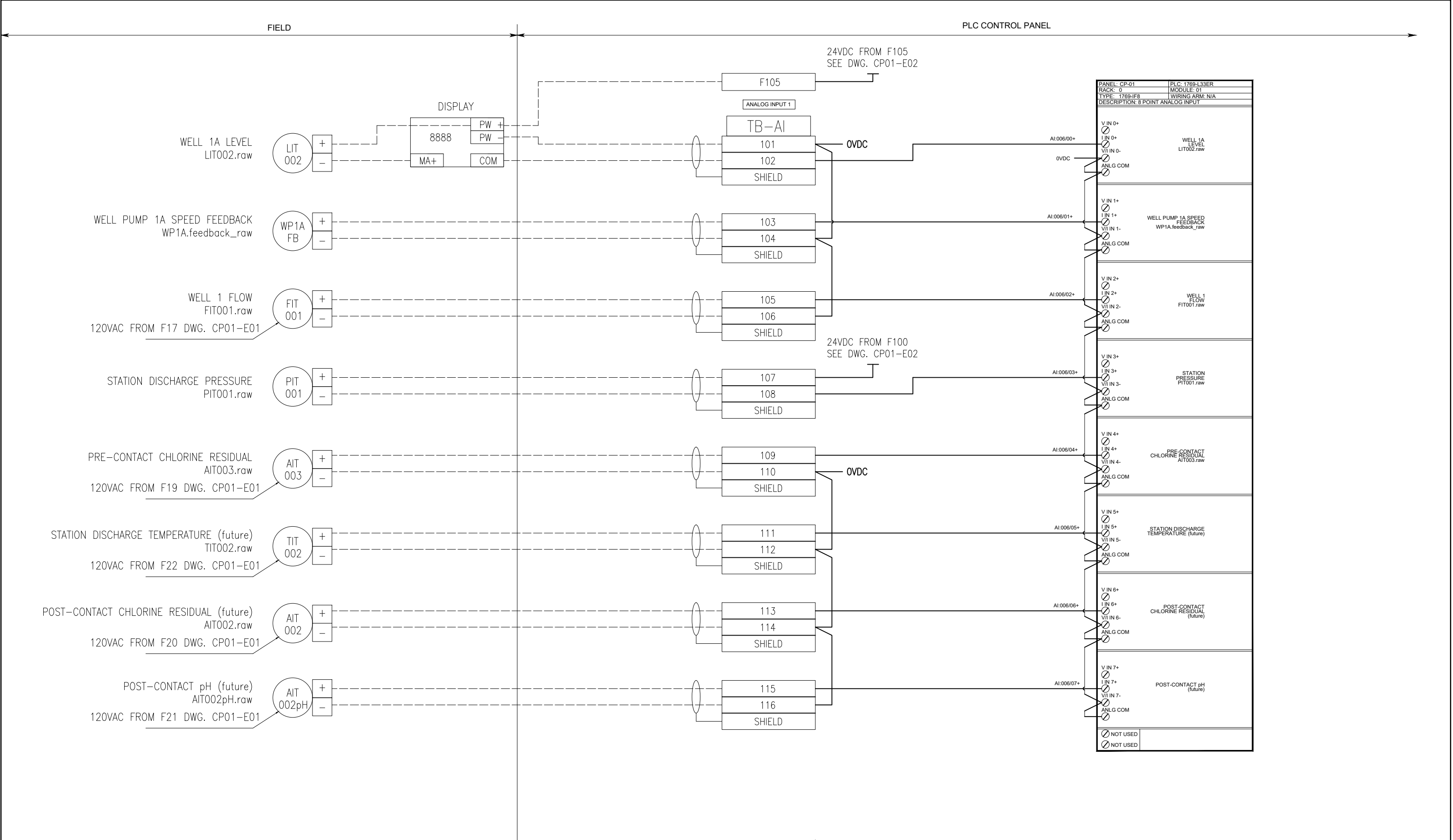
SHEET
10 of 17

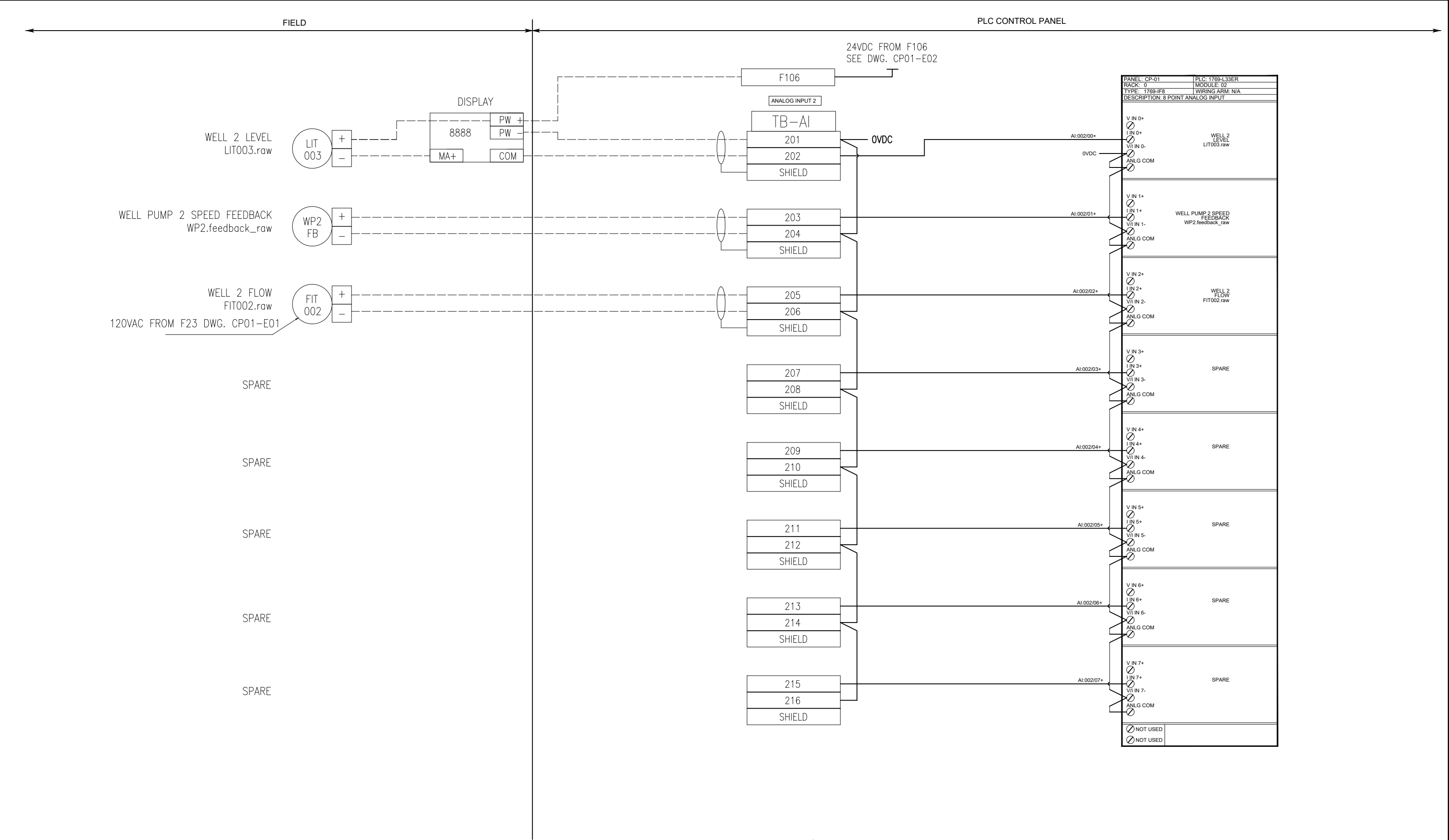
DWG
CP01-E05

REV
2









120VAC FROM F23 DWG. CP01-E01

SPARE

SPARE

SPARE

SPARE

SPARE

DISP

8888

PW +

PW -

MA+

COM

24VDC FROM F106
SEE DWG. CP01-E02

F106

ANALOG INPUT 2

TB-AI

201

202

SHIELD

0VDC

203

204

SHIELD

205

206

SHIELD

207

208

SHIELD

209

210

SHIELD

211

212

SHIELD

213

214

SHIELD

215

216

SHIELD

PANEL: CP-01

RACK: 0

TYPE: 1769-IF8

DESCRIPTION: 8 POINT ANALOG INPUT

PLC: 1769-L33ER

MODULE: 02

WIRING ARM: N/A

V IN 0+

I IN 0+

V IN 0-

I IN 0-

ANLG COM

WELL 2 LEVEL
LIT003.raw

V IN 1+

I IN 1+

V IN 1-

I IN 1-

ANLG COM

WELL PUMP 2 SPEED FEEDBACK
WP2.feedback_raw

V IN 2+

I IN 2+

V IN 2-

I IN 2-

ANLG COM

WELL 2 FLOW
FIT002.raw

V IN 3+

I IN 3+

V IN 3-

I IN 3-

ANLG COM

SPARE

V IN 4+

I IN 4+

V IN 4-

I IN 4-

ANLG COM

SPARE

V IN 5+

I IN 5+

V IN 5-

I IN 5-

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I IN 6-

ANLG COM

SPARE

V IN 7+

I IN 7+

V IN 7-

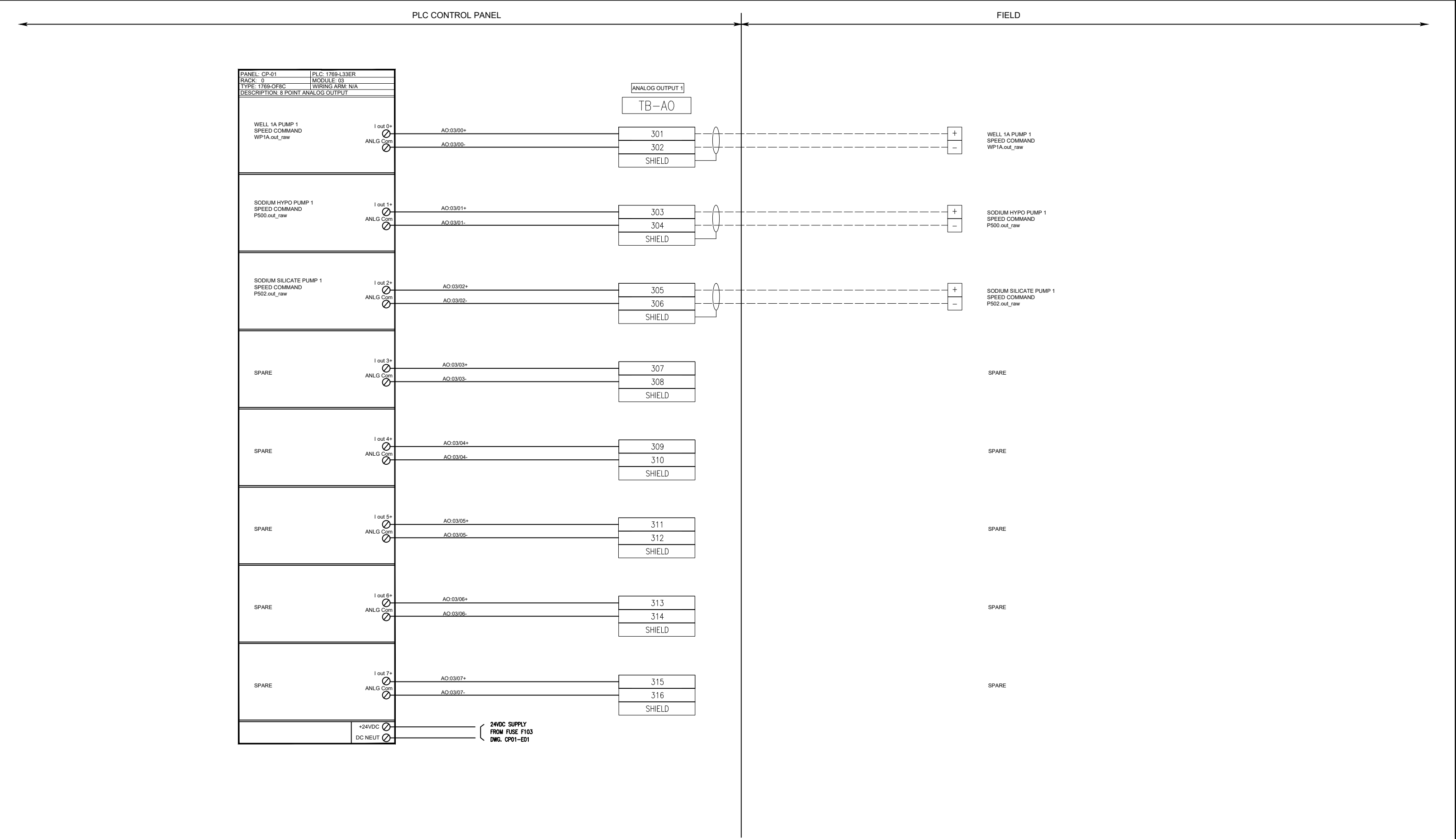
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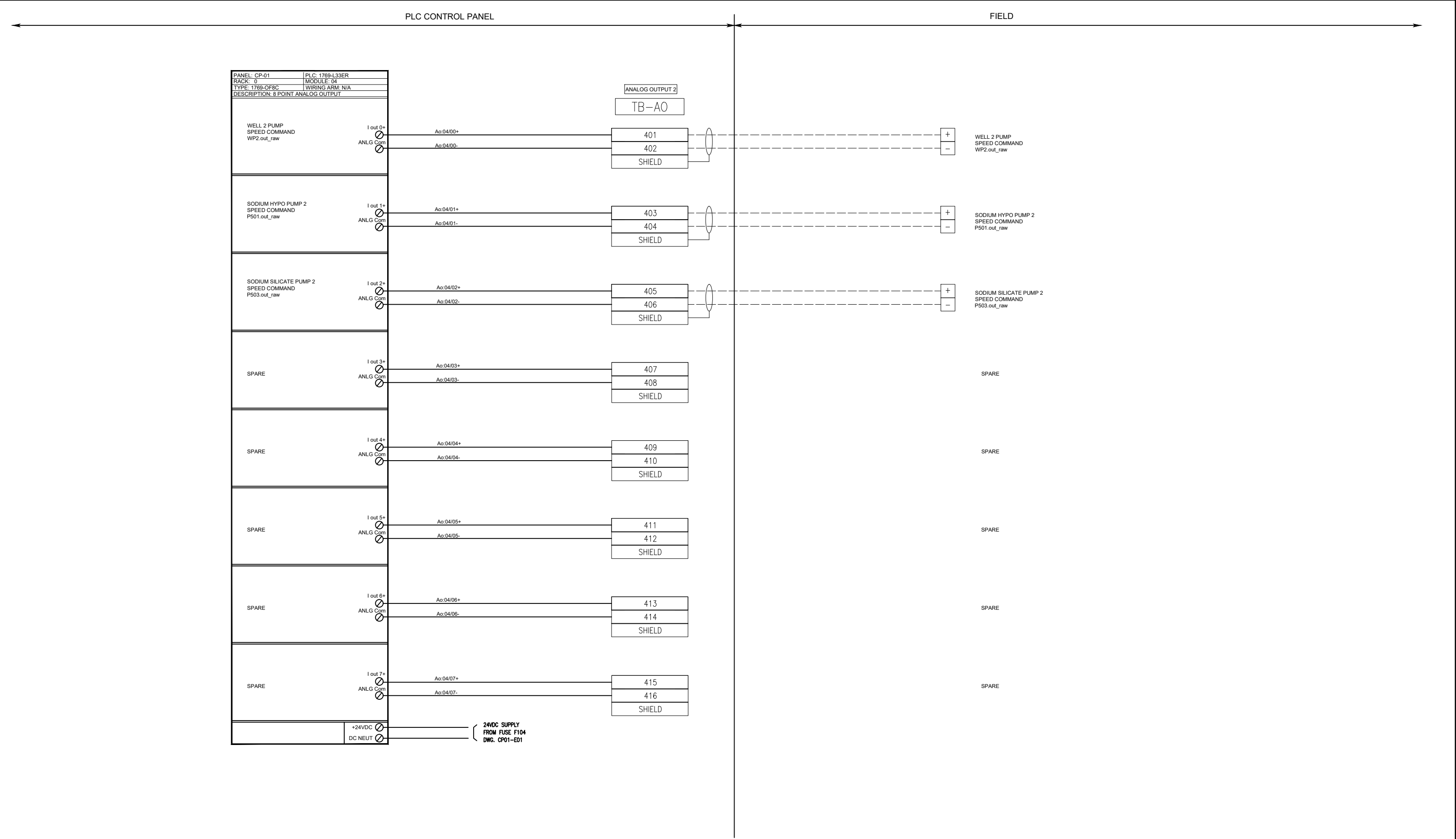
ANLG COM

SPARE

NOT USED

NOT USED





TOWN OF COLBORNE	
STANDPIPE PLC CONTROL PANEL	
DRAWING NUMBER	DESCRIPTION
CP02-INDEX	DRAWING INDEX
CP02-A01	PANEL LAYOUT AND POWER SHEMATICS
CP02-C01	COMMUNICATIONS
CP02-E01	EMBEDDED DIGITAL INPUT MODULE
CP02-E02	EMBEDDED DIGITAL OUTPUT MODULE
CP02-E03	EMBEDDED ANALOG INPUT MODULE
CP02-E04	EMBEDDED ANALOG OUTPUT MODULE

SEAL



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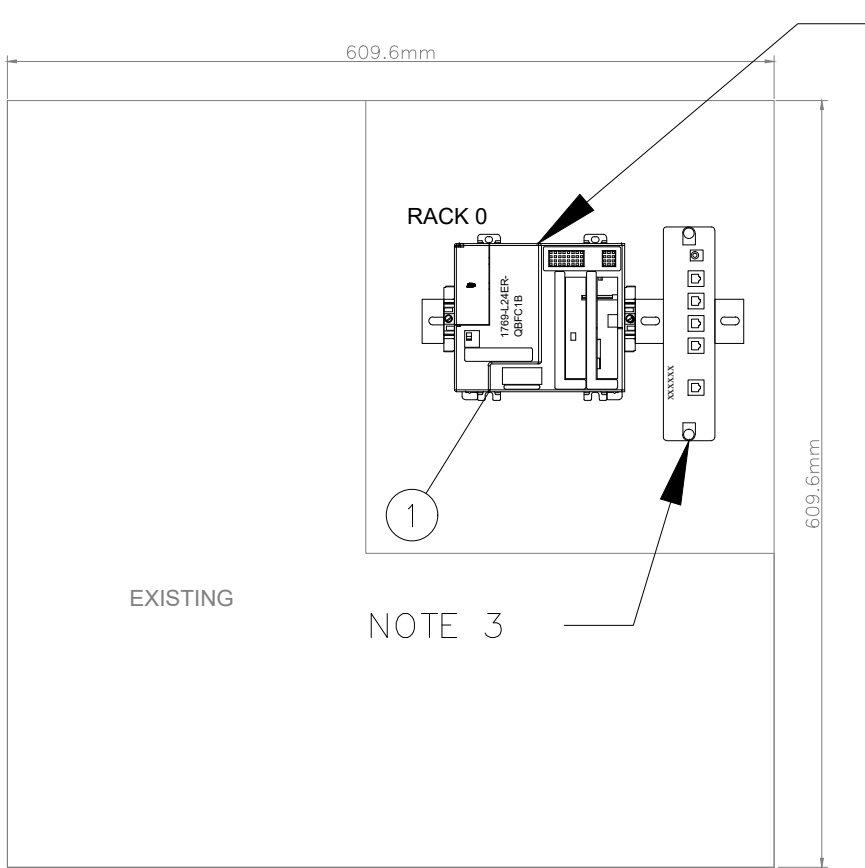


Township of Cramahe

CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne Standpipe PLC Control Panel

DRAWING INDEX

SHEET 1 of 7	DWG CP02-INDEX	REV 2

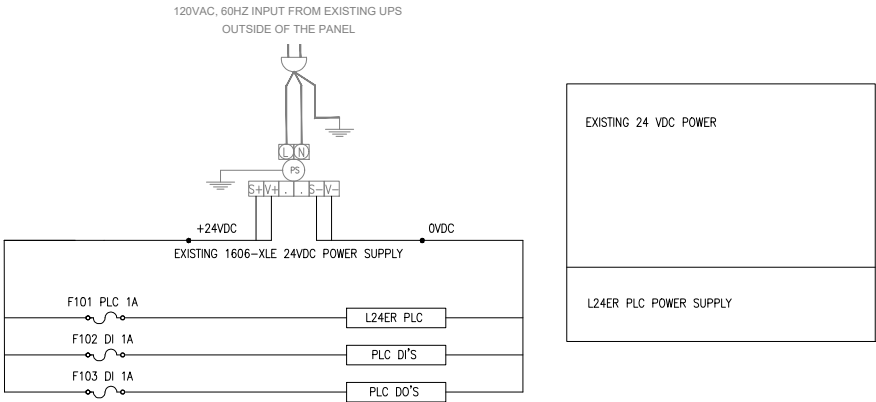


NOTE 1



EXISTING UPS

POWER SCHEMATICS



BILL OF MATERIALS

Item	Qty	Manufacturer	Part No.	Description
1	1	ALLEN-BRADLEY	1769-L24ER-QBFC1B	CONTROLLER, COMPACTLOGIX
2	3	Weidmuller	1011000000	FUSED TERMINAL

NOTES:

- CONTRACTOR TO REPLACE THE EXISTING PRIBUSIN HARDWARE WITH THE NEW ALLEN-BRADLEY COMPACTLOGIX PLC. NEW PLC POWER SUUPLY TO BE WIRED FROM EXISTING 24VDC POWER MODULE. REFER TO WIRING DIAGRAMS, E01 TO E04 FOR IO TERMINATIONS.
- ALL WORK TO BE COORDINATED WITH PLANT OPERATIONS TO MINIMIZE DOWN TIME. PLANT COMPLIANCE REQUIREMENTS TAKE PRECEDENCE OVER CONSTRUCTION.
- WIRELESS RADIO TO BE INSTALLED BY OTHERS INSIDE THE PLC CONTROL PANEL.

LEGEND:	
NEW	_____
EXISTING	_____
DEMOLISH	_____

SEAL



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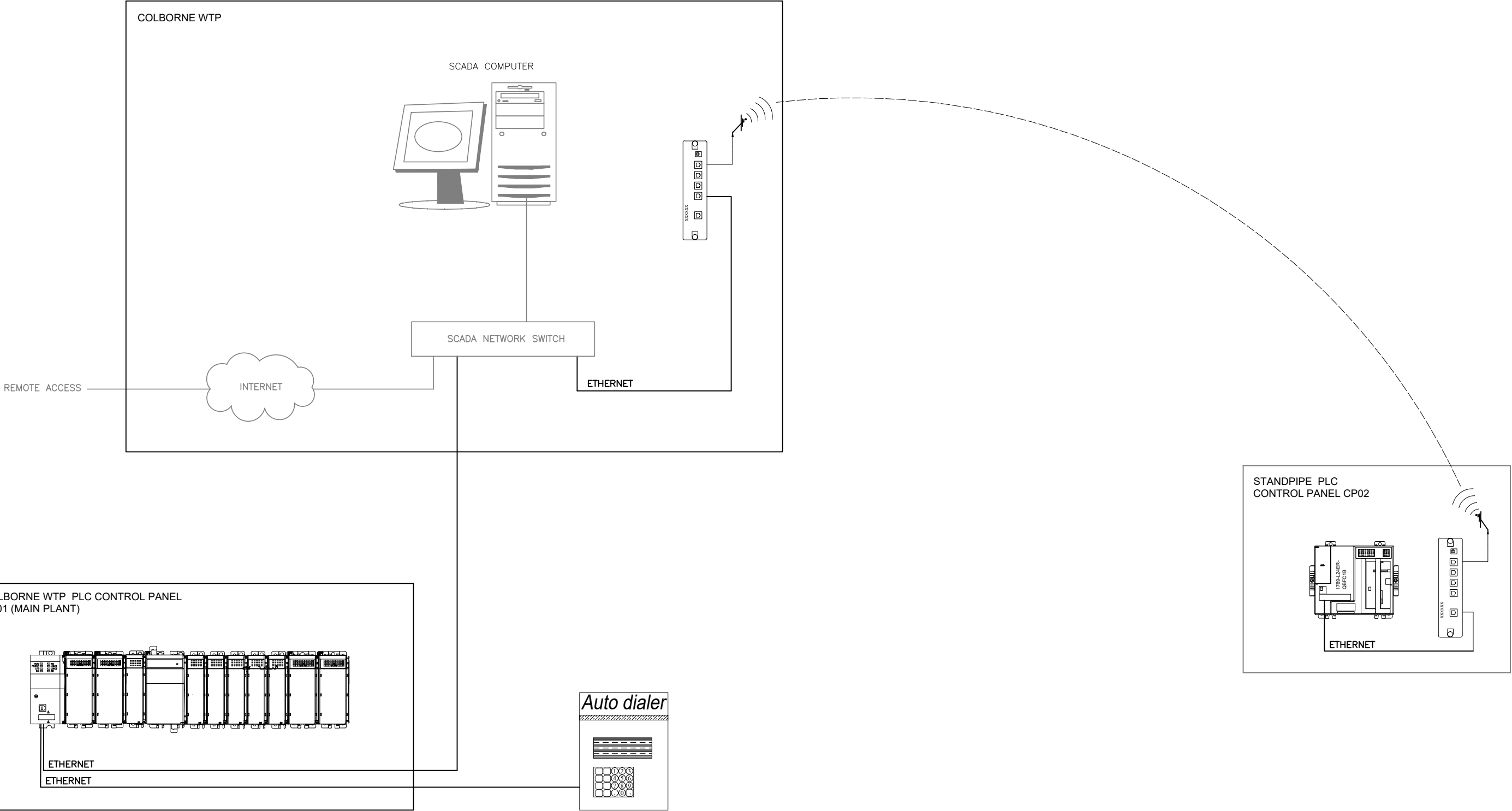


Township of Cramahe

CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne Standpipe PLC Control Panel

MAIN CONTROL PANEL

SHEET 2 of 7	DWG CP02-A01	REV 2



LEGEND:

NEW _____

EXISTING _____

- NOTES:
- 1. CONTRACTOR TO CONFIRM ANTENNA LOCATIONS WITH CONTRACT ADMINISTRATOR BEFORE INSTALLATION.
 - 2. CONTRACTOR TO CONFIRM CONNECTIONS TO WTP NETWORK SWITCH WITH CONTRACT ADMINISTRATOR.

SEAL



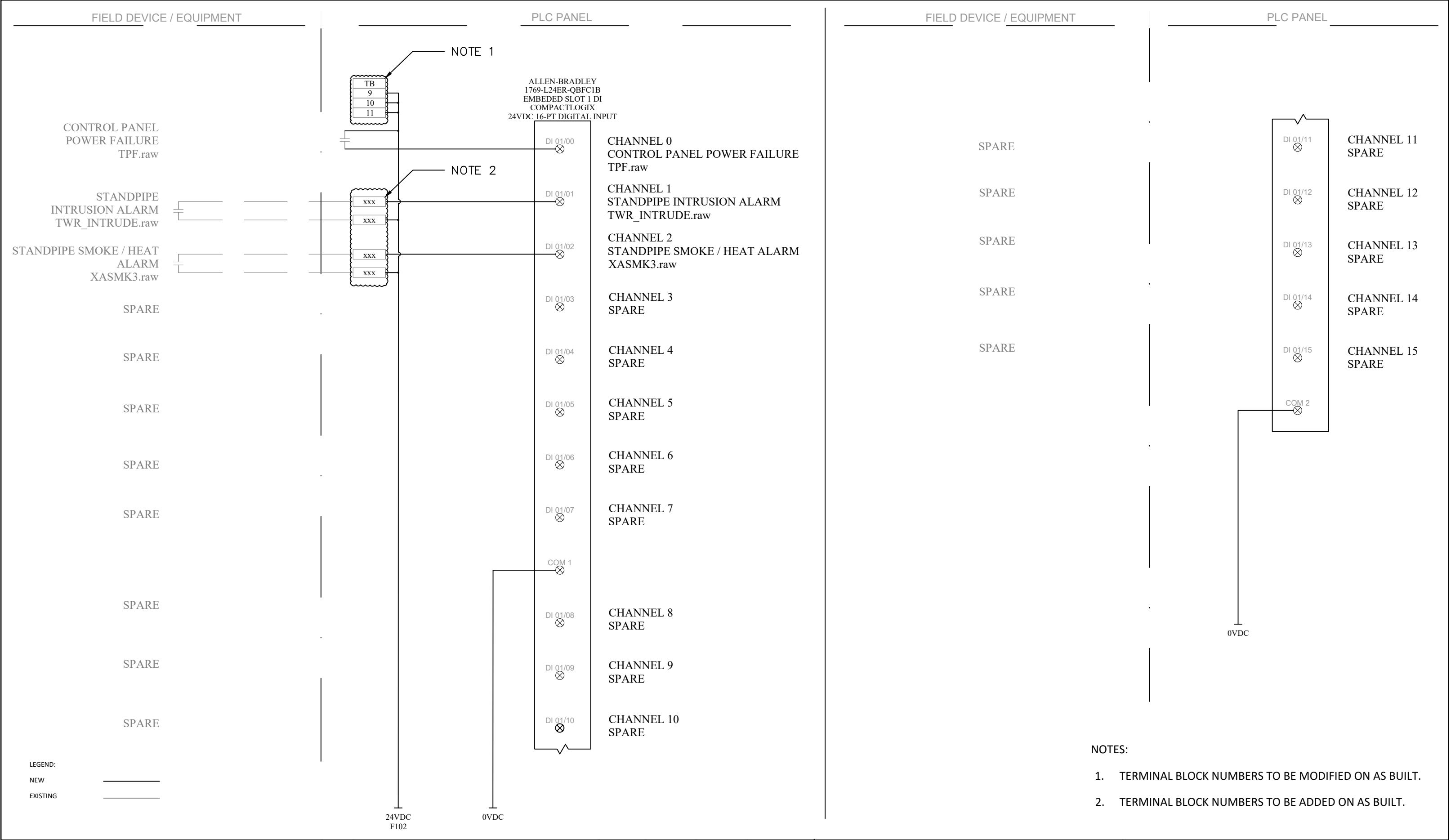
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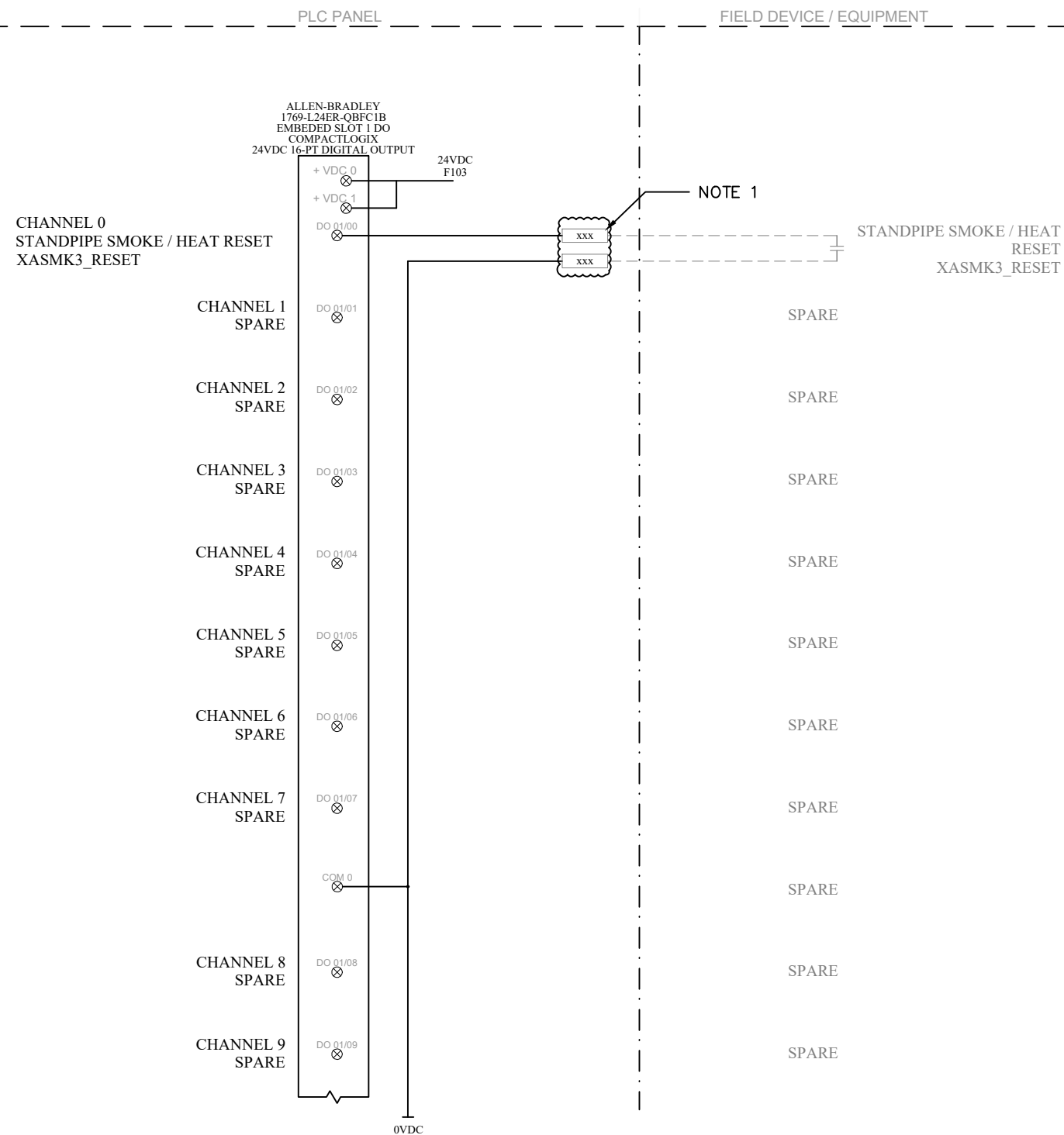


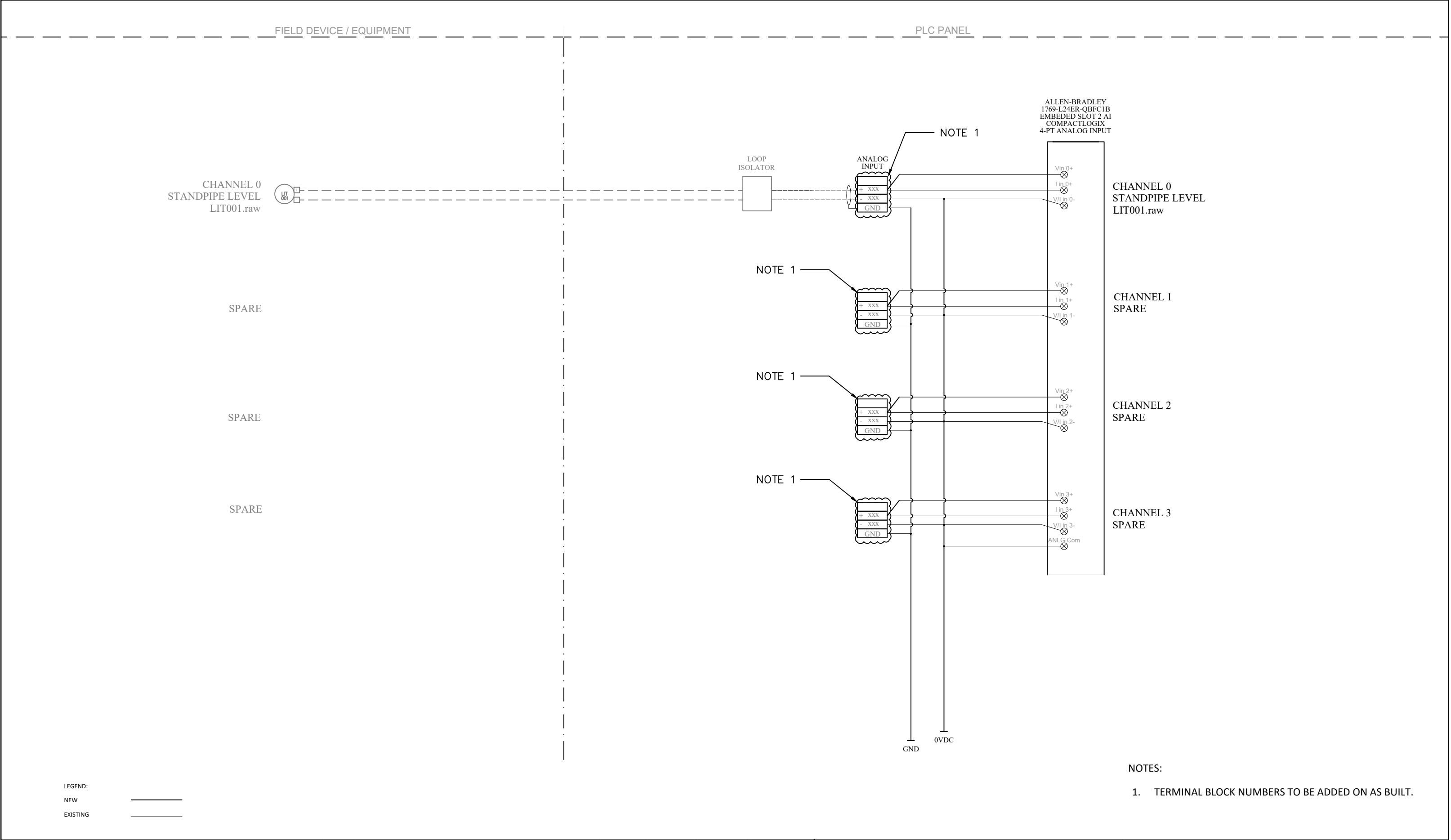
CA0042058.3870 Town of Colborne WTP MCC and SCADA System Upgrades
Colborne Standpipe PLC Control Panel

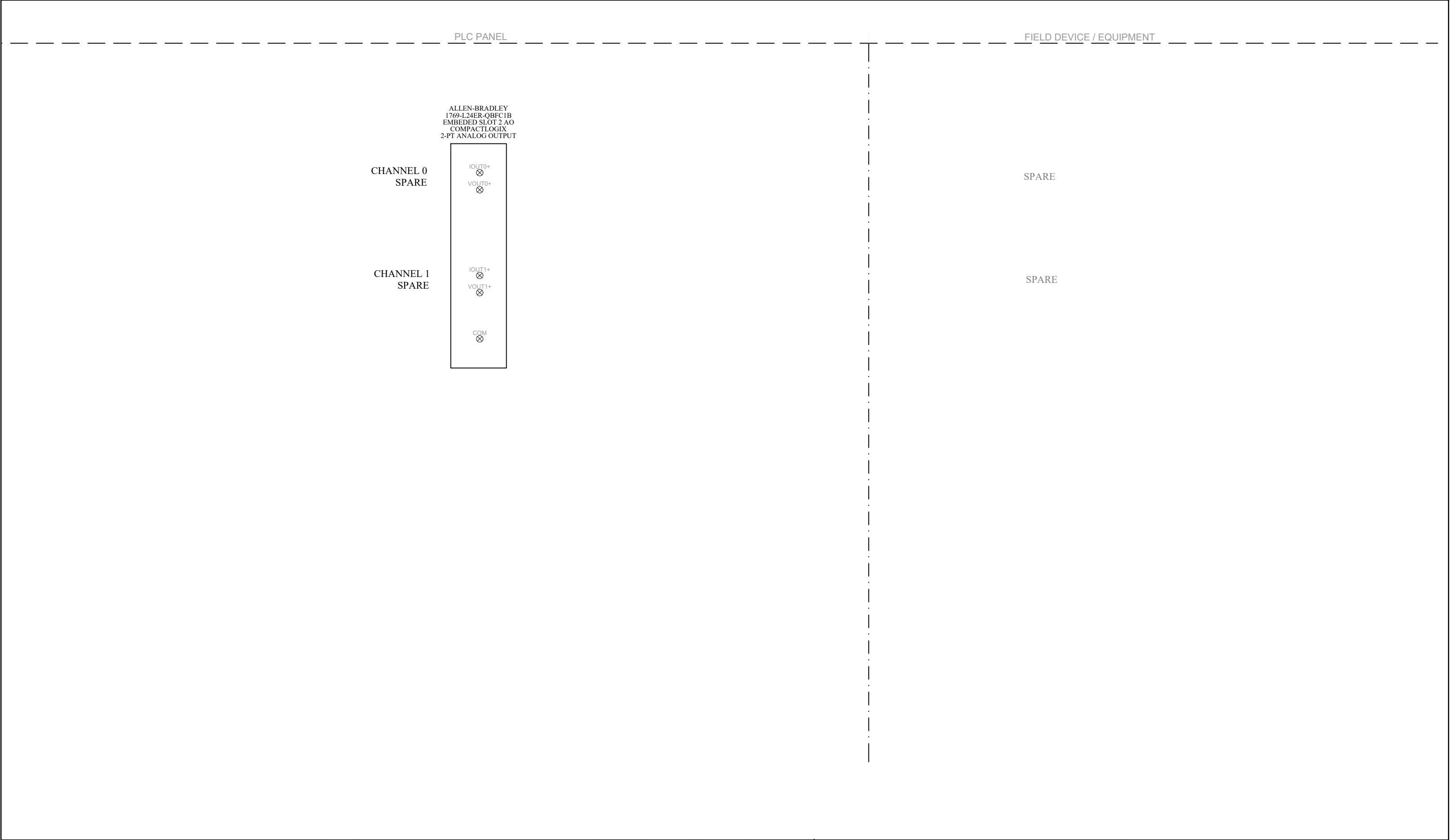
COMMUNICATIONS

SHEET 3 of 7	DWG CP02-C01	REV 2









Township of Cramahe
Colborne Water Treatment Plant Electrical & SCADA
System Upgrades

Contract No. 2025-01

Specifications

The following specifications are supplemental to those provided herein and on the Contract Drawings.

SPECIFICATIONS

- Division 1 – General Requirements
- Division 13 – Instrumentation and Control
- Division 16 – Electrical

REFERENCED DOCUMENTS

- Hydro One Design Drawing – 64678626
- Schedule B 64678626 – 2025-01-08 11,29,23
- Trenching Guidelines
- Hydro One Retail Metering Guide – 2024 Edition

DIVISION 1 – GENERAL REQUIREMENTS

<u>Section No.</u>	<u>Section Name</u>
01010	SUMMARY OF WORK
01025	MEASUREMENT AND PAYMENT
01040	PROJECT CO-ORDINATION
01050	FIELD ENGINEERING
01300	SUBMITTALS
01310	PROJECT MANAGEMENT
01351	HEALTH AND SAFETY
01400	QUALITY CONTROL
01410	REGULATORY REQUIREMENTS
01420	REFERENCES
01600	MATERIALS AND EQUIPMENT
01630	SUBSTITUTIONS
01640	MANUFACTURERS' SERVICES
01650	EQUIPMENT STARTUP AND PERFORMANCE TESTING
01660	COMMISSIONING
01710	CLEANING
01730	OPERATION & MAINTENANCE MANUALS
01750	SPARE PARTS AND MAINTENANCE MATERIALS
01760	WARRANTY WORK
01780	CONTRACT CLOSEOUT

**SECTION 01010
SUMMARY OF WORK**

1	GENERAL.....	1
1.1	INTENT OF SECTION.....	1
1.2	DEFINITIONS	1
1.3	DESCRIPTION OF WORK (GENERAL)	2
1.4	DESCRIPTION OF WORK (FURTHER DETAILS)	3
1.5	CONTRACT METHOD	5
1.6	SEQUENCE OF WORK.....	5
1.7	CONTRACTOR’S USE OF PREMISES.....	8
1.8	CONTRACT DRAWINGS	8
1.9	CONSTRUCTION DRAWINGS AND SPECIFICATIONS FURNISHED	9
1.10	SUPPLEMENTARY DRAWINGS	9
2	PRODUCTS (NOT USED)	10
3	EXECUTION (NOT USED)	10

SECTION 01010 SUMMARY OF WORK

1 GENERAL

1.1 INTENT OF SECTION

- 1.1.1 This section outlines in general terms the work to be done under this Contract, the sequence of work, the Contractor's use of the site and the Contract Documents.
- 1.1.2 Supervise, organize, coordinate, and direct all construction operations of sub-trades and suppliers.
- 1.1.3 In addition to constructing the Works shown on the drawings, design, construct, maintain and unless otherwise specified or shown on the drawings, remove when construction is completed all temporary works and facilities required for the construction of the works. Complete disposal of any unnecessary materials or debris and restoration of facilities to original clean state. Temporary works and facilities may include but are not limited to the following:
 - 1.1.3.1 Sheet piling systems for excavations whether part or all is left in place or not.
 - 1.1.3.2 Formwork for concrete.
 - 1.1.3.3 Falsework and bracing for formwork or for other parts of the works while under construction.
 - 1.1.3.4 Bracing and shoring for partially completed trenches.
 - 1.1.3.5 All erosion control measures.
 - 1.1.3.6 Temporary electrical equipment.
- 1.1.4 The description of works is not necessarily complete but is for the general information of the Contractor. A full and proper description is to be gained from the Contract Documents as a whole including all drawings and surveys.

1.2 DEFINITIONS

- 1.2.1 Removal: to take away from present location.
- 1.2.2 Disposal: to remove from site.
- 1.2.3 Demolition: to tear down or break up and remove from site.
- 1.2.4 Decommission: Remove from service with all associated components.
- 1.2.5 Provide/Supply: to make available.

1.2.6 Install: to place in position, connect, wire and make operational.

1.2.7 Works: the entirety of the work to be executed under contract.

1.3 DESCRIPTION OF WORK (GENERAL)

1.3.1 The Works in this contract consists of upgrades in the Township of Cramahe, at the Colborne Water Treatment Plant (WTP) located at 321 Purdy Road, Colborne, ON, K0K 1S0, as well as at the Colborne Standpipe located at 220 Herley Road, Colborne, ON, K0K 1S0.

1.3.2 The Work, at a high-level, includes the following: replacement and relocation of existing incoming power feed, replacement of existing MCC, replacement and relocation of Well #2 VFD, replacement and relocation of existing Instrument Control Panel, replacement of existing Pribusin with wireless radio (by others). Equipment startup, testing and commissioning.

1.3.3 Provide and supply all special tools or equipment required for the installation, setup, configuration and commissioning of the Works.

1.3.4 Supply of all necessary labour, material, equipment, transportation, services and facilities for the Work.

1.3.5 Furnishing of materials, equipment, tools, devices and labour as required for the Work.

1.3.6 Construct the complete Works as specified herein.

1.3.7 Provide confined space entry, working at heights and other relevant training as required.

1.3.8 Provide protection of active or energized utilities in area of demolition.

1.3.9 Provide protection for existing facilities to remain in service.

1.3.10 Provide removal of exposed conduit associated with the items being demolished, sealing the ends of all buried conduits abandoned in place and removal of all power and network wiring between the demolished equipment and the terminal junction box, termination panel, control panel, panel board, etc. Confirm that all wiring is de-energized before cutting and taking away conduits and wiring.

1.3.11 Maintain housekeeping and provide daily cleanup of the work area.

1.3.12 Clean up of all spills during construction in a timely manner and maintain good housekeeping.

1.3.13 Construct and test all structures, mounting poles and pads shown on the drawings and specified herein.

- 1.3.14 Coordinating all stages of Works with the Operating Authority for the provision of temporary and permanent power supply as required. All costs resulting from this requirement are to be paid by the Contractor. This includes any fuel used for temporary power supply.
 - 1.3.15 Field verification of all existing equipment to be reused. Where inconsistencies are identified, contractor to locate and suggest alternatives for approval by Owner and Contract Administrator.
 - 1.3.16 Provide demolition of existing equipment and wiring as indicated in contract drawings. Existing PLCs are to be retained and returned to the Owner.
 - 1.3.17 Demolition work can only commence once the new equipment and wiring is commissioned. Where old equipment needs to be removed prior to the installation of the new equipment, coordination with the Owner and Operating Authority is required and scheduled.
 - 1.3.18 Install all equipment and devices as indicated on contract drawings; this Work includes but is not limited to procurement and installation of all wires, electrical equipment, SCADA equipment and control devices and any other ancillaries as required or as indicated on the drawings.
 - 1.3.19 Provide equipment tagging and labelling in accordance with the Contract drawings.
 - 1.3.20 Provide start-up and commissioning support.
 - 1.3.21 FAT & SAT performance testing of all equipment, cables, equipment supplied, installed, and constructed under this Contract.
 - 1.3.22 Perform performance testing to ensure that any new equipment and associated appurtenances meet the specified performance requirements.
 - 1.3.23 Complete restoration of the site. Make good all disturbed surfaces, structures or equipment affected by the construction. In general, restore all disturbances to “as good or better” condition than before construction.
 - 1.3.24 Maintain the Works for the period of guaranteed maintenance, correcting any deficiencies that arise in a timely manner.
- 1.4 DESCRIPTION OF WORK (FURTHER DETAILS)
- 1.4.1 The Work under this Contract, in further detail, is as follows:
 - 1.4.1.1 Supply and installation of new underground power feed cable and conduit from Hydro One overhead transformer bank to main plant, as per Hydro One requirements, refer to Item G in Schedule of Tender Data, Referenced Documents for Hydro One requirements. (Coordinate with Hydro One for connection to transformer bank).

- 1.4.1.2 Disconnecting the existing underground feeder cable between the existing transformer bank and existing Disconnect Switch from both ends. Underground cable and conduit to be marked and abandoned in place.
- 1.4.1.3 Supply and installation of a new Fused Disconnect Switch (FDS) (600V system) and rigid metal conduit(s) outside the main plant entrance door. FDS to be equipped with an outdoor enclosure that is at minimum a NEMA Type 3R.
- 1.4.1.4 Supply and installation of new power meter base, new rigid metal conduit(s), and NEMA Type 3R enclosure for the power meter, as per Hydro One requirements. Coordinate with Hydro One to install the new Hydro One supplied power meter.
- 1.4.1.5 Removal and disposal of existing (old) power meter base, existing (old) FDS, and conduit(s) after commissioning of new power feed. Hydro One to remove the existing (old) power meter, coordinate accordingly.
- 1.4.1.6 Supply and installation of a new Motor Control Center panel (MCC-1) and new lighting panel (LP-1) along with conduits as per Contract drawings.
- 1.4.1.7 Supply and installation of a NEMA 14-50 outlet equipped with a lockable weatherproof enclosure, suitable for outdoor use (with a cover). Addition of a separate 50A circuit. The 80% rated type 60A 208V, 2-pole CB to be included in the new lighting panel LP-1, and to be equipped with ground fault protection.
- 1.4.1.8 Supply and installation of a new standalone 60HP Variable Frequency Drive (VFD) and Passive Harmonic Filter for Well #2 Pump in Well #2 Pumphouse along with conduits and cables as per Contract drawings.
- 1.4.1.9 Removal and disposal of existing MCC including the 60HP VFD and relevant cables/conduits.
- 1.4.1.10 Removal and disposal of electrical components in Well #2 Pumphouse and installation of new similar equipment in the same location as per Contract drawings. The 100A FDS for the 60HP motor in Well #2 Pumphouse to be permanently removed and no new installation is required for this FDS. The new 60HP VFD to include a disconnect switch.
- 1.4.1.11 Supply and installation of a new Instrumentation Control Panel in main plant (CP01 – Colborne WTP Main Control Panel) on a backplate in new MCC (rightmost section) as per Contract drawings.
- 1.4.1.12 Removal of existing Instrumentation Control Panel in the main plant including the existing Pribusin hardware.
- 1.4.1.13 Replacement of existing Pribusin hardware in existing Standpipe control panel (CP02) with new CompactLogix PLC at the Colborne Standpipe.

- 1.4.1.14 Coordination of the installation of wireless radio equipment installed by others in both main plant and Colborne Standpipe.
- 1.4.1.15 Re-routing of relevant cables and conduit for all affected equipment. Supply and install new cable / conduit as per drawings, specifications, and as required.
- 1.4.1.16 Equipment testing and commissioning.
- 1.4.1.17 Coordination with the Electrical Safety Authority (ESA) for all electrical installations, as needed.
- 1.4.2 Without limiting the scope, the Work also consists of the following:
 - 1.4.2.1 Coordinate with the Owner, Operating Authority, and Contract Administrator all additions, removals and modifications described herein and in the contract drawings and, where applicable, the addendums.
 - 1.4.2.2 Sequence the Work such that any plant process interruptions are minimized and obtain approval by the Owner, Operating Authority, and the Contract Administrator before beginning work.
 - 1.4.2.3 Coordinate with the Owner / Operating Authority for access to the building(s) for the duration of the Work.
 - 1.4.2.4 Refer to contract drawings and the rest of contract documents for any additional work required whether specifically noted. Approved change orders are required for any additional work or tasks or materials.

1.5 CONTRACT METHOD

- 1.5.1 Construct the Work under a single lump sum price contract.

1.6 SEQUENCE OF WORK

- 1.6.1 Refer to Section 01040 for construction coordination constraints.
- 1.6.2 Contractor to prepare Construction Schedule.
- 1.6.3 Contractor cannot disconnect and remove any of the existing equipment from service unless all new equipment and associated parts have arrived onsite. The Owner will not be responsible for any costs associated with delays.
- 1.6.4 Contractor to prepare and submit detailed sequence of work plan pertaining to all Work.
 - 1.6.4.1 The following steps can be used as a guideline for the order of construction activity and the required coordination, however Contractor to modify as needed based on site review and ESA/Hydro One requirements.

- 1.6.4.1.1 Supply and install a new 4-Wire 200A @ 600V Fused Disconnect Switch (FDS) and a new 16S power meter base beside the building door entrance of Main Plant. Contractor to let Hydro One know when power meter base is ready. Hydro One to provide new power meter and install on the base in NEMA Type 3R enclosure. The NEMA Type 3R enclosure to be supplied and installed by Contractor.
- 1.6.4.1.2 Supply and install new cable and rigid metal conduit between the new FDS and the new 4-wire power meter. Terminate on both sides.
- 1.6.4.1.3 Supply and install new cable and rigid metal conduit between the new Power Meter and the existing Automatic Transfer Switch (ATS). Terminate on power meter side.
- 1.6.4.1.4 Supply and install underground feed cable from new transformer bank (at new pole location) to the newly installed FDS. Supply and preassemble private riser with conductor and weather head ensuring enough conductor slack is left for Hydro One to be able to complete connections. Provide conduit/straps/bolts. Complete the above as per Hydro One drawings and ESA specifications. Terminate the new line on the new FDS side. Coordinate with ESA to inspect when complete and then Hydro One to terminate on new transformer once ESA permit received. Coordinate with Owner/Operating Authority as this will require Switching from existing utility power to Genset power. The existing Genset will provide power to facility via ATS (only a momentary facility shutdown).
- 1.6.4.1.5 Terminate cable from new power meter to existing ATS. The new FDS must be locked in OFF position. Genset must be shut down and no power to the facility. Facility must be completely de-energized.
- 1.6.4.1.6 Remove existing (old) power meter base, existing (old) FDS, and relocate existing I&C junction box(es) (to make room for new MCC and Control Panel as per contract drawings). Hydro One to remove the existing (old) power meter, coordinate accordingly.
- 1.6.4.1.7 Supply and install new MCC and PLC Control Panel as per contract drawings.
- 1.6.4.1.8 Supply and install new lighting panel as per Contract drawings.
- 1.6.4.1.9 Supply and install new NEMA 14-50 outlet equipped with a lockable weatherproof enclosure, suitable for outdoor use (with a cover), on the East side of the Main Plant building in the step inward as per Contract drawings. Addition of a separate 50A circuit.

The 80% rated type 60A 208V, 2-pole CB to be included in the new lighting panel LP-1, and to be equipped with ground fault protection.

1.6.4.1.10 Supply and install all conduit/cable for electrical /I&C equipment to and from new MCC and PLC control panel, (leaving existing controls / power connected / operational).

1.6.4.1.11 Startup, test, and commission new MCC, lighting panel, and control panel. Switch all controls for Well #1A pump to the new PLC control panel in MCC. (Shut down plant for no longer than 8 hours; ensure to have written approval from Operating Authority and Owner prior to any shutdowns. Shut down approval request to be sent in writing at least three (3) business days in advance.

1.6.4.1.12 Supply and install new equipment (VFD, etc.), and cable in Well #2 pumphouse as per contract drawings and then startup, test, and commission the equipment.

1.6.4.1.13 Supply and install new PLC equipment at the Colborne Standpipe as per contract drawings. Startup, test, and commission the equipment.

1.6.4.1.14 Remove existing (old) equipment (e.g. MCC, VFD, etc.), and remove/abandon cables, as per contract drawings.

1.6.4.1.15 Coordinate ESA inspection for all electrical installations, as needed.

1.6.4.2 Provided the basic contract constraints and milestones are maintained, Contractor shall submit a detailed description of the alternative sequence proposed to the Contract Administrator for review and approval, prior to commencing the work.

1.6.4.3 The work should be carried out in a logical sequence in order to accommodate continuous operation of the stations. Coordinate all construction activities through the Contract Administrator with the Operations staff and verify that these activities do not interfere with the operation of the facility.

1.6.4.4 Coordinate construction of the Work with the construction schedule.

1.6.5 When shutdowns and/or switchovers of any process or electrical systems are required, the Contractor shall coordinate all trades involved, the Owner Operation Staff, the Operating Authority, including the Contract Administrator. Detailed written sequences are required to be submitted to the Contract Administrator to permit such coordination. Refer to Section 01040 for scheduling constraints and limitations of construction.

1.6.6 The Contractor may sequence the work as required; However, the following shall be obeyed as a priority:

1.6.6.1 Safe site conditions shall be maintained at all times.

1.6.6.2 The Contractor shall submit the sequence to the Contract Administrator for review including any power shutdowns.

1.6.6.3 The Contractor shall at all times maintain access to the site for the Owner / Operating Authority.

1.7 CONTRACTOR'S USE OF PREMISES

1.7.1 Confine work to within the Limit of Contract within working area.

1.7.2 Conform with local by-laws, including but not limited to those related to noise control, traffic regulations and roadblocks.

1.7.3 Return working areas to a pre-construction condition satisfactory to the Owner / Contract Administrator.

1.7.4 Provide pedestrian and vehicular access. Provide and maintain safe, protected pedestrian ways at least 1.2 metres wide should sidewalk encroachments be necessary.

1.7.5 Clear site daily of construction debris.

1.7.6 Provide fencing around the Work and storage areas in accordance with the Occupational Health and Safety Act.

1.7.7 Do not enter upon or occupy with workers, tools or materials of any nature, any lands other than those designated as working areas on the Contract Drawings, except after consent has been received from the proper parties and a certified copy of such consent is furnished to the Contract Administrator. Any rental or damages paid for occupying private lands other than those stipulated as working areas will be at the Contractor's expense.

1.7.8 Maintain safe conditions on site at all times.

1.8 CONTRACT DRAWINGS

1.8.1 The IFC (Issued for Construction) Contract Drawings, as listed in the List of Contract Documents, accompany and form part of these Specifications. In every case detail drawing(s) take precedence over general drawings.

1.8.2 The Drawings are prepared in SI units.

1.8.3 Read the Drawings as a whole in conjunction with the Contract Documents & Specifications as details applicable to one section may appear on the drawings of another section or sections.

- 1.8.4 The Owner may supply drawings covering additional work. These will be identified as additional work. This work will not commence unless accompanied by an approved change order.
- 1.8.5 Drawings give general location of existing equipment and are not to scale. It is responsibility of the Contractor to site verify all locations and dimensions prior to fabrication and installation, and to locate equipment and devices limiting interference with walkways, crane routes and keeping required headroom.
- 1.8.6 Follow the Drawings to become familiar with all conditions affecting the Work and verify spaces in which the work will be installed.
- 1.8.7 Do not scale the drawings to determine dimensions but obtain information for accuracy by referring to architectural and structural drawings where available, or preferably by site measurements. Site measurements can be obtained during a pre-bid site visit.
- 1.8.8 Any modifications necessary due to location and mounting arrangement of all equipment and devices, and location and routing details of conduits, are to be included in Tender price. This includes minor offsets, adjustments or additional conduit supports where required to suit the site conditions or installation requirements to provide a satisfactory working system. The Contractor shall carry out this work at no additional charge to the Owner.
- 1.8.9 The Owner reserves the right to alter, at no additional cost, the location of equipment within five meters, provided the changes are made before installation.

1.9 CONSTRUCTION DRAWINGS AND SPECIFICATIONS FURNISHED

1.9.1 Owner responsibilities:

- 1.9.1.1 To provide electronic copies of IFC (Issued for Construction) drawings and specifications to Contractor.

1.9.2 Contractor responsibilities:

- 1.9.2.1 Maintain at site one complete set of drawings and specifications. Make available to Contract Administrator at any time.
- 1.9.2.2 Maintain and update one (1) set of construction “As Built Drawings” on site during the course of construction. As Built Drawings are to be made available to the Contract Administrator for review at any time.

1.10 SUPPLEMENTARY DRAWINGS

- 1.10.1 Contract Administrator may furnish supplementary drawings from time to time to assist proper execution of work. Such drawings will be issued for clarification only and will have same meaning and intent as if included with plans referred to in Contract Documents.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

1	GENERAL.....	1
1.1	INTENT.....	1
1.2	SUBMITTALS.....	1
1.3	SCHEDULE OF PRICES	2
1.4	CASH AND CONTINGENCY ALLOWANCES	2
1.5	SCHEDULE OF ESTIMATED PROGRESS PAYMENTS.....	3
1.6	APPLICATION FOR PAYMENT.....	3
1.7	PAYMENT.....	4
1.8	NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS	4
2	PRODUCTS (NOT USED)	5
3	EXECUTION (NOT USED)	5

**SECTION 01025
MEASUREMENT AND PAYMENT**

1 GENERAL

1.1 INTENT

- 1.1.1 This Section stipulates the Contract requirements and submittals needed to develop payment certificates.

1.2 SUBMITTALS

1.2.1 Informational:

- 1.2.1.1 Provide a detailed breakdown of prices. Price each Section of the Specifications and in accordance with Contract documents. This breakdown is to be presented within two (2) weeks following the issuance the Notice to Proceed and shall as a minimum include the following items:
 - 1.2.1.1.1 Quantities of Works, separating labour and material.
 - 1.2.1.1.2 Supporting invoices, including those for any subcontractors.
 - 1.2.1.1.3 Location by facility or area.
- 1.2.1.2 Format and detail shall be acceptable to the Owner. The Owner reserves the right, at its sole discretion to make changes. A Divisional Schedule of Pricing spreadsheet totaling the value of the contract with Divisional and Sectional delineation inclusive of subtotals for monthly Progress Payment assessment shall be submitted within fifteen (15) Working Days following the date of the signing of the Contract. First payment will not be made until this detail is reviewed and accepted by the Contract Administrator. The Owner may adjust any unbalanced items, but the total price shall equal the lump sum price for that Section of the Schedule of Prices. \$0 values for spec sections are not acceptable.
- 1.2.1.3 Provide a Schedule of Estimated Progress Payments, as set forth in Subsection 1.5 below and in accordance with the following requirements:
 - 1.2.1.3.1 Submit with the initially acceptable Schedule of Prices.
 - 1.2.1.3.2 Submit adjustments thereto with the Application for Payment.
 - 1.2.1.3.3 Application for Payment.

1.2.1.3.4 Final Application for Payment.

1.3 SCHEDULE OF PRICES

1.3.1 Any schedule which is deemed by the Contract Administrator to be unbalanced or front-end loaded will not be acceptable.

1.3.2 Summation of the complete Schedule of Prices representing all of the Work shall equal the Contract Price.

1.3.3 Mobilization and Demobilization

1.3.3.1 The price provided for this item shall be consistent with the actual costs involved, but should not in any event, exceed 4% of the Lump Sum Total Price (not including HST). In the event the amount provided for this item exceeds 4% of the Lump Sum Total Price, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost of this item to the Demobilization component, which shall be paid upon completion of demobilization.

1.3.4 Section 01310 – Project Management

1.3.4.1 The price provided for this Section shall be consistent with the actual costs involved, but should not in any event, be less than 0.5% of the Sub-Total of Lump Sum Prices for all Divisions (not including HST). In the event the amount provided for this Section is less than 0.5% of the Sub-Total of Lump Sum Prices for all Divisions, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost for this Section from another Section as it sees fit.

1.3.5 Section 01780 – Contract Close-out and Section 01730 – Operation and Maintenance Manuals

1.3.5.1 The combined price provided for these Sections shall be consistent with the actual costs involved, but shall not in any event, be less than 1% of the Sub-Total of Lump Sum Prices for Divisions all, (not including HST). In the event the amount provided for these Sections is less than 1% of the Sub-Total of Lump Sum Prices for all Divisions, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost for these Sections from another Section as it sees fit.

1.4 CASH AND CONTINGENCY ALLOWANCES

1.4.1 Consult with the Contract Administrator in the selection of Products or services. Obtain proposals from Suppliers and installers and offer recommendations.

1.4.2 The Contractor shall submit, with the monthly application for payment, an original copy of the invoice showing the date of purchase, from whom the

purchase was made, the date of delivery of the Product or service, and the price, including delivery to the Site and applicable taxes.

- 1.4.3 Any Cash and/or Contingency Allowance payments will only be made with the prior written authorization of the Contract Administrator. The Contractor shall have no claim on any unused portion of any Cash and/or Contingency Allowances.

1.5 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

- 1.5.1 Prepare and provide a schedule of estimated payment requests anticipated throughout the Contract beginning within thirty (30) Days of the commencement of the Work and monthly thereafter.
- 1.5.2 Base estimated progress payments on the initially accepted progress schedule and cash flow, substantiated by a fully itemized statement showing the estimated value of the permanent Work executed up to the end of the monthly period. Adjust to reflect subsequent adjustments in the progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.6 APPLICATION FOR PAYMENT

- 1.6.1 The Contractor shall submit an Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) as applicable, a listing of materials on Site as applicable, and such other supporting data as may be requested by the Contract Administrator.
- 1.6.2 The Contractor shall use a detailed Application for Payment Form in a format acceptable to the Owner and in accordance with the Contract Documents.
- 1.6.3 The Contractor shall provide a separate breakdown for Work to be paid for on the basis of unit prices or from cash allowances.
- 1.6.4 The Contractor shall provide with each application after the first, a sworn statement, using a Statutory Declaration Form certifying that all accounts for the subcontracts, construction machinery and equipment, materials, products, labour and other indebtedness which may have been incurred by the Contractor, and for which the Owner might in any way be held responsible, have been paid in full, except for amounts properly retained as holdback or as an identified amount in dispute.
- 1.6.5 The Contractor shall provide a current Workplace and Safety Insurance Board (WSIB) certificate stating that the Contractor is in good standing with the WSIB and that all assessments have been paid by the Contractor to the date of the certificate.
- 1.6.6 The Contractor shall list each Change Order and Written Amendment executed prior to the date of submission as a separate line item.

- 1.6.7 The Contractor shall submit an updated Progress Schedule, pursuant to Section 01310 – Project Management.
- 1.6.8 The Contractor shall submit Construction Photographs to illustrate the progress of the Work, pursuant to Section 01310 – Project Management.
- 1.6.9 The Contractor shall provide proof that it has recorded information on the Contract Drawings to reflect “As Constructed” information.
- 1.6.10 The Owner shall not release monies for Payment Certificates until the Contractor has provided all of the supporting documentation, as specified herein.
- 1.6.11 Deviations from the above specified requirements or incomplete submissions shall require resubmission of the application for payment.

1.7 PAYMENT

1.7.1 General:

- 1.7.1.1 Progress payments will be made monthly.
- 1.7.1.2 The date for the Contractor’s submission of the monthly Application for Payment shall be established at the Preconstruction Meeting.
- 1.7.2 Payment for all of the Work shown or specified in the Contract Documents is included in the Contract Price.
- 1.7.3 Payment for unit price items covers all of the Work necessary to furnish and install the items identified in the schedule of Additional Unit Prices in the Form of Tender.
- 1.7.4 Payment for equipment shall be made as follows:
 - 1.7.4.1 For all non-preselected equipment, payment will generally be 15% on shop drawings, 35% for a successful FAT, 40% for a successful SAT, and 10% on commissioning.

1.8 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

1.8.1 Payment will not be made for the following:

- 1.8.1.1 Loading, hauling, and disposing of rejected material.
- 1.8.1.2 Quantities of material wasted or disposed of in manner not called for under the Contract Documents.
- 1.8.1.3 Rejected loads of material, including material rejected after it has been placed by reason of failure of the Contractor to conform to requirements of the Contract Documents.

1.8.1.4 Material not unloaded from a transporting vehicle.

1.8.1.5 Defective Work not accepted by the Owner.

1.8.1.6 Material remaining on hand after completion of the Work.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01040
CO-ORDINATION**

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	SUPERVISION	1
1.3	UTILITY NOTIFICATION AND COORDINATION	1
1.4	COORDINATION OF CONSTRUCTION	1
1.5	CO-OPERATION WITH OTHER CONTRACTORS.....	2
1.6	FACILITY OPERATIONS AND CONSTRUCTION CONSTRAINTS	2
1.7	OTHER PROJECTS AT THE SITE(S)	3
1.8	HOURS OF OPERATION.....	4
1.9	CONSTRUCTION PHOTOGRAPHS	4
1.10	ADJACENT FACILITIES AND PROPERTIES	4
1.11	PUBLIC RELATIONS.....	5
1.12	PUBLIC NOTICES	5
1.13	BASIS OF PAYMENT	5
2	PRODUCTS (NOT USED)	6
3	EXECUTION (NOT USED)	6

SECTION 01040 CO-ORDINATION

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 This Section outlines the requirements for coordination with Owner staff, the Operating Authority, utilities, the Contract Administrator and other Contractors. It is not intended to form the basis for removing any responsibility of the Contractor or their Subcontractor.

1.2 SUPERVISION

- 1.2.1 Maintain on the site, where applicable, a general superintendent who shall be fully qualified to properly direct the progress of this Contract continuously including the co-ordination and work of sub-contractors.
- 1.2.2 During periods when work on this project is not being carried out, maintain protective fencing, where required, or a competent watchman on the site, to guard the site and works and the properties and possessions thereon of the Contractor and his sub-contractors as well as those of the Owner.

1.3 UTILITY NOTIFICATION AND COORDINATION

- 1.3.1 Coordinate the Work with various utilities within Project limits.
- 1.3.2 Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.

1.4 COORDINATION OF CONSTRUCTION

- 1.4.1 The Work on this contract is to be completed in its entirety by the Contractor using the Contractor's own forces or the forces of individual subcontractors and sub-trades.
- 1.4.2 The Contractor shall examine the work of all trades and ensure that conditions are satisfactory for the completion of any subsequent work.
- 1.4.3 The Contractor shall notify the Contract Administrator immediately of any adverse conditions, which may affect subsequent work and shall not proceed with any subsequent work until such conditions are rectified.
- 1.4.4 The Contractor is responsible for transporting all Contractor personnel and equipment to site. The Owner will not pay for any additional Contractor transportation costs outside of the original bid.

- 1.4.5 Coordinate Work with Owner where interruption to the Owner's operation is inevitable and abide by the agreed upon schedule.

1.5 CO-OPERATION WITH OTHER CONTRACTORS

- 1.5.1 Co-operate and make suitable working arrangements with other Contractor(s) to ensure satisfactory completion of the work.
- 1.5.2 It shall be the responsibility of the Contractor named in the Contract Agreement to coordinate construction activity under this contract with others having business at the site including other contractors, the Owner, and local authorities and their personnel. Contractor staging and space must be maintained.
- 1.5.3 At the interface with other contracts, jointly plan and coordinate with other contractors the work so that the project:
 - 1.5.3.1 Will not be delayed.
 - 1.5.3.2 Will not be endangered in any way.
 - 1.5.3.3 Will be correctly completed.
- 1.5.4 Obtain the written approval of the Contract Administrator for all arrangements that have been made with other Contractor(s).
- 1.5.5 The Contract Administrator will determine coordination and execution of the work in the event that Contractors are unable to reach a satisfactory working agreement.
- 1.5.6 The Owner reserves the right to require the Contractor to alter their schedule to accommodate other operational maintenance by the Owner or their designated Contractors.
- 1.5.7 Coordinate with the Contract Administrator for SCADA system, network components, installations, inspections, commissioning, and testing.

1.6 FACILITY OPERATIONS AND CONSTRUCTION CONSTRAINTS

- 1.6.1 Continuous operation of the Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified. In the event of conflict between construction activities and facility operations, facility operations have priority unless otherwise specified.
- 1.6.2 Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of the Owner's operations.
- 1.6.3 When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of the Owner's facilities.

1.6.4 Process or Facility Shutdown:

- 1.6.4.1 Where applicable provide fourteen (14) days advance written request for approval of need to shut down a process or facility to the Owner and Contract Administrator.
- 1.6.4.2 Power outages will be considered three (3) business days' written request to the Owner, Operating Authority, and Contract Administrator. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
- 1.6.5 Install and maintain temporary connections required to keep the Owner's operations online. Sequences other than those specified shall be considered upon written request to the Owner and Contract Administrator, if they afford equivalent continuity of operations.
- 1.6.6 Do not proceed with Work affecting the facility's operation without obtaining the Owner's, Operating Authority's, and Contract Administrator's advance (three (3) business days) approval of the need for, and duration of such Work.
- 1.6.7 All PLCs and related equipment are considered process critical and need to remain energized at all times. Very short outages (less than the capacity of the back-up power UPS – Typically 1 Hour) may be permitted under the co-ordination of the Contract Administrator and at the discretion of the Owner and Operating Authority.
- 1.6.8 No existing system shall be disconnected or otherwise made inoperable until all replacement equipment and material are on site and verified by the Contract Administrator.
- 1.6.9 Present a Project Work Schedule in conformance with the constraints provided below. Provide adequate resources and schedule receipt of material to execute the required scope of work within the identified time periods.
- 1.6.10 The Work Schedule shall show the Contract completion date starting from the date the Order to Commence (O to C) is given.
- 1.6.11 Contractor shall coordinate and obtain permission from the Owner before accessing any and all properties under the scope of this project.

1.7 OTHER PROJECTS AT THE SITE(S)

- 1.7.1 For this project there may be other construction projects active at the same time. Coordination with the Engineer and Owner will be required. A detailed construction sequencing plan will be developed by the contractor and agreed upon by the Engineer and Owner prior to the commencement of any construction activities.

1.8 HOURS OF OPERATION

- 1.8.1 The hours of operation, for this contract, are to be between 07:00-17:00, Monday to Thursday, excluding Statutory Holidays. If required submit a request in writing to the Contract Administrator for approval to complete work outside normal working hours. Approval of this request is at the discretion of the Contract Administrator, Operating Authority, and Owner and will not be considered for work that can be executed during normal working hours.

1.9 CONSTRUCTION PHOTOGRAPHS

- 1.9.1 Contractor to photograph all phases of the project including pre-construction, construction progress, and post-construction. Make available to the Contract Administrator, the Operating Authority, and Owner.
- 1.9.2 The Contract Administrator shall have the right to select the subject matter and vantage point from which photographs are to be taken.
- 1.9.3 Pre-construction and Post-construction:
 - 1.9.3.1 Take digital photographs of the work area, electrical equipment, and panels prior to any work, and after the work is completed from similar angles for proper before and after comparison.
 - 1.9.3.2 For each control panel at each site, a minimum of front and sides of the panel with the doors closed, and a minimum of 4 pictures inside the panel, two general layout pictures and minimum of 2 specific work area pictures (i.e. focus on the PLC or affected work area).
 - 1.9.3.3 Particular emphasis shall be directed to the SCADA system component mounting locations.
- 1.9.4 Construction Progress Photos:
 - 1.9.4.1 Provide photos to demonstrate progress of construction, showing every aspect of areas that will be modified or enhanced under the terms of this contract.
- 1.9.5 Digital Images:
 - 1.9.5.1 Upload photos to secure file sharing service and provide Contract Administrator, the Operating Authority, and Owner with necessary credentials for access.

1.10 ADJACENT FACILITIES AND PROPERTIES

- 1.10.1 Examination:

1.10.1.1 After the Effective Date of the Agreement, and before Work at site is started, the Contractor, Contract Administrator, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in the vicinity of Work, as applicable, which could be damaged by construction operations.

1.10.1.2 Periodic re-examination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

1.10.2 Documentation:

1.10.2.1 Record and submit documentation of observations made on examination inspections in accordance with Subsection 1.9 Construction Photographs.

1.10.2.2 Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of contractor's work or activities.

1.11 PUBLIC RELATIONS

1.11.1 Refer all comments/ complaints to Owner project manager.

1.12 PUBLIC NOTICES

1.12.1 Give adequate notice of the schedule (time and location) of the movement of materials, construction activities, maintenance and repairs to affected landowners and occupants of properties adjacent to the work areas.

1.12.2 Notify the Owner project manager immediately in writing of any complaints of damage to property or personal injury.

1.12.3 Notify the Contract Administrator as soon as possible of action taken in respect to any complaints and the outcome of such actions.

1.12.4 Notify local residents prior to any blockages of driveways and make any necessary arrangements for alternative access.

1.13 BASIS OF PAYMENT

1.13.1 No additional payment will be given for work required or delays encountered in coordination of the work whether arranged directly between Contractors or on instructions from the Contract Administrator. Full responsibility for work so arranged or directed by the Contract Administrator shall be the Contractors.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01050
FIELD ENGINEERING**

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	CONSTRUCTION LAYOUT	1
1.3	FIELD MEASUREMENTS AND TESTS.....	1
1.4	SURVEY MONUMENTS	1
2	PRODUCTS (NOT USED)	1
3	EXECUTION (NOT USED)	1

SECTION 01050 FIELD ENGINEERING

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 This Section outlines the requirements for survey, layout and engineering considerations at the Site in the execution of the construction work.

1.2 CONSTRUCTION LAYOUT

- 1.2.1 Be responsible for laying out the work, based on the benchmark and reference lines shown on the Drawings or established by the Contract Administrator.
- 1.2.2 Be responsible for the accuracy of levels and layout during the construction period.

1.3 FIELD MEASUREMENTS AND TESTS

- 1.3.1 Measure all field dimensions required for the proper execution of the Work. Field measurements of critical items shall be carried out by the Contractor before fabrication/procurement and shall be shown on the shop drawings.
- 1.3.2 Field verify the locations and elevations of SCADA equipment and related equipment that will be supplied and installed or which affect structures that said items will be connected to or installed at or on.

1.4 SURVEY MONUMENTS

- 1.4.1 Do not remove survey monuments, iron bars, round iron pipes, and stakes representing property boundaries and locations encountered in the line of work without the written permission of the Contract Administrator.
- 1.4.2 Replacement of all monuments removed or damaged are to be done by an Ontario Land Surveyor at the expense of the Contractor. The cost for the replacement of survey monuments removed without the permission of the Contract Administrator or damaged during construction are to be at the Contractor's expense.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01300
SUBMITTALS**

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	ADMINISTRATIVE	1
1.3	SHOP DRAWINGS AND PRODUCT DATA AND SAMPLES	1
1.4	SHOP DRAWINGS FOR TEMPORARY WORKS	2
1.5	CONTRACT ADMINISTRATOR’S REVIEW	3
1.6	OPERATING AND MAINTENANCE MANUALS	4
1.7	SAMPLES	4
1.8	PAYMENT SCHEDULE	4
1.9	TESTS AND REPORTS	4
1.10	INTERFERENCE DRAWINGS	5
2	PRODUCTS (NOT USED)	6
3	EXECUTION (NOT USED)	6

SECTION 01300 SUBMITTALS

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 This section outlines the requirements of the Contractor for submission of Shop Drawings, Product Data and Samples.

1.2 ADMINISTRATIVE

- 1.2.1 Provide the Contract Administrator with a submittal schedule for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and claim for extension by reason of such default will not be allowed.
- 1.2.2 Do not proceed with work affected by a submittal until the submittal has been reviewed by the Contract Administrator.
- 1.2.3 Review submittals prior to submission to the Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and shall be considered rejected.
- 1.2.4 Verify that field measurements and affected adjacent Work are co-ordinated.
- 1.2.5 Keep one reviewed copy of each submission on site.
- 1.2.6 Apply the appropriate Contract drawing numbers to the Shop Drawings.

1.3 SHOP DRAWINGS AND PRODUCT DATA AND SAMPLES

- 1.3.1 Submit shop drawings, product data and samples requested by Contract Administrator, and where called for in other sections of the specifications.
- 1.3.2 Do not proceed with work until relevant submissions are reviewed by Contract Administrator.
- 1.3.3 Present shop drawings, correspondence, data and specifications in SI Metric units.
- 1.3.4 Where items or information are not produced in SI Metric units converted values are acceptable.
- 1.3.5 Notify the Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reason for deviation.

- 1.3.6 Notify the Contract Administrator, in writing, when resubmitting any revisions other than those requested by Contract Administrator.
 - 1.3.6.1 Location where equipment or material is to be installed.
 - 1.3.6.2 Name of sub-contractor or supplier.
 - 1.3.6.3 Title of drawing and date.
- 1.3.7 Check and initial all shop drawings before submission to Contract Administrator.
- 1.3.8 Shop drawings will not be reviewed, and will be returned and considered rejected, unless they have been previously checked and initialled by Contractor.
- 1.3.9 Make corrections or changes required by Contract Administrator and re-submit revised drawings.
- 1.3.10 Do not make changes to shop drawings after final review without written permission of the Contract Administrator.
- 1.3.11 The Contractor will allow 15 working days for the Contract Administrator's review of each submission. No claims for delay will be entertained if review extends beyond this time.
- 1.3.12 If a shop drawing submittal is rejected and then the resubmittal is rejected two (2) more times, any additional review effort and cost shall be borne by the Contractor.

1.4 SHOP DRAWINGS FOR TEMPORARY WORKS

- 1.4.1 Submit for review shop drawings of temporary works which:
 - 1.4.1.1 Control the dimensions and locations of any part of the structures to be constructed under the contract.
 - 1.4.1.2 Impose loads on parts of the works which are still under construction or on existing structures.
 - 1.4.1.3 Identify exact location of any fencing and or entry gates.
- 1.4.2 Submit shop drawings for review. Payment will not be made for work started or completed without the required drawing review. Submit shop drawings well in advance of the time when they are required for construction. This includes the time for the initial Contract Administrator review per item 1.4.13 and any subsequent reviews if needed. Coordinate shop drawings prepared by different trades so that information is available to prevent conflict or errors where the work of one trade affects the work of another.
- 1.4.3 Submitted shop drawings will be returned to the Contractor after review.

- 1.4.4 Shop drawings will be reviewed for conformity with the required arrangement and dimensions of the permanent structures and for general conformity with the specifications.
- 1.4.5 If resubmittal is requested, discuss the comments made and resolve all issues raised by them, then resubmit the shop drawings amended accordingly.
- 1.4.6 Do not begin construction of temporary works before review of the shop drawings is completed.
- 1.4.7 Review of the Contractor's drawings does not relieve the Contractor of the responsibility for the results arising from errors or omissions of design or from the use or abuse of the temporary works.
- 1.4.8 Keep one copy of each stamped, reviewed drawing at the site of the work for reference during the duration of the construction work.
- 1.4.9 Make no changes to drawings after they have been reviewed.
- 1.4.10 Submit shop drawings in SI metric units.

1.5 CONTRACT ADMINISTRATOR'S REVIEW

- 1.5.1 This review by the Contract Administrator is for the sole purpose of ascertaining conformance with the general design concept. This review will not mean that the Contract Administrator approves the detail design inherent in the shop drawings, responsibility for which will remain with the Contractor submitting same, and such review will not relieve the Contractor of his responsibility for errors or omissions in the shop drawings of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the jobsite, for information that pertains solely to fabrication processes or techniques of construction and installation and for coordination of the work of all sub-trades.
- 1.5.2 Review of drawings and specifications will, in every case, be subject to final acceptance of the equipment and materials after they have been put into commission, all guarantees have been fulfilled, and the general operation of the equipment and materials has been found satisfactory to the Contract Administrator.
- 1.5.3 Review does not release Contractor of responsibility for the proper installation and performance of any material or equipment nor from the liability to replace same should it prove defective or deficient.
- 1.5.4 Where substitutions to the first named or specified a product is made, any and all costs resulting from the changes on other design items shall be borne by the contractor.
- 1.5.5 Drawings marked "Revise and Re-submit" must be amended and re-submitted for review prior to proceeding or ordering to proceed.

1.5.5.1 No order will be given for such work and such work will not proceed unless drawings have been returned marked either “Reviewed” or “Reviewed as Modified”.

1.5.6 Contract Administrator will review and return shop drawings to the Contractor within fifteen (15) working days. No claims for delay will be entertained if review extends beyond this time.

1.5.7 Submissions that are not requested by the Contract Administrator, or called for in the specifications, will not be reviewed by the Contract Administrator but will be returned marked “Not Reviewed”. In such cases the materials and/or equipment shall conform strictly with the requirements of the specifications and drawings.

1.5.8 Shop drawings for fabricated panels including wiring schematics, loops drawings and panel layout drawings shall be submitted in both hard copies as well as CAD and PDF format. Native CAD files shall be made available at no additional cost.

1.6 OPERATING AND MAINTENANCE MANUALS

1.6.1 Refer to section 01730 Operation and Maintenance Manuals for information.

1.7 SAMPLES

1.7.1 Submit for review samples as requested in respective specification Sections. Label samples as to origin and intended use in the Work.

1.7.2 Deliver samples prepaid to Contract Administrator’s business address, or as otherwise instructed.

1.7.3 Notify the Contract Administrator in writing, at the time of submission of deviations in samples from requirements of Contract Documents.

1.7.4 Adjustments made on samples by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Contract Administrator prior to proceeding with the Work.

1.7.5 Make changes in samples, which the Contract Administrator may require, consistent with Contract Documents.

1.8 PAYMENT SCHEDULE

1.8.1 Refer to Section 01025 Measurement and Payment for payment submittals.

1.9 TESTS AND REPORTS

1.9.1 Insofar as practical, test materials and equipment on site. Where shop test is necessary, give Contract Administrator and the Operating Authority two (2) weeks’ notice in writing of proposed shop test date.

- 1.9.2 Before operating equipment, engage the services of a qualified manufacturer's service representative to inspect, operate, test and adjust the equipment after installation.
- 1.9.3 Submit the manufacturer's representative's signed report describing in detail the inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken for correct maintenance. Verify that the equipment and its installation conform to the requirements of the Contract for the service intended and is ready for permanent operation. Bind copies of report into the installation, operation and maintenance manuals.
- 1.9.4 Inspection includes:
 - 1.9.4.1 Soundness (without cracked or otherwise damaged parts).
 - 1.9.4.2 Completeness of installation as specified and as recommended by manufacturer.
 - 1.9.4.3 Correctness of setting, alignment and relative arrangement of various parts of the security system.
- 1.9.5 Operate, test and adjust equipment to prove it is correctly installed to operate under the intended conditions.
- 1.9.6 Equipment will only be accepted after receipt of the manufacturer's representative's report.
- 1.9.7 Submit notice in writing at least three (3) business days before manufacturer's representative is scheduled to perform these services.
- 1.9.8 Modify or replace equipment or materials failing required tests.
- 1.9.9 Perform additional testing required due to changes of materials requested by Contractor or due to failure of materials or construction to meet Specifications at no additional cost to the Owner.

1.10 INTERFERENCE DRAWINGS

- 1.10.1 Where required and before installation of civil, electrical and SCADA systems, prepare an integrated set of interference drawings in cooperation with all trades.
- 1.10.2 As the work progresses, prepare and submit updated interference drawings.
- 1.10.3 After discussion with Contract Administrator, at no additional cost, make necessary relocations due to interference of trades, as a result of incomplete drawings.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01310
PROJECT MANAGEMENT**

1	GENERAL.....	2
1.1	DESCRIPTION	2
1.2	RELATED SECTIONS SPECIFIED ELSEWHERE	2
1.3	CONSTRUCTION ORGANIZATION AND PRECONSTRUCTION MEETING	2
1.4	ON-SITE DOCUMENTS.....	3
1.5	SCHEDULE MANAGEMENT	4
1.6	COORDINATION OF CONSTRUCTION	4
1.7	CONSTRUCTION PROGRESS MEETINGS.....	5
2	PRODUCTS (NOT USED)	6
3	EXECUTION (NOT USED)	6

SECTION 01310
PROJECT MANAGEMENT

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 Coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities, operations and construction Work, under the instructions of the Contract Administrator.

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

- 1.2.1 All Divisions and Sections are related to this Section.

1.3 CONSTRUCTION ORGANIZATION AND PRECONSTRUCTION MEETING

- 1.3.1 Within seven (7) working days after Order to Commence, Contractor to schedule a preconstruction meeting (project kick-off) to discuss and resolve administrative procedures and responsibilities.
- 1.3.2 Attendance required:
 - 1.3.2.1 Contractor's Superintendent
 - 1.3.2.2 Contractor's Project Manager
 - 1.3.2.3 Contract Administrator/Resident Inspector
 - 1.3.2.4 Owner's Project Manager
 - 1.3.2.5 Operating Authority
 - 1.3.2.6 Others, as appropriate
- 1.3.3 Establish a time and location for the meeting and notify concerned parties a minimum of five (5) working days before the meeting.
- 1.3.4 The Agenda for the meeting is to include the following:
 - 1.3.4.1 Appointment of official representative for participants in Work.
 - 1.3.4.2 Schedule of Work, progress scheduling, permit status.
 - 1.3.4.3 Schedule of submission of all shop drawings.
 - 1.3.4.4 Where required temporary facilities, site sign, offices, storage sheds, utilities, and fences.

- 1.3.4.5 Delivery schedule of specified equipment.
- 1.3.4.6 Site security and use of site.
- 1.3.4.7 Ministry of Labour Notice of Project
- 1.3.4.8 Ministry of Environment, Conservation and Parks (MECP), Form 1
- 1.3.4.9 Health and Safety
- 1.3.4.10 Proposed changes, change orders, procedures, approvals required, and administrative requirements.
- 1.3.4.11 Record drawings, manuals, etc.
- 1.3.4.12 Monthly progress claims, administrative procedures, photographs, and holdbacks.
- 1.3.4.13 Appointment of inspection and testing agencies or firms.
- 1.3.4.14 Insurances and transcript of policies.
- 1.3.4.15 Coordination with other Contractors

1.4 ON-SITE DOCUMENTS

- 1.4.1 Maintain at job site, one copy of each of the following:
 - 1.4.1.1 Notice of Project.
 - 1.4.1.2 Contract drawings.
 - 1.4.1.3 Specifications.
 - 1.4.1.4 Addenda.
 - 1.4.1.5 Reviewed shop drawings.
 - 1.4.1.6 Contract Change Orders.
 - 1.4.1.7 Other modifications to Contract.
 - 1.4.1.8 Field test reports.
 - 1.4.1.9 Copy of approved Work schedule.
 - 1.4.1.10 Health and Safety Plan.
 - 1.4.1.11 Material Safety and Data Sheets

1.4.1.12 Manufacturers' installation and application instructions.

1.4.1.13 All required Approvals and Permits.

1.4.1.14 Red-line drawings.

1.5 SCHEDULE MANAGEMENT

- 1.5.1 Submit to the Contract Administrator within seven (7) working days of issuance of Order to Commence Work, the preliminary construction progress schedule, based on the tender and all required schedules.
- 1.5.2 After review by the Contract Administrator, revise and resubmit all schedules to comply with revised project schedule.
- 1.5.3 Identify and track all critical items on all schedules and advise the Contract Administrator of any changes to the schedules.
- 1.5.4 Actively manage and coordinate the work to avoid delays against reviewed schedules.
- 1.5.5 Revise schedules, reorganize and replace construction to minimize the impact of any identified delays.
- 1.5.6 Provide monthly schedule outlook showing upcoming construction activities.
- 1.5.7 Required schedules will be submitted to the contract administrator no later than 24 hours prior to scheduled construction meetings.

1.6 COORDINATION OF CONSTRUCTION

- 1.6.1 This is a lump sum contract to be completed in its entirety by the Contractor using the Contractor's own forces or the forces of individual subcontractors and subtrades.
- 1.6.2 All of the specifications, drawings and Front-End Documents will be interpreted as one contract and the Contractor will be wholly responsible for coordination of all work by the Contractor's own forces, subtrades or subcontractors to complete the work.
- 1.6.3 No Section or Division of these specifications will be construed or interpreted as being the responsibility of any subtrade, subcontractor or supplier.
- 1.6.4 The Contractor will examine the work of all trades and ensure that conditions are satisfactory for the completion of any subsequent work.
- 1.6.5 The Contractor will notify the Contract Administrator immediately of any adverse conditions, which may affect subsequent work and will not proceed with any subsequent work until such conditions are rectified.

1.7 CONSTRUCTION PROGRESS MEETINGS

- 1.7.1 During the course of the work and up to Substantial Performance, the Contract Administrator will schedule and administer monthly progress meetings throughout the progress of the Works. Progress meetings may be more frequent during critical construction milestones.
- 1.7.2 Attendance required:
 - 1.7.2.1 Contractor's Superintendent.
 - 1.7.2.2 Major subcontractors, as required.
 - 1.7.2.3 Contract Administrator/Resident Inspector.
 - 1.7.2.4 Owner's Project Manager.
 - 1.7.2.5 Others, as appropriate.
- 1.7.3 The Contract Administrator will prepare agenda for meetings.
- 1.7.4 The Contract Administrator will distribute written or electronic notice to the Contractor and other parties a minimum of 2 working days prior to meetings.
- 1.7.5 The Contract Administrator will record minutes of meetings and circulate these to attending parties and affected parties not in attendance within 5 working days after meeting.
- 1.7.6 The Agenda for the meeting is to include the following:
 - 1.7.6.1 Review, approval of minutes of previous meeting.
 - 1.7.6.2 Review of Work progress since previous meeting.
 - 1.7.6.3 Field observations, problems, and conflicts.
 - 1.7.6.4 Construction schedule.
 - 1.7.6.5 Review of submittal schedules.
 - 1.7.6.6 Review proposed changes for affect on construction schedule and on completion date.
 - 1.7.6.7 Health and Safety Issues.
 - 1.7.6.8 Public Relations.
 - 1.7.6.9 Other business.

- 1.7.7 Representatives of Contractor attending meeting should be thoroughly informed and knowledgeable with respect to proposed topic of discussion and authorized to act and make commitments with respect to matters agreed to at meeting.
- 1.7.8 Informal meetings with the Contractor, Contract Administrator, and Owner will be scheduled, as required, to address issues arising between monthly progress meetings.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01351
HEALTH AND SAFETY**

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	SUBMITTALS.....	1
1.3	REGULATORY REQUIREMENTS	3
1.4	GENERAL REQUIREMENTS.....	4
1.5	RESPONSIBILITY	4
1.6	COMPLIANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT	5
1.7	MEETINGS.....	5
1.8	WORK STOPPAGE.....	6
1.9	HEALTH AND SAFETY OFFICER.....	6
1.10	PERSONNEL HEALTH, SAFETY AND HYGIENE.....	6
1.11	CONTINGENCY AND EMERGENCY RESPONSE.....	7
2	PRODUCTS (NOT USED)	7
3	EXECUTION (NOT USED)	7

**SECTION 01351
HEALTH AND SAFETY**

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 The Contractor shall be designated as the Constructor, as defined by the OHSA.
- 1.1.2 All works will conform to the Occupational Health and Safety Act (the Act), and applicable Regulations made under the Act including but not limited to O. Reg. 213/91 (as amended) and all applicable industry standards and guidelines.
- 1.1.3 Comply with all Federal and Provincial Health and Safety Acts and Regulations, Local Municipality Health and Safety By-Laws and with all applicable industry safety standards.
- 1.1.4 Comply with all Owner Health and Safety policies, safe working procedures, programs, rules and requests.
- 1.1.5 Canada Labour Code, Part II Canada Occupational Safety and Health Regulations (as amended).
- 1.1.6 Comply with and understand site evacuation processes.

1.2 SUBMITTALS

- 1.2.1 Contractor's site-specific Health and Safety Plan: Within 15 working days after date of Notice to Proceed and prior to mobilization on site, submit a site-specific Health and Safety Plan. The site-specific Health and Safety Plan must address the items as outlined below.
 - 1.2.1.1 Site-specific safety hazard assessment and hazard analysis for each site task and operation along with the identified mitigating factors.
 - 1.2.1.1.1 Submit Construction Safety Checklists after completion.
 - 1.2.1.1.2 Submit copies of all reports or directives issued by Federal and/or Provincial health and safety inspector(s).
 - 1.2.1.1.3 Submit CAD 7 report from the Workplace Safety & Insurance Board outlining the accident history for the last 3 years, or a summary of accident history for the last three (3) years.
 - 1.2.1.1.4 Submit on-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

- 1.2.1.1.5 Submit Material Safety Data Sheets (MSDS) and documentation on the safe handling procedures for any “hazardous” materials or chemicals that the Contractor, sub-contractors, or representatives, plan to bring on site.
- 1.2.1.1.6 Submit, and post at the Work site, the emergency numbers for police, fire and ambulance for the locale of the Work, as well as the names and after-hours numbers for key site personnel related to health, safety or security of the site.
- 1.2.1.2 Personnel training requirements including as follows:
 - 1.2.1.2.1 Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.
 - 1.2.1.2.2 Work practices by which personnel can minimize risks from hazards, safe use of engineering controls and equipment on site including recognition of symptoms and signs, which might indicate overexposure to hazards, and elements of site-specific Health and Safety Plan.
 - 1.2.1.2.3 Site control measures to be employed at site including site map, site work zones, use of ‘buddy system’, site communications including site security, alerting means for emergencies, standard operating procedures or safe work practices, and identification of nearest medical assistance.
 - 1.2.1.2.4 Emergency response requirements addressing: Pre-emergency planning, personnel roles, lines of authority and communication, emergency recognition and prevention, safe distances and places of refuge, site security and control, evacuation routes and procedures, emergency medical treatment and first aid, emergency alerting and response procedures, critique of response and follow-up, emergency equipment, site topography, layout, prevailing weather conditions, and procedures for reporting incidents to local, provincial, or federal agencies.
 - 1.2.1.2.5 Written respiratory protection program for applicable project activities.
 - 1.2.1.2.6 Procedures for dealing with heat and/or cold stress.
 - 1.2.1.2.7 Confined space entry procedures.
 - 1.2.1.2.8 Spill containment program if drummed waste material is generated, excavated, stored, or managed on site.

- 1.2.1.3 The Contract Administrator will review the Contractor's site-specific Health and Safety Plan and provide comments, as it relates to the safety of the on-site Owner inspectors, to the Contractor within ten (10) working days after receipt of plan. Revise plan as appropriate and resubmit plan to the Contract Administrator within ten (10) working days after receipt of comments.
- 1.2.1.4 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.
- 1.2.1.5 In any emergency, the Contractor will stop the work, make changes, or order extra work to ensure the safety of life or protection of the Works or neighbouring property.
- 1.2.1.6 Off-site Contingency and Emergency Response Plan:
 - 1.2.1.6.1 Prior to commencing work involving handling of hazardous materials, develop an off-site Contingency and Emergency Response Plan.
 - 1.2.1.6.2 Plan must provide immediate response to serious site occurrences such as explosion, fire, or migration of toxic or hazardous material from site.
- 1.2.1.7 All formal submissions required by the Constructor including registration and notification of project to the provincial Ministry of Labour.
- 1.2.1.8 Make all other pertinent submittals in accordance with Section 01300 – Submittals.

1.3 REGULATORY REQUIREMENTS

- 1.3.1 Comply with all applicable laws and regulations including all applicable industry standards and guidelines relating to the Work to ensure safe operations at site and the preservation of the public health and safety.
- 1.3.2 Comply with all requirements for guardrails, formwork and ladders, and the erection of scaffolding.
- 1.3.3 Fall protection shall be provided and worn as required by legislation.
- 1.3.4 Meet current and revised (O.Reg.632/05) Ministry of Labour regulatory requirements for Confined Space Entry Programs, when applicable.
- 1.3.5 Meet current Canadian Standards Association, CSA Z460, Control of Hazardous Energy, requirements for lock out.

- 1.3.6 Meet current Canadian Standards Association, CAN/CSA Z94.4, Selection, Use and Care of Respirators.
- 1.3.7 Comply with Workplace Hazardous Materials Information System (WHMIS) Regulation, R.R.O. 1990, Reg. 860 and O. Reg. 36/93), (as amended).
- 1.3.8 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations, SOR/86-304 (as amended), Part X – Hazardous Substances.
- 1.3.9 Comply with all relevant Electrical Safety Authority (ESA) Rules and Regulations.

1.4 GENERAL REQUIREMENTS

- 1.4.1 Develop written site-specific Health and Safety Plan prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- 1.4.2 Comply with all specified and applicable standards and regulations to ensure safe and minimal risk working environment for site personnel and minimize impact of activities involving contact with any hazardous materials or hazardous wastes on general public and surrounding environment.
- 1.4.3 Relief from or substitution for any portion or provision of minimum Health and Safety Guidelines specified herein or reviewed site-specific Health and Safety Plan must be submitted to the Contract Administrator in writing. The Contract Administrator will respond in writing, either accepting or requesting improvements.
- 1.4.4 Correct deficiencies and resubmit Health & Safety Plan when so requested by Contract Administrator.
- 1.4.5 All contractor and subcontractor workers must have photo identification onsite that includes the worker's name and company.
- 1.4.6 Contractor responsible for their workers plant's sign in/out. During an evacuation, contractor is responsible for head count. Contractor must notify Owner if there is a missing person during an evacuation.

1.5 RESPONSIBILITY

- 1.5.1 The Contractor shall be designated as and fulfill the role of 'Constructor', as defined by the Act and O. Reg. 213/91 (as amended).
- 1.5.2 The Contractor shall be solely responsible for the safety of persons, equipment, and property on site and for protection of persons off site and the environment to extent that they may be affected by the conduct of Work.

- 1.5.3 The Contractor shall comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- 1.5.4 The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Work by employing or appointing a competent Health and Safety Officer (refer to Subsection 1.9).
- 1.5.5 The construction supervisor will represent the Contractor at the Work, and all notices and instructions given to the supervisor by the Contract Administrator, or representative, will be held to have been received by the Contractor.

1.6 COMPLIANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT

- 1.6.1 It is specifically drawn to the attention of the Contractor that the Occupational Health and Safety Act provides, in addition to other items that:
 - 1.6.1.1 A Constructor shall ensure, on a project undertaken by the Contractor that:
 - 1.6.1.1.1 The measures and procedures prescribed by this Act and regulations are carried out on the project.
 - 1.6.1.1.2 Every employer and every worker performing work on the project complies with this Act and the regulations.
 - 1.6.1.1.3 The health and safety of workers on the project is protected.
 - 1.6.1.2 This Contract is deemed to be an individual project for the purposes of the Occupational Health and Safety Act and the regulations made thereunder and the Contractor to whom the Contract is awarded unequivocally acknowledges that he is the Constructor as defined in the said Act on this project and shall carry out all of the obligations and shall bear all of the responsibilities of the Constructor as set out in the said Act and Regulations.
 - 1.6.1.3 If the Owner is designated as the “Constructor” as a result of the Contractor’s actions, all the increases in costs shall be borne by the Contractor.
- 1.6.2 Strictly comply with Occupational Health and Safety Act Regulations for construction projects.

1.7 MEETINGS

- 1.7.1 Coordinate and attend all site meetings (e.g. site orientation, “toolbox talks”, pre-commissioning meeting).

- 1.7.2 Debrief the necessary parties on the content and outcome of site meetings, including the Contract Administrator, as needed.

1.8 WORK STOPPAGE

- 1.8.1 Give precedence to health and safety of public and site personnel and protection of environment over cost and schedule considerations for Work.
- 1.8.2 Assign responsibility and obligation to Health and Safety Officer to stop or start Work when, at Health and Safety Officer's discretion, it is necessary or advisable for reasons of health or safety.
- 1.8.3 Provide Contract Administrator with written report of action taken to correct non-compliance of health and safety issues identified.
- 1.8.4 If at any time the Contract Administrator, or representative(s), observes the works to be unsafe, the Contractor and the site Health and Safety Officer may be advised immediately in writing. Should the Contractor and/or site Health and Safety Officer fail to take adequate measures; the Contract Administrator may issue a stop work order and will immediately inform the relevant authorities. The Contractor will not be compensated for the stoppage of such work so ordered by the Contract Administrator.

1.9 HEALTH AND SAFETY OFFICER

- 1.9.1 Employ and assign to the Work a competent and authorized representative as Health and Safety Officer. Health and Safety Officer must:
 - 1.9.1.1 Have minimum 2 years' site-related working experience specific to activities associated with the Works.
 - 1.9.1.2 Have basic working knowledge of specified occupational safety and health regulations.
 - 1.9.1.3 Be responsible for completing Health and Safety Training Sessions and ensuring that personnel not successfully completing the required training are not permitted to enter site to perform Work.
 - 1.9.1.4 Be responsible for daily implementing, enforcing and monitoring the site-specific Health and Safety Plan.
 - 1.9.1.5 Be available to be on site during execution of Work, as needed.

1.10 PERSONNEL HEALTH, SAFETY AND HYGIENE

- 1.10.1 Ensure personnel entering site are trained in accordance with specific legislated training requirements. Training sessions must be completed by Health and Safety Officer, or recognized industry-training agency.

- 1.10.2 All work will be performed by workers qualified and skilled in their trades, as required by law or the scope of the Work.
- 1.10.3 Levels of Protection: Establish levels of protection for each Work area based on planned activity and location of activity. Personal Protective Equipment must meet minimum legislated requirements and be Canadian Standards Association approved as required by industry standards.
- 1.10.4 Develop protective equipment usage procedures and ensure that procedures are strictly followed by site personnel.
- 1.10.5 Emergency and First-Aid Equipment: During construction, the Contractor will provide and maintain in clean, orderly conditions, an equipped first aid kit in accordance with requirements under the Workplace Safety & Insurance Act. First aid supplies and materials must be readily accessible at all times to the Contractor's employees and to the Contract Administrator's staff. Locate and maintain portable emergency eye wash stations and appropriate fire extinguishers, as required by law including Construction Regulation and Fire Code.
- 1.10.6 Site Communications:
 - 1.10.6.1 Post-emergency numbers near site telephones.
 - 1.10.6.2 Ensure personnel use of "buddy" system and develop hand signal system appropriate for site activities.
 - 1.10.6.3 Provide an alarm system to notify employees of site emergency situations or to stop Work activities if necessary.
 - 1.10.6.4 Furnish selected personnel, including Contract Administrator's representative, with 2-way radios to ensure adequate safety and communication during an emergency.

1.11 CONTINGENCY AND EMERGENCY RESPONSE

- 1.11.1 Arrange and attend coordination meeting to be held with appropriate authorities to identify Emergency Response Coordinator through whom all information and coordination will occur in event of an incident.
- 1.11.2 Develop and maintain a site control plan for logging in visitors and guests.
- 1.11.3 Develop emergency evacuation procedures based on the Owner's requirements.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01400
QUALITY CONTROL

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	RELATED SECTIONS SPECIFIED ELSEWHERE	1
1.3	GENERAL	1
1.4	SUBMITTALS.....	1
1.5	INSPECTION.....	2
1.6	INDEPENDENT INSPECTION AGENCIES/LABORATORY SERVICES	2
1.7	ACCESS TO WORK	3
1.8	PROCEDURES	3
1.9	REJECTED WORK	4
1.10	TESTS AND MIX DESIGNS	4
1.11	WORKMANSHIP.....	4
1.12	EQUIPMENT AND SYSTEMS	5
2	PRODUCTS (NOT USED)	5
3	EXECUTION (NOT USED)	5

SECTION 01400 QUALITY CONTROL

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 This section outlines the Contract requirements regarding quality control during the construction of the required works.

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

- 1.2.1 All Divisions and Sections are related to this Section.

1.3 GENERAL

- 1.3.1 Design workmanship and materials used for structures to comply with:
 - 1.3.1.1 Ontario Building Code
 - 1.3.1.2 Building By-Laws of Municipality
 - 1.3.1.3 National Building Code of Canada
 - 1.3.1.4 Other regulations outlined in Section 01410
- 1.3.2 Where reference is made to a Standard or Standard Specification, latest revision at time of tender closing will apply.
- 1.3.3 Remove from site all materials rejected after delivery.
- 1.3.4 Adhere to manufacturer's recommendations with respect to handling, preparation, installation, testing, operation or protection of any product or material to be incorporated in work.
- 1.3.5 Ensure that all materials supplied are compatible with each other unless specific adjacent materials have been specified. Correct any defective work caused by non-compatibility of materials.
- 1.3.6 Ensure that all materials supplied and used for the Work are compatible with the environment in which they are installed and are expected to operate. Replace any incompatible materials that do not conform or are not designed for continuous operation in the environment in which they are installed.

1.4 SUBMITTALS

- 1.4.1 Submit to Contract Administrator full information on materials equipment, and related arrangements to be furnished.

- 1.4.2 Submit information in accordance with Section 01300.
- 1.4.3 Submit sufficient information to enable Contract Administrator to determine whether proposed materials, equipment and arrangements meet contract requirements.
- 1.4.4 Submit copies of inspection and test reports promptly to Contract Administrator.

1.5 INSPECTION

- 1.5.1 Allow the Contract Administrator and their representative(s) access to the Works at all times. If part of Work is in preparation at locations other than the job site, allow access to such work whenever it is in progress.
- 1.5.2 Give timely notice requesting inspection if work is designated for special tests, inspections or approvals by the Contract Administrator instructions.
- 1.5.3 If the Contractor covers or permits to be covered work that has been designated for special tests, inspections, or approvals before such is made then uncover such work. Have inspections or tests satisfactorily completed and make good such work.
- 1.5.4 The Contract Administrator may order any part of the Works to be examined if work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, the Contractor shall correct such work and pay cost of examination and correction. If such work is found in accordance with Contract Documents, the Owner will pay the cost of examination and replacement.

1.6 INDEPENDENT INSPECTION AGENCIES/LABORATORY SERVICES

- 1.6.1 The Owner 's Testing Laboratory or an Independent Inspection/Testing Agencies may be engaged by the Owner for the purpose of inspecting and/or testing portions of Work. The cost of such services will be borne by the Owner.
- 1.6.2 Employment of inspection/testing agencies does not relieve the Contractor from responsibility to perform work in accordance with the Contract Documents.
- 1.6.3 Where applicable coordinate with testing laboratory as designated by the Contract Administrator, the inspection and testing of the following, but not limited to:
 - 1.6.3.1 Concrete and asphalt testing
 - 1.6.3.2 Weld testing
 - 1.6.3.3 Materials and compaction testing
- 1.6.4 The Owner will appoint and pay for services of testing laboratory except for the following that are to be paid for by Contractor:

1.6.4.1 Inspection and testing required by laws, ordinances, rules, regulations, or orders of public authorities.

1.6.4.2 Inspection and testing performed exclusively for Contractor's convenience.

1.6.4.3 Mill tests and certificates of compliance.

1.6.4.4 Tests specified to be carried out by Contractor under the supervision of Contract Administrator.

1.6.5 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Defects and irregularities to be corrected as advised by the Contract Administrator at no cost to the Owner. The Contractor is to pay costs for retesting and re-inspection.

1.6.6 Contractor's responsibilities:

1.6.6.1 Furnish labour and facilities to:

1.6.6.1.1 Provide access to Work to be inspected and tested.

1.6.6.1.2 Facilitate inspections and tests.

1.6.6.1.3 Make good Work disturbed by inspection and test.

1.6.6.1.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

1.6.7 Notify Contract Administrator sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of tests.

1.6.8 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

1.6.9 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Contract Administrator.

1.7 ACCESS TO WORK

1.7.1 Allow inspection/testing agencies access to the Works, off-site manufacturing, and fabrication plants.

1.7.2 Cooperate to provide reasonable facilities for such access.

1.8 PROCEDURES

1.8.1 Notify appropriate agency and the Contract Administrator in advance of requirement for tests, in order that attendance arrangements can be made.

- 1.8.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in work.
- 1.8.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.9 REJECTED WORK

- 1.9.1 Remove defective work, whether a result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Engineer as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- 1.9.2 Make good other contractor's work damaged by such removals or replacements promptly.
- 1.9.3 If in opinion of the Contract Administrator it is not expedient to correct defective work or work not performed in accordance with the Contract Documents, the Owner may deduct from Contract Price difference in value between work performed and that called for by Contract Documents, amount of which will be determined by the Contract Administrator.

1.10 TESTS AND MIX DESIGNS

- 1.10.1 Furnish test results and mix designs as may be requested.
- 1.10.2 The cost of tests and mix designs beyond those called for in Contract Documents will be appraised by the Contract Administrator and may be authorized as recoverable.

1.11 WORKMANSHIP

- 1.11.1 The quality of the workmanship and materials will be first class, and the Works will present a neat and attractive appearance when finished.
- 1.11.2 If ordered by the Contract Administrator, the Contractor will make enough openings in the Works and/or materials as are necessary to inspect the Works.
- 1.11.3 Should the Contract Administrator find the work and/or materials so opened up to be faulty in any respect, the Contractor will remove and make good all defective work and/or materials and will bear the expense of all such opening, inspecting, and making good.
- 1.11.4 Should the Contract Administrator find the Work and/or materials so opened up to be in acceptable condition, the expense of such opening and closing will be borne by the Owner.

1.12 EQUIPMENT AND SYSTEMS

1.12.1 Submit adjustment and balancing reports for mechanical, electrical, and building equipment systems.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01410
REGULATORY REQUIREMENTS

1 GENERAL..... 1

1.1 REGULATIONS 1

1.2 COMPLIANCE WITH REGULATIONS.....1

1.3 CODES AND STANDARDS 2

1.4 PERMITS 2

1.5 SUBMITTALS 3

2 PRODUCTS (NOT USED) 3

3 EXECUTION (NOT USED) 3

SECTION 01410
REGULATORY REQUIREMENTS

1 GENERAL

1.1 REGULATIONS

1.1.1 Comply with all regulations affecting the Work, including but not limited to:

1.1.1.1 Environment Canada

1.1.1.2 Transport Canada

1.1.1.3 National Building Code

1.1.1.4 Occupational Health and Safety Act

1.1.1.5 Municipal by-laws and servicing standards

1.1.1.6 Municipal Utilities

1.1.1.7 Ontario Safe Drinking Water Act (SDWA)

1.1.1.8 Ontario Building Code

1.1.1.9 Technical Standards & Safety Authority (TSSA)

1.1.1.10 The Energy Act – Provincial Hydro Electrical Safety Codes and Bulletins, CSA Certification Standards and Electrical Bulletins.

1.1.1.11 Ontario Regulation made pursuant to the Power Corporation Act regarding the Electrical Safety Code.

1.1.1.12 Environmental Protection Act

1.1.1.13 Codes and Standards of the National Fire Protection Association

1.1.1.14 Ontario Electrical Safety Code

1.1.1.15 National Fire Protection Association (NFPA)

1.1.1.16 National Sanitation Foundation (NSF)

1.2 COMPLIANCE WITH REGULATIONS

1.2.1 Ascertain requirements and regulations of authorities listed above.

1.2.2 Comply with all such requirements and regulations as applicable to the Work.

- 1.2.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

1.3 CODES AND STANDARDS

- 1.3.1 Perform with in accordance with the latest named published editions of codes and standards.
- 1.3.2 Provide materials and workmanship, which meet or exceed the specifically named code or standard.
- 1.3.3 Execute Work in accordance with the applicable Federal, Provincial, Territorial and Municipal statutes, laws, regulations to the location of the Work to be performed.
- 1.3.4 In the event of conflict of above statutes, laws, regulations and codes, execute work in accordance with the requirements of the Authority having jurisdiction.
- 1.3.5 Enforce all safety measures in accordance with the Ontario Occupational Health and Safety Act and applicable local Construction Safety.
- 1.3.6 Enforce all safety measures in accordance with the Workplace Hazardous Materials Information System (WHMIS).
- 1.3.7 For the purpose of the Occupational Health and Safety Act, the Contractor for the Works will be designated “Constructor” and will assume the responsibility of the Constructor as set out in the Act and its regulations. The Contract Administrator will monitor the quality and quantity of work, undertake progress payment inspections and inspections for compliance with specifications and plans. The Owner will NOT be a “Constructor” by reason thereof.
- 1.3.8 Provide the Director of Construction Health and Safety Branch of the Ministry of Labour with the information required under Section 4 of the Ontario Regulation 691/80 prior to commencing work.

1.4 PERMITS

- 1.4.1 Apply for, obtain and pay for all permits required for the Works, including but not limited to:
 - 1.4.1.1 All utilities
 - 1.4.1.2 Electrical Safety Authority
 - 1.4.1.3 Ministry of Consumers and Commercial Relations
 - 1.4.1.4 Ministry of Labour
 - 1.4.1.5 Relevant Township of Cramahe permits

1.4.1.6 Electrical Safety Authority Inspection Approval

1.4.1.7 CSA International

1.4.2 The Owner will secure:

1.4.2.1 Building Permit

1.4.3 Arrange for regular inspections and a final inspection, not limited to the following:

1.4.3.1 Ontario Building Inspector

1.4.3.2 Electrical Safety Authority

1.4.3.3 CSA International

1.4.3.4 Electrical Utilities

1.4.4 Where electrical enclosures and panels do not have CSA labels, arrange for each such electrical enclosure or panel to be field inspected by CSA and or ESA.

1.5 SUBMITTALS

1.5.1 Submit a copy of all permit applications

1.5.2 Submit certificates of approval from all inspecting authorities

1.5.3 Submit a copy of all inspection reports

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01420
REFERENCES

PART 1	GENERAL.....	1
1.1	RELATED SECTIONS SPECIFIED ELSEWHERE	1
1.2	REFERENCES.....	1
PART 2	PRODUCTS (NOT USED)	3
PART 3	EXECUTION (NOT USED)	3

SECTION 01420 REFERENCES

1 GENERAL

1.1 RELATED SECTIONS SPECIFIED ELSEWHERE

1.1.1 All Divisions and Sections are related to this Section.

1.2 REFERENCES

- 1.2.1 AA – Aluminum Association
- 1.2.2 AASHTO – American Association of State Highway and Transportation Officials
- 1.2.3 ACI – American Concrete Institute
- 1.2.4 AIEE – American Institute of Electrical Engineers
- 1.2.5 AISI – American Iron and Steel Institute
- 1.2.6 AITC – American Institute of Timber Construction
- 1.2.7 AMCA – Air Movement and Control Association Inc.
- 1.2.8 ANSI – American National Standards Institute
- 1.2.9 API – American Petroleum Institute
- 1.2.10 ARI – Air Conditioning and Refrigeration Institute
- 1.2.11 ASHRAE – American Society of Heating, Refrigeration and Air-Conditioning Engineers
- 1.2.12 ASME – American Society of Mechanical Engineers
- 1.2.13 ASTM – American Society for Testing and Materials
- 1.2.14 AWCI – Association of the Wall and Ceiling Industries
- 1.2.15 AWMAC – Architectural Woodwork Manufacturers Association of Canada
- 1.2.16 AWS – American Welding Society
- 1.2.17 AWWA – American Water Works Association
- 1.2.18 CEC – Canadian Electric Code
- 1.2.19 CEMA – Canadian Electrical Manufacturer’s Association

- 1.2.20 CESA – Canadian Engineering Standards Association
- 1.2.21 CGA – Canadian Gas Association
- 1.2.22 CGSB – Canadian General Standards Board
- 1.2.23 CISC – Canadian Institute of Steel Construction
- 1.2.24 CITC – Canadian Institute of Timber Construction
- 1.2.25 CMB – Construction Materials Board
- 1.2.26 CRCA – Canadian Roofing Contractors Association
- 1.2.27 CSA – Canadian Standards Association
- 1.2.28 CSC – Construction Specifications Canada
- 1.2.29 CSDFMA – Canadian Steel Door and Frame Manufacturing Association
- 1.2.30 CSPI – Corrugated Steel Pipe Institute
- 1.2.31 CSSBI – Canadian Sheet Steel Building Institute
- 1.2.32 CWC – Canadian Wood Council
- 1.2.33 EEMAC – Electrical and Electronic Manufacturers’ Association of Canada
- 1.2.34 FCC – Fire Commissioner of Canada
- 1.2.35 HEPC – Hydro Electric Power Commission
- 1.2.36 ICPI – Interlocking Concrete Pavement Institute
- 1.2.37 IEEE – Institute of Electrical and Electronics Engineers
- 1.2.38 IFI – International Fasteners Institute
- 1.2.39 ISA – Instrument Society of America
- 1.2.40 MECP – Ministry of the Environment, Conservation and Parks
- 1.2.41 MNR – Ministry of Natural Resources
- 1.2.42 MTO - Ministry of Transportation Ontario
- 1.2.43 MSS – Manufacturers Standardization Society of the Valve and Fittings Industry
- 1.2.44 NAAMM – National Association of Architectural Metal Manufacturers

- 1.2.45 NACE – National Association of Corrosion Engineers
- 1.2.46 NBC –National Building Code
- 1.2.47 NFC – National Fire Code
- 1.2.48 NEMA – National Electrical Manufacturers Association
- 1.2.49 NFPA – National Fire Protection Association
- 1.2.50 NFSA – National Fire Sprinkler Association
- 1.2.51 NRC – National Research Council
- 1.2.52 NSF – National Sanitation Foundation
- 1.2.53 OESC – Ontario Electrical Safety Code
- 1.2.54 OPSD – Ontario Provincial Standard Drawings
- 1.2.55 PCI – Prestressed Concrete Institute
- 1.2.56 SCC – Standards Council of Canada
- 1.2.57 SMACNA – Sheet Metal and Air Conditioning Contractors’ National Association
- 1.2.58 SSPC – Steel Structures Painting Council
- 1.2.59 TSSA – Technical Standards and Safety Authority
- 1.2.60 TTMAC – Terrazzo, Tile and Marble Association of Canada
- 1.2.61 UL – Underwriters’ Laboratories
- 1.2.62 ULC – Underwriters’ Laboratories of Canada

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

1	GENERAL.....	1
1.1	GENERAL	1
1.2	RELATED WORK SPECIFIED ELSEWHERE	1
1.3	REFERENCE STANDARDS	1
1.4	NSF (NATIONAL SANITATION FOUNDATION) CERTIFICATION	1
1.5	QUALITY	2
1.6	AVAILABILITY.....	2
1.7	STORAGE, HANDLING, AND PROTECTION	3
1.8	TRANSPORTATION	3
1.9	MANUFACTURER’S INSTRUCTIONS.....	3
1.10	QUALITY OF WORK	4
1.11	COORDINATION	4
1.12	REMEDIAL WORK	4
1.13	LOCATIONS OF FIXTURES	4
1.14	FASTENINGS.....	5
1.15	FASTENINGS – EQUIPMENT.....	5
1.16	PROTECTION OF WORK IN PROGRESS	5
1.17	EXISTING UTILITIES.....	6
1.18	USE OF CRANES.....	6
2	PRODUCTS (NOT USED)	6
3	EXECUTION (NOT USED)	6

SECTION 01600 MATERIAL AND EQUIPMENT

1 GENERAL

1.1 GENERAL

- 1.1.1 This Section specifies the requirements for material and equipment to be incorporated in the works.
- 1.1.2 Be responsible for ensuring that all products (equipment, material, articles, etc.) supplied under the Contract complies with the requirements of the Contract, and with the requirements of the Specifications for equipment and material and that all suppliers of such equipment, etc., comply with such requirements. Failure on the part of a supplier to comply with such requirements shall not relieve the Contractor of responsibility for ensuring that the requirements of the Contract have been fulfilled.
- 1.1.3 Give preference to products of Canadian origin or manufacture and ensure all products are CSA approved.
- 1.1.4 Where possible, give preference to equivalent products of local suppliers.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- 1.2.1 All divisions and sections are related to this section.

1.3 REFERENCE STANDARDS

- 1.3.1 Conform to standards, in whole or in part, as requested in each of the specifications.
- 1.3.2 If there is a question as to whether any product or system is in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance.
- 1.3.3 The cost for such testing will be borne by the Owner in the event of conformance with Contract Documents and by the Contractor in the event of non-conformance.
- 1.3.4 Conform to the latest date of issue of referenced standards in effect on date of submission of Tender, except where specific date or issue is specifically noted.

1.4 NSF (NATIONAL SANITATION FOUNDATION) CERTIFICATION

- 1.4.1 All products to be provided as part of the Works that come into contact or may come in contact with potable water within the system shall meet all applicable standards set forth by both the American Water Works Association (AWWA) and

the American National Standards Institute (ANSI) safety criteria standards NSF/60 and NSF/61.

- 1.4.2 Contractor shall provide four (4) copies of the NSF certification, where applicable.

1.5 QUALITY

- 1.5.1 Products, materials, equipment and articles (referred to as products throughout the specifications) incorporated in the Works shall be new, not damaged or defective, and of best quality (compatible with specifications) for purposes intended. If requested, furnish evidence as to type, source and quality of products provided.
- 1.5.2 Defective products identified prior to completion of the Work will be rejected regardless of previous inspections. Inspection by the Contract Administrator or any agent of the Owner at no time relieves the Contractor from responsibility for the supply of acceptable quality products.
- 1.5.3 Remove and replace defective products at the expense of the Contractor and be responsible for delays and expenses caused by the rejection of defective products.
- 1.5.4 Should any dispute arise as to the quality or fitness of any products, the decision to accept the product(s) rests strictly with the Contract Administrator based upon the requirements and interpretation of the Contract Documents.
- 1.5.5 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Works.
- 1.5.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.6 AVAILABILITY

- 1.6.1 Immediately upon signing the Contract, review the product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Contract Administrator of such, in order that substitutions or other remedial action may be considered and authorized in ample time to prevent delay in performance of the work.
- 1.6.2 In the event of failure to notify the Contract Administrator at commencement of the Works and, should it subsequently appear that the Works may be delayed for such reason, the Contract Administrator reserves the right to substitute more readily available products of similar character, at no increase in the Contract Price or at no change to the Contract Time.
- 1.6.3 No modifications at site or station shutdowns are permitted until all materials and equipment, including temporary equipment, are onsite and ready for installation.

1.7 STORAGE, HANDLING, AND PROTECTION

- 1.7.1 Handle and store products in a manner to prevent damage, alteration, deterioration and soiling, all in accordance with manufacturer's instructions.
- 1.7.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until they are to be incorporated in the Works.
- 1.7.3 Store products subject to damage from weather in weatherproof enclosures.
- 1.7.4 Store cementitious products clear of earth or concrete floors, and away from walls.
- 1.7.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms in well-drained area and cover with waterproof tarpaulins during inclement weather.
- 1.7.6 Store sheet materials on flat, solid supports and keep clear of ground. Slope to shed moisture.
- 1.7.7 Store and mix paints in heated and ventilated areas. Remove oily rags and other combustible debris from the site daily. Take every precaution necessary to prevent spontaneous combustion.
- 1.7.8 Remove and replace damaged products at own expense and to the satisfaction of the Contract Administrator.
- 1.7.9 Touch-up damaged factory finished surfaces to the Contract Administrator's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.8 TRANSPORTATION

- 1.8.1 Pay the costs of transportation of products required in performance of the Works.

1.9 MANUFACTURER'S INSTRUCTIONS

- 1.9.1 Unless otherwise indicated in the specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- 1.9.2 Notify the Contract Administrator in writing of conflicts between Specifications and manufacturer's instructions. The Contract Administrator will clarify or establish the most appropriate solution to the conflict.
- 1.9.3 Improper installation or erection of products, due to failure in complying with manufacturer's instructions, authorizes the Contract Administrator to require

removal and re-installation at no increase in the Contract Price or at no change to the Contract Time.

- 1.9.4 All equipment must be installed with future maintenance access considerations. This includes unobstructed physical access such as camera platform access or anchor points (for a safety harness) and the ability to disconnect the power to individual items and not groups of items (i.e. cameras).

1.10 QUALITY OF WORK

- 1.10.1 Ensure Quality of the Works is of the highest standard and is executed by workers experienced and skilled in their respective duties for which they are employed. Immediately notify the Contract Administrator if the nature of the work is such as to make it impractical to produce required results.
- 1.10.2 Do not employ anyone unskilled in his or her required duties. The Contract Administrator reserves the right to require dismissal from the Works of any workers deemed incompetent or careless.
- 1.10.3 Decisions as to standard or fitness or the Quality of Work, in cases of dispute, rest solely with the Contract Administrator, whose decision is final.

1.11 COORDINATION

- 1.11.1 Ensure the cooperation of all works in layout of the Works. Maintain efficient and continuous supervision over the entire works.
- 1.11.2 Be responsible for construction and placement of openings, sleeves, accessories, and any materials or work necessary to fully coordinate all of the Works outlined in the Specifications.
- 1.11.3 Before installation, inform the Contract Administrator of all potential interferences and complete installation as directed by the Contract Administrator.

1.12 REMEDIAL WORK

- 1.12.1 Perform remedial work required to repair or replace parts or portions of the Works identified as defective or unacceptable. Coordinate adjacent affected work as required.
- 1.12.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of the Works.

1.13 LOCATIONS OF FIXTURES

- 1.13.1 Consider location of fixtures, outlets and mechanical, electrical and security items indicated as approximate and fully coordinate their final placement and positioning.

- 1.13.2 Where in doubt, or in the case of potential interferences, inform the Contract Administrator and install as directed.

1.14 FASTENINGS

- 1.14.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- 1.14.2 Prevent electrolytic action between dissimilar metals and materials.
- 1.14.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing work, unless stainless steel or other materials are specifically requested in the affected Specifications.
- 1.14.4 Space anchors within the individual load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
- 1.14.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 1.14.6 Fastenings that cause spalling or cracking of material to which anchorage is made are not acceptable.

1.15 FASTENINGS – EQUIPMENT

- 1.15.1 Use fastenings of standard commercial sizes and patterns with galvanized or 316 stainless steel material, or approved equal, suitable for service.
- 1.15.2 Use heavy hexagon head bolts, semi-finished unless otherwise specified. Use 316 stainless steel for exterior, wet or damp areas.
- 1.15.3 Bolts will not project more than one diameter beyond nuts.
- 1.15.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.16 PROTECTION OF WORK IN PROGRESS

- 1.16.1 Adequately protect the work completed or in progress. Work damaged or defaced, due to a failure to provide protection, is to be removed and replaced, or repaired, as directed by the Contract Administrator, at no increase in the Contract Price or at no change to the Contract Time.
- 1.16.2 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of the Contract Administrator.

1.17 EXISTING UTILITIES

1.17.1 When breaking into or connecting to existing services or utilities, execute the work at times directed by local governing authorities, with a minimum of disturbance to the work and pedestrian and vehicular traffic.

1.17.2 Protect and maintain existing active services and relocate if required. When services are encountered, cap off in a manner approved by the authority having jurisdiction and stake and record the location of the capped service.

1.18 USE OF CRANES

1.18.1 Where applicable contractor to certify cranes before and after use and provide copies of supporting documentation to Contract Administrator.

1.18.2 Contractor shall be responsible for all repairs.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01630
SUBSTITUTIONS**

1	GENERAL.....	1
1.1	SUBSTITUTION	1
2	PRODUCTS (NOT USED)	1
3	EXECUTION (NOT USED)	1

SECTION 01630 SUBSTITUTIONS

1 GENERAL

1.1 SUBSTITUTION

1.1.1 After the acceptance of a bid (tender), the Contractor may apply to the Contract Administrator to substitute, as an approved equal, another article or group of related articles.

1.1.1.1 Justify the proposed substitution in a written application to the Contract Administrator, indicating reasons for the substitution, (e.g. significant delay in delivery, strikes, unavailability, improved quality or field service), and the amount of contract cost reduction. Submit sufficient descriptive and technical information for the Contract Administrator to thoroughly compare articles or groups of articles with those specified.

1.1.1.2 Failure to comply with this requirement to the Contract Administrator's acceptance will result in rejection of the request due to insufficient information.

1.1.1.3 Submit complete details and specifications to meet design requirements.

1.1.2 Allow sufficient time to evaluate substitutions.

1.1.3 Substitution submissions will be received only from the Contractor and not any Subcontractors or suppliers.

1.1.4 The acceptance or rejection of a proposed substitution is at the discretion of the Contract Administrator and their decision is final.

1.1.5 Assume liabilities and additional costs that may subsequently arise as a result of accepted substitution.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01640
MANUFACTURERS' SERVICES

1	GENERAL.....	1
1.1	QUALIFICATION OF MANUFACTURER’S REPRESENTATIVE	1
2	PRODUCTS (NOT USED)	1
3	EXECUTION	1
3.1	FULFILLMENT OF SPECIFIED MINIMUM SERVICES	1
3.2	MANUFACTURER’S CERTIFICATE OF COMPLIANCE	2
3.3	MANUFACTURER’S CERTIFICATE OF PROPER INSTALLATION.....	2
3.4	SUPPLEMENTS	2

SECTION 01640
MANUFACTURERS' SERVICES

1 GENERAL

1.1 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- 1.1.1 Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. Additional qualifications may be specified elsewhere.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- 3.1.1 Furnish manufacturers' services when required by an individual specification section, to meet the requirements of this Section.
- 3.1.2 Perform Factory Acceptance Testing (FAT) on all 'major' equipment and prepare report in accordance with Contract Documents.
- 3.1.3 Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.
- 3.1.4 Schedule manufacturer's services to avoid conflict with other onsite testing or other manufacturers' onsite services.
- 3.1.5 Determine, before scheduling services, that all conditions necessary to allow successful testing has been met.
- 3.1.6 Only those days of service approved by the Contract Administrator will be credited to fulfill the specified minimum services.
- 3.1.7 When specified in individual specification sections, manufacturer's onsite services shall include:
 - 3.1.7.1 Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
 - 3.1.7.2 Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.

3.1.7.3 Revisiting the site as required to correct problems and until installation and operation are acceptable to the Contract Administrator.

3.1.7.4 Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.

3.1.7.5 Assistance during functional and performance testing, and system start-up and evaluation.

3.1.7.6 Additional requirements may be specified elsewhere.

3.2 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

3.2.1 When specified in individual Specification section, submit prior to shipment of product or material.

3.2.2 The Contract Administrator may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

3.2.3 Signed by product manufacturer certifying that product or material specified conforms to or exceeds specified. Attach supporting reference data, affidavits, and certifications as appropriate.

3.2.4 May reflect recent or previous test results on material or product, if acceptable to the Contract Administrator.

3.2.5 Include this Certificate as part of the FAT Report.

3.3 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

3.3.1 When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed, and signed by the equipment manufacturer's representative.

3.3.2 Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

3.4 SUPPLEMENTS

3.4.1 Forms: Manufacturer's Certificate of Proper Installation.

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

CLIENT: _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ System has been performance tested and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 202

Manufacturer: _____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

END OF SECTION

SECTION 01650
EQUIPMENT STARTUP AND PERFORMANCE TESTING

1	GENERAL.....	1
1.1	GENERAL	1
1.2	QUALITY ASSURANCE.....	1
1.3	SUBMITTALS.....	2
1.4	CONTRACTOR EQUIPMENT STARTUP	4
1.5	PERFORMANCE TESTING / SITE ACCEPTANCE TESTING.....	5
2	PRODUCTS (NOT USED)	6
3	EXECUTION	6
3.1	GENERAL	6

SECTION 01650
EQUIPMENT STARTUP AND PERFORMANCE TESTING

1 GENERAL

1.1 GENERAL

- 1.1.1 This section contains requirements for the Contractor's performance in conducting and documenting all equipment inspection and testing required under this contract as applied to all civil, electrical, instrumentation, and SCADA systems, provided under this contract.
- 1.1.2 This section supplements but does not supersede specific inspection and testing requirements found elsewhere in this Contract, including:
 - 1.1.2.1 Division 13
 - 1.1.2.2 Division 16
 - 1.1.2.2.1 Refer to Division 16 requirements that need to be performed before equipment startup.
- 1.1.3 The sequence of procedures to undertake this portion of the work will be:
 - 1.1.3.1 Contractor Equipment Startup, where applicable.
 - 1.1.3.2 Performance Testing / Site Acceptance Testing
 - 1.1.3.3 Facility Commissioning (Refer to Section 01660)
- 1.1.4 Each step of the above sequence will be completed to the satisfaction of the Contract Administrator prior to proceeding to the next step in the sequence.
- 1.1.5 The Owner reserves the right to be present for and observe all inspection, testing and commissioning activities. Contractor shall notify Owner Operations and provide a testing schedule five (5) working days in advance of each step in the sequence.
- 1.1.6 The Manufacturer's Technical Service Representative must be an experienced, factory-trained technical service representative, qualified to certify the correct installation and operation of a particular piece of equipment.

1.2 QUALITY ASSURANCE

- 1.2.1 The quality assurance program, where applicable, will include:
 - 1.2.1.1 A calibration program for all instruments, meters, monitors and gauges installed under this contract.

- 1.2.1.2 A calibration program for all instruments, gauges, meters, and thermometers used for determining the performance of equipment and systems installed under this contract.
- 1.2.1.3 All test equipment and other equipment used for calibrating or verifying the performance of equipment installed under this contract will be calibrated to within plus or minus two percent of actual value at full scale ($\pm 2\%$ FS).
- 1.2.1.4 A testing plan detailing how all testing work required under this project manual will be implemented. The test plan will be divided into process systems or areas for ease of preparation and implementation. The test plan will include test procedures for the Contractor Equipment Startup and Performance Testing.
- 1.2.1.5 A testing schedule detailing sequence, time and duration of Equipment Startup and Performance Testing. The schedule will follow the critical path method and will be updated as required to reflect changes.
- 1.2.1.6 A testing program for all electrical, instrumentation, SCADA and mechanical equipment and systems installed under this contract.
- 1.2.1.7 A documentation program to record the results of all equipment and system inspection and tests.
- 1.2.1.8 For the purposes of this section, a system will include all items of equipment, devices and appurtenances connected in such a fashion as their operation or function complements, protects or controls the operation or function of the others. The Contractor will coordinate the activities of all subcontractors and suppliers to implement the requirements of this section.
- 1.2.1.9 Test equipment employed for individual test runs will be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale.

1.3 SUBMITTALS

- 1.3.1 Provide submittals to the Contract Administrator.
- 1.3.2 The following documentation, where applicable, shall be submitted for review a minimum of two (2) weeks in advance of the commencement of the earliest of the activities to which the material applies:
 - 1.3.2.1 A detailed schedule, listing equipment and calendar dates when the Contractor plans to commence Equipment Startup and Performance Testing of the completed systems, along with a description of the

temporary systems and installations planned to allow operational testing to take place. Similar types of equipment should be grouped together.

- 1.3.2.2 Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract
- 1.3.2.3 Sample forms for documenting the results of all Equipment Startup and Performance tests.
- 1.3.2.4 A description of the Contractor's proposed plan for documenting the calibration of all test instruments.
- 1.3.2.5 A description of the Contractor's proposed plan for calibration of all instrument systems, including flowmeters and all temperature, pressure, weight, and analysis systems.
- 1.3.2.6 The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.
- 1.3.2.7 The instrument calibration certificate must at the very minimum include the following information:
 - 1.3.2.7.1 Date of calibration
 - 1.3.2.7.2 Name of calibrating person, laboratory or institution
 - 1.3.2.7.3 Instrument Tag
 - 1.3.2.7.4 Instrument Make, Model, Model # and Serial Number
 - 1.3.2.7.5 Instrument span
 - 1.3.2.7.6 Calibration range
 - 1.3.2.7.7 Signature and Date
- 1.3.2.8 Equipment Startup Reports containing all Equipment Startup documentation, including but not limited to Check-out Lists, Calibration Forms, Inspection Reports, Verification Forms, etc., which are signed off by all parties, including the Contractor, Contract Administrator, Owner, and Manufacturer's Representative, prior to commencement of the Performance Test.
- 1.3.2.9 Draft Contractor's Operations and Maintenance Manuals as per Section 01730.
- 1.3.2.10 Performance Test results must be submitted and reviewed by the Contract Administrator prior to commencement of Facility

Commissioning. This includes signed and dated calibration certificates for each item installed or to be installed under this contract.

- 1.3.3 The Contractor will develop test documentation forms specific for each system and associated equipment items installed under this contract. Acceptable documentation forms for all systems and items of equipment will be produced for review by the Contract Administrator a minimum of four (4) weeks prior to any Performance Testing. Once the Contract Administrator has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor will produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this contract. Contractor is required to use sign-off sheets.

- 1.3.3.1.1 Startup and Commissioning Status Reports

- 1.3.3.1.2 Control Loop Check out/Verification Forms

- 1.3.3.1.3 Instrumentation Calibration Form

- 1.3.3.1.4 Electrical Equipment Inspection Report

- 1.3.3.1.5 Electrical Installation/Startup Checklist

- 1.3.3.1.6 Instruments Installation Checklist

- 1.3.3.1.7 Panel/PLC/Computer Installation Checklist

1.4 CONTRACTOR EQUIPMENT STARTUP

- 1.4.1 Contractor to conduct inspections and testing of all equipment components and sub-components and arrange for inspections of the installations by qualified equipment Manufacturer's Technical Service Representatives as required.
- 1.4.2 The inspections and testing include, and is not limited to, the inspections and testing defined elsewhere in this Division (1) and also in Divisions 13 and 16. This stage is witnessed by the Contract Administrator and Deficiency Reports are prepared by the Contract Administrator.
- 1.4.3 The Contractor is required to remedy outstanding incomplete or incorrect work in accordance with terms of Contract.
- 1.4.4 During this phase, the Owner reserves the right to observe the Contractor Equipment Startup proceedings. If the start-up proceedings occur without the Owner and there is no written confirmation that the Owner waived their right to be present, then start-up proceedings may be repeated at no cost to the Owner.
- 1.4.5 The next steps will not proceed until the Contractor Startup has been successfully completed to the satisfaction of a qualified Manufacturer's Technical Service Representative and the Contract Administrator.

- 1.4.6 Verification tests will consist of but may not be limited to the following:
 - 1.4.6.1 Insulation tests for all electrical equipment and electrical systems.
 - 1.4.6.2 Functional testing and checkout of all electrical systems.
- 1.4.7 In general, tests for any individual system will be performed in the order listed above. The order may be altered as authorized by the Contract Administrator in writing after receipt of a written request, complete with justification of the need for the change in sequence.
- 1.4.8 Once all affected equipment has been subjected to the required check-out procedures and the Contract Administrator has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these specifications.
- 1.4.9 Retesting: If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, removed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, will, unless otherwise directed by the Contract Administrator, be repeated within reasonable time and in accordance with the specified conditions. The Contractor will pay all reasonable expenses incurred by the Owner as a result of repeating such tests.
- 1.4.10 Post-Test Inspection: Once testing has been completed, all equipment installed under the Contract will be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies will be corrected to the satisfaction of the Contract Administrator. All devices which exhibit unusual or unacceptable operating characteristics will be disassembled and inspected. Any defects found during the course of the inspection will be repaired or the specific part or entire equipment item will be replaced to the complete satisfaction of the Contract Administrator at no cost to the Owner.

1.5 PERFORMANCE TESTING / SITE ACCEPTANCE TESTING

- 1.5.1 Once equipment startup has been completed, the individual systems will be started and tested according to Division 13 and Division 16 specifications for a minimum of 15 consecutive calendar days, unless otherwise required by the individual specifications.
- 1.5.2 Contractor to conduct Performance Testing of all equipment in conjunction with the qualified Manufacturers' Technical Service Representatives where required by the Contract Documents, and under the witness of the Contract Administrator.
- 1.5.3 The Owner reserves the right to be present to witness any or all of the Performance Tests.

- 1.5.4 Deficiency Reports will be updated by the Contract Administrator. Deficiencies that are uncovered will be corrected and retesting will be conducted as required.
- 1.5.5 Following acceptance by all parties that the equipment has passed the Performance Tests, the equipment is now in the Owner's control and operation.
- 1.5.6 Documentation to support the validation of the Performance Test will be submitted by the Contractor.
- 1.5.7 The Performance Testing period for each piece of equipment or system will be not less than three (3) consecutive business days starting on a Monday, unless otherwise directed by the Contract Administrator. Should the Performance Testing period be halted for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the Performance Testing program will be repeated until the specified continuous period has been accomplished without interruption.
- 1.5.8 The Owner staff may be present to witness all or any part of the Performance Period. Failure by the Contractor to provide adequate notice or to obtain confirmation prior to a particular Performance Test may result in the Owner having the Contractor repeat the test at no cost to the Owner.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 GENERAL

- 3.1.1 The Contractor will organize teams made up of qualified representatives of equipment manufacturers, subcontractors, the Contractor's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this contract. The objective of the testing program will be to demonstrate, to the Contract Administrator's complete satisfaction that the structures, systems, and equipment constructed and installed under this contract meet all performance requirements and the facility is ready for the Facility Commissioning stage to commence. In addition, the testing program will produce a record of baseline operating conditions for the Owner to use in the preventive maintenance program.
- 3.1.2 The Contractor will provide, at no expense to the Owner, all power, fuel, compressed air supplies, potable water, all labour, temporary piping, heating, ventilating, air conditioning and all other items and work required to complete the installed tests. Temporary facilities will be maintained until permanent systems are in service.

END OF SECTION

**SECTION 01660
COMMISSIONING**

1	GENERAL.....	1
1.1	GENERAL	1
1.2	DEFINITIONS	1
1.3	QUALITY ASSURANCE.....	1
1.4	COMMISSIONING	1
2	PRODUCTS (NOT USED)	2
3	EXECUTION	2
3.1	ROLE OF CONTRACTOR	2
3.2	ROLE OF OWNER.....	2
3.3	CONTRACTOR’S RESPONSIBILITY	3
3.4	COMPLETION OF FACILITY COMMISSIONING	3

SECTION 01660 COMMISSIONING

1 GENERAL

1.1 GENERAL

- 1.1.1 This section contains requirements for the Contractor's performance during the Commissioning of the equipment and systems constructed and installed during the course of this contract. All commissioning work, as described in this section, will be performed by the Contractor.

1.2 DEFINITIONS

- 1.2.1 Start-up and Commissioning consists of placing all the various systems into continuous operation in an orderly manner, operating the system for fourteen (14) consecutive calendar days, and conducting full range performance testing to fully verify and validate that the systems and the facility perform in the manner intended as per the design.

1.3 QUALITY ASSURANCE

- 1.3.1 The Contractor will assemble a commissioning team under the direction of an individual duly authorized to commit the Contractor's personnel and resources to respond to requests for assistance on the part of the Contract Administrator.
- 1.3.2 The commissioning team will, at all times, be equipped and ready to provide for emergency repairs, adjustments, and corrections to the equipment and systems installed and modified as a part of this contract.
- 1.3.3 Working with representatives of the Owner and the Contract Administrator, the Contractor will develop and produce a detailed, written plan for the Facility Commissioning and initial operation, under actual operating conditions, of the equipment and systems installed and constructed under this contract. The document, after review by the Contract Administrator, will serve as the guidance manual for the commissioning process. The document will be prepared and submitted to the Contract Administrator for review a minimum of two (2) weeks prior to commencement of commissioning.

1.4 COMMISSIONING

- 1.4.1 System Commissioning will not begin until completion of the Equipment Start-Ups and Performance Testing, including sign-off by the Contractor, Manufacturer's Technical Service Representative, Contract Administrator, Owner's System Integrator, where applicable, that the systems met all test requirements.

- 1.4.2 The Contractor is responsible for the successful completion of the commissioning activities and for planning and scheduling commissioning activities and will have equipment manufacturer representatives at the site as well as qualified electrical, control and instrumentation personnel.
- 1.4.3 Once the new equipment is fully installed and commissioned, the Owner is responsible for operating and controlling the equipment.
- 1.4.4 Deficiency Reports will be updated by the Contract Administrator. Deficiencies that are uncovered will be corrected by the Contractor and retesting will be conducted by the Contractor as required. A deficiency list will be used to track closure of deficiencies.
- 1.4.5 Contractor to submit Facility Commissioning Report as per the manufacturer and to the satisfaction of the Contract Administrator.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 ROLE OF CONTRACTOR

- 3.1.1 The Contractor will remove all temporary piping, bulkheads, controls and other alterations to the permanent systems that may have been needed during the performance and operational testing and will perform the tasks necessary to make the improvements constructed under this contract fully operational.
- 3.1.2 Facility Commissioning is considered to be complete when all systems have been operating continuously for a period of fourteen (14) calendar days without fault and in accordance with the full range of specified performance requirements.
- 3.1.3 Failure of any part of Work during the period of continuous automatic operation will require restart of that portion or system of Work, following recertification of the fault or failure.
- 3.1.4 Substantial Performance is subject to successful completion of System Commissioning to the satisfaction and acceptance of the Contract Administrator and the Owner.

3.2 ROLE OF OWNER / OPERATING AUTHORITY

- 3.2.1 The Owner / Operating Authority will be responsible for operation of the system following System Commissioning and training. Prior to handover to the Owner / Operating Authority, the portion of the work to be commissioned will be fully operational, performing all functions for which it was designed.

3.3 CONTRACTOR'S RESPONSIBILITY

- 3.3.1 The Contractor will be available at all times during Commissioning period to provide immediate assistance in case of failure of any portion of the system being operated. The Contractor will be prepared to make modifications to the system or individual components in order to meet the requirements of the Contract.
- 3.3.2 During the System Commissioning period, the Owner will be responsible for all normal operational costs and the Contractor will bear the costs of repairs or replacements, including labour and materials, required to keep the portion of the plant being commissioned, operational.
- 3.3.3 If, as a result of the actions of the Contractor, it is necessary to suspend start-up commissioning or continuous operation during the System Commissioning period due to deficiencies or failure in any system, the full cost of interruption, call-back, testing and resumption of start-up, commissioning or continuous operation will be paid by the Contractor.

3.4 COMPLETION OF FACILITY COMMISSIONING

- 3.4.1 At the end of the Facility Commissioning period and when all systems have been proven to function as per the design intention to the satisfaction of the Contract Administrator and the Owner, application for Substantial Performance of the Contract may be made as outlined in General Conditions of Contract. Each of the items outlined in Supplemental General Conditions must be fully complied with before the Contract can be certified as substantially performed.
- 3.4.2 Upon Completion of Contract and the start of the Warranty Period, a sticker must be placed on all panels that are under warranty, designating the start date and duration of the Warranty Period.

END OF SECTION

**SECTION 01710
CLEANING**

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	GENERAL	1
1.3	PROJECT CLEANLINESS	1
1.4	FINAL CLEANING	1
2	PRODUCTS (NOT USED)	2
3	EXECUTION (NOT USED)	2

SECTION 01710 CLEANING

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 This Section specifies the requirements for progressive and final cleaning of the Works.

1.2 GENERAL

- 1.2.1 The particular requirements of this Section set the standards to be met for the final condition of the whole of the Works.

1.3 PROJECT CLEANLINESS

- 1.3.1 Maintain the Works in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other contractors.
- 1.3.2 Remove waste material and debris from the Site and deposit in waste containers at the end of each working day.
- 1.3.3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

1.4 FINAL CLEANING

- 1.4.1 When the work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for the performance of the remaining Work.
- 1.4.2 Remove waste products and debris other than that caused by the Owner, other contractors or their employees.
- 1.4.3 Do not burn waste materials on site, unless approved by the proper authorities and submitted in writing to the Contract Administrator.
- 1.4.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- 1.4.5 Ensure any and all listed/hazardous waste (ex. paint, coatings, used oil, PPE/rags soaked in paint etc.) is properly manifested and transported to an off-site disposal or storage facility in accordance with R.R.O. 1990, Reg. 347 and the Resource Productivity and Recovery Authority's (RPRA) Hazardous Waste Program Registry.

- 1.4.6 Leave the Work and adjacent areas affected in a cleaned condition satisfactory to the Owner and the Contract Administrator.
 - 1.4.6.1 Sweep clean or vacuum clean all of the Works and remove and dispose of all debris off site, before the inspection process commences.
 - 1.4.6.2 Replace broken, scratched or disfigured surfaces including glass.
 - 1.4.6.3 Remove stains, splatter, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floor.
 - 1.4.6.4 Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
 - 1.4.6.5 Inspect equipment and ensure specified workmanship and operation.
 - 1.4.6.6 Broom clean and wash exterior walks, steps, surfaces, and clean paved areas.
 - 1.4.6.7 Remove dirt and other disfiguration from exterior surfaces.
 - 1.4.6.8 Clean equipment and fixtures to a sanitary condition.
 - 1.4.6.9 Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01730
OPERATION AND MAINTENANCE MANUALS

1	GENERAL.....	2
1.1	DEFINITION	2
1.2	QUALITY ASSURANCE	2
1.3	SEQUENCING AND SUBMITTAL	2
1.4	GENERAL.....	3
1.5	MANUALS FOR EQUIPMENT AND SYSTEMS	4
1.6	MANUALS FOR MATERIALS AND FINISHES	7
1.7	SUPPLEMENTS	8
2	PRODUCTS (NOT USED)	8
3	PART 3 EXECUTION (NOT USED)	8

ATTACHMENTS:

Maintenance Summary Form
Warranty Reporting Form

SECTION 01730 OPERATION AND MAINTENANCE MANUALS

1 GENERAL

1.1 DEFINITION

- 1.1.1 Maintenance Operation: As used in the Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. *Examples of typical maintenance operations are lubrication, belt tensioning, panel cleaning, UPS battery inspection, PLC battery inspection, and replacement, video surveillance equipment cleaning, door inspections and cleaning, routine adjustments and maintenance overhauls complete with time intervals for performance of such tasks.*

1.2 QUALITY ASSURANCE

- 1.2.1 Manuals for equipment and systems shall be prepared by equipment manufacturer or system supplier.

1.3 SEQUENCING AND SUBMITTAL

1.3.1 Preliminary Manuals:

- 1.3.1.1 Submit to the Contract Administrator for review. Notify Contract Administrator by email and upload an electronic version on a secure file sharing platform with a copy of the submittal. Provide the Contract Administrator with the necessary credentials for access.
- 1.3.1.2 Manuals for Equipment and Systems: Submit prior to shipment date for equipment, system, subsystem, or component. Include copy of warranties, and service agreements if specified.
- 1.3.1.3 Manuals for Materials and Finishes: Submit at least 15 days prior to request for final inspection.

1.3.2 Final Manuals:

- 1.3.2.1 Submit two (2) hard copies of Final Manuals and upload an electronic version on a secure file sharing platform with a copy of the submittal. Provide the Owner, Operating Authority, and Contract Administrator with the necessary credentials for access.
- 1.3.2.2 Submit one (1) hard copy of any revised material undertaken during Contract Administrator's review and upload an electronic version on a secure file sharing platform.
- 1.3.2.3 Manuals for Equipment and Systems: Submit not less than 14 days prior to equipment or system field testing or startup.

1.3.2.4 Manuals for Materials and Finishes: Submit within 10 days after final inspection.

1.4 GENERAL

1.4.1 Furnish for each item of equipment or system as specified in the contract documents.

1.4.2 Hard (paper) copies of the manual to be submitted in durable binders with commercial quality pages inside arranged as to avoid obliterating data, and in a logical sequence with proper headings/dividers and necessary equipment information.

1.4.3 Electronic copies of the manuals to be submitted in PDF format, and provided in native files (e.g., Word, CAD or Excel, as applicable).

1.4.4 Include:

1.4.4.1 Table of contents arranged in a systematic order:

1.4.4.1.1 Contractor, name of responsible principal, address and telephone number.

1.4.4.1.2 List with Each Product: Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.

1.4.4.1.2.1 Identify area of responsibility of each.

1.4.4.1.2.2 Provide local source of supply for parts and replacement.

1.4.4.1.3 Identify each product-by-product name and other identifying numbers or symbols as set forth in Contract Documents.

1.4.4.2 Product Data:

1.4.4.2.1 Include only those sheets that are pertinent to specific product.

1.4.4.2.2 Clearly annotate each sheet to:

1.4.4.2.2.1 Identify specific product or part installed.

1.4.4.2.2.2 Identify data applicable to installation.

1.4.4.2.2.3 Delete references to inapplicable information.

1.4.4.3 Drawings: Supplement product data with approved Shop Drawings as necessary to clearly illustrate:

1.4.4.3.1 Relations of component parts of equipment and systems.

- 1.4.4.3.2 Control and flow diagrams.
- 1.4.4.3.3 Coordinate drawings with Project record documents to assure correct illustration of completed installation.
- 1.4.4.3.4 Do not use Project record documents as maintenance manual drawings.
- 1.4.4.4 Instructions and Procedures: Within text, as required to supplement product data.
 - 1.4.4.4.1 Handling, storage, maintenance during storage, assembly, erection, installation, adjusting, testing, operating, shutdown in emergency, troubleshooting, maintenance, interface, and as may otherwise be required.
 - 1.4.4.4.2 Organize in a consistent format under separate heading for each different procedure.
 - 1.4.4.4.3 Provide a logical sequence of instructions for each procedure.
 - 1.4.4.4.4 Provide information sheet for Plant personnel, including:
 - 1.4.4.4.4.1 Proper procedures in the event of failure.
 - 1.4.4.4.4.2 Instances that might affect the validity of warranties or Bonds.
 - 1.4.4.4.5 Provide a Preventative Maintenance schedule for all equipment.
- 1.4.4.5 Warranties, Bonds, and Service Agreements: In accordance with Section 01780 – Contract Closeout.
- 1.4.5 Failure to submit Operations and Maintenance Manuals as specified may result in delayed progress payments or deductions at the discretion of the Owner.
- 1.4.6 Final Operations and Maintenance Manuals must be submitted and accepted by the Contract Administrator prior to issuing Substantial Completion.

1.5 MANUALS FOR EQUIPMENT AND SYSTEMS

- 1.5.1 Content for Each Unit (or Common Units) and System:
 - 1.5.1.1 Description of unit and component parts, including controls, accessories, and appurtenances:
 - 1.5.1.1.1 Function, normal operating characteristics and limiting conditions.

1.5.1.1.2 Performance curves, engineering data, nameplate data, and tests.

1.5.1.1.3 Complete nomenclature and commercial number of replaceable parts.

1.5.1.2 Operating Procedures:

1.5.1.2.1 Startup, break in, routine, and normal operating instructions.

1.5.1.2.2 Test procedures and results of factory tests where required.

1.5.1.2.3 Regulation, control, stopping, and emergency instructions.

1.5.1.2.4 Description of operation sequence by control manufacturer.

1.5.1.2.5 Shutdown instructions for both short and extended durations.

1.5.1.2.6 Summer and winter operating instructions, as applicable.

1.5.1.2.7 Safety precautions.

1.5.1.2.8 Special operating instructions.

1.5.1.2.9 Installation instructions.

1.5.1.3 Maintenance and Overhaul Procedures:

1.5.1.3.1 Routine operations and overhauls complete with time intervals for performance of tasks.

1.5.1.3.2 Guide to troubleshooting.

1.5.1.3.3 Disassembly, removal, repair, reinstallation, and reassembly.

1.5.1.4 Installation Instructions: Including alignment, adjusting, calibrating, and checking.

1.5.1.5 Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.

1.5.1.6 Spare parts ordering instructions.

1.5.1.7 Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals, cameras, door lock components, gate hardware).

1.5.1.8 Manufacturer's printed operating and maintenance instructions.

1.5.2 Maintenance Summary:

- 1.5.2.1 Compile an individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or subunits.
- 1.5.2.2 Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
- 1.5.2.3 Recommended Spare Parts:
 - 1.5.2.3.1 Data to be consistent with manufacturer's Bill of Materials/Parts
 - 1.5.2.3.2 List furnished in O&M manuals.
 - 1.5.2.3.3 "Unit" is the unit of measure for ordering the part.
 - 1.5.2.3.4 "Quantity" is the number of units recommended.
 - 1.5.2.3.5 "Unit Cost" is the current purchase price.

1.5.3 Content for Each Electric or Electronic Item or System:

- 1.5.3.1 Description of Unit and Component Parts:
 - 1.5.3.1.1 Function, normal operating characteristics, and limiting conditions.
 - 1.5.3.1.2 Performance curves, engineering data, nameplate data, and tests.
 - 1.5.3.1.3 Complete nomenclature and commercial number of replaceable parts.
 - 1.5.3.1.4 Interconnection wiring diagrams, including all control and lighting systems.
- 1.5.3.2 Circuit Directories of Panelboards:
 - 1.5.3.2.1 Electrical service.
 - 1.5.3.2.2 Controls.
 - 1.5.3.2.3 Communications.
 - 1.5.3.2.4 Access Closets
 - 1.5.3.2.5 Network Servers
- 1.5.3.3 List of electrical relay settings, and control and alarm contact settings.

- 1.5.3.4 Electrical interconnection wiring diagram, including control and lighting systems.
- 1.5.3.5 As built control diagrams by control manufacturer.
- 1.5.3.6 Operating Procedures:
 - 1.5.3.6.1 Routine and normal operating instructions.
 - 1.5.3.6.2 Sequences required.
 - 1.5.3.6.3 Safety precautions.
 - 1.5.3.6.4 Special operating instructions.
- 1.5.3.7 Maintenance Procedures:
 - 1.5.3.7.1 Routine operations.
 - 1.5.3.7.2 Guide to troubleshooting.
 - 1.5.3.7.3 Adjustment and checking.
 - 1.5.3.7.4 List of relay settings, control and alarm contact settings.
- 1.5.3.8 Manufacturer's printed operating and maintenance instructions.
- 1.5.3.9 List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

1.6 MANUALS FOR MATERIALS AND FINISHES

- 1.6.1 Content for Architectural Products, Applied Materials and Finishes:
 - 1.6.1.1 Manufacturer's data, giving full information on products:
 - 1.6.1.1.1 Catalog number, size, and composition.
 - 1.6.1.1.2 Color and texture designations.
 - 1.6.1.1.3 Information required for reordering special-manufactured products.
 - 1.6.1.2 Instructions for Care and Maintenance:
 - 1.6.1.2.1 Manufacturer's recommendation for types of cleaning agents and methods.
 - 1.6.1.2.2 Cautions against cleaning agents and methods that are detrimental to product.

1.6.1.2.3 Recommended schedule for cleaning and maintenance.

1.6.2 Content for Moisture Protection and Weather Exposed Products:

1.6.2.1 Manufacturer's data, giving full information on products:

1.6.2.1.1 Applicable standards.

1.6.2.1.2 Chemical composition.

1.6.2.1.3 Details of installation.

1.6.2.2 Instructions for inspections, maintenance, and repair.

1.7 SUPPLEMENTS

1.7.1 The supplements listed below, are part of this Specification:

1.7.1.1 Forms: Maintenance Summary Form.

1.7.1.2 Warranty Reporting Forms.

2 PRODUCTS (NOT USED)

3 PART 3 EXECUTION (NOT USED)

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 45 KGS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a. Name _____ Telephone No. _____

b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

[illegible]

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY

Part No.	Description	Unit	Quantity	Unit Cost

Note: Identify parts provided by this Contract with two asterisks.

WARRANTY ISSUE # _____.

Site Address: _____

Division—CHECK ONE: ☐ SCADA, ☐ Electrical, ☐ Other _____. (If applicable) Equipment / Instrument Tag No. _____, WMS No. _____

EMERGENCY, (TO BE COMPLETED WITHIN 24 HOURS.)

FORM SUBMITTED BY: _____, _____, _____
PRINT NAME SIGNATURE DATE

CONTRACTOR / SUPPLIER RESPONSE: COVERED BY WARRANTY NOT COVERED BY WARRANTY
DESCRIPTION OF WORK COMPLETED:

[illegible]

THIS SECTION IS TO BE COMPLETED AND RETURNED ACKNOWLEDGING WORK COMPLETION BY:

CONTRACTOR

PRINT NAME

SIGNATURE

DATE

If you do not receive, or if you have any problems with this transmission, please call as soon as possible. Thank you

END OF SECTION

SECTION 01750
SPARE PARTS AND MAINTENANCE MATERIALS

1	GENERAL.....	1
1.1	GENERAL	1
1.2	MAINTENANCE MATERIALS	1
1.3	SPECIAL TOOLS	1
1.4	SPARE PARTS	1
2	PRODUCTS (NOT USED)	2
3	EXECUTION (NOT USED)	2

SECTION 01750
SPARE PARTS AND MAINTENANCE MATERIALS

1 GENERAL

1.1 GENERAL

- 1.1.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual specification sections.
- 1.1.2 Supply special tools, wrenches, and accessories that are required for removing worn parts, making adjustments, and carrying out maintenance works.

1.2 MAINTENANCE MATERIALS

- 1.2.1 Deliver specified items packaged to prevent damage.
- 1.2.2 Identify, on carton or package, colour, room number, system or area, as applicable, where item is to be used.

1.3 SPECIAL TOOLS

- 1.3.1 Assemble special tools as specified.
- 1.3.2 Include following:
 - 1.3.2.1 Identification tag reference.
 - 1.3.2.2 Identification of equipment or system for which tools are applicable.
- 1.3.3 Instruction on intended use of tool.
- 1.3.4 Identify special tools to indicate equipment or system for which tools are intended.

1.4 SPARE PARTS

- 1.4.1 Contractor to provide a spare parts list for all equipment. The spare parts list to be completed as per the Owner's inventory and maintenance program. The spare parts list is to be provided to the Contract Administrator prior to Commissioning.
- 1.4.2 Contractor to supply spare parts as recommended by the manufacturer to cover the Warranty Period and as specified in individual specification sections.
- 1.4.3 Contractor to supply spare parts and maintenance materials to the site prior to and as a condition to achieving the Certificate of Completion.
- 1.4.4 Assemble spare parts as specified.

1.4.5 Include the following:

1.4.5.1 Part number.

1.4.5.2 Identification of equipment or system for which parts are applicable. Use appropriate Owner Tag as indicated on the drawings or in the specifications.

1.4.5.3 Installation instructions as applicable.

1.4.5.4 Name and address of nearest supplier.

1.4.6 Upon delivery of spare parts and maintenance material, have receipt of delivery and submit to the Contract Administrator and the Owner.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01760
WARRANTY WORK**

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	RELATED SECTIONS SPECIFIED ELSEWHERE	1
1.3	GENERAL	1
1.4	SUBMITTALS.....	1
1.5	INSPECTION AND DECLARATION OF CONTRACT COMPLETION	1
1.6	WORK DURING WARRANTY PERIOD	2
1.7	REPAIR BY OWNER.....	2
2	PRODUCTS (NOT USED)	2
3	EXECUTION (NOT USED)	2

SECTION 01760 WARRANTY WORK

1 GENERAL

1.1 DESCRIPTION

1.1.1 This Section specifies requirements for work during the Warranty Period.

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

1.2.1 All Divisions and Sections are related to this Section.

1.3 GENERAL

1.3.1 Provide all warranties outlined in the Contract Documents from the time of Substantial Performance of the Works or components of the works, as defined elsewhere in these Contract documents and in the Construction Lien Act of Ontario and its Regulations.

1.3.2 Perform warranty work required during progress of the work and during the Warranty Period.

1.3.3 Warranty Period will begin after final commissioning. Final Commissioning is defined as all work complete with no deficiencies and equipment is under control of the Owner and the Operating Authority.

1.4 SUBMITTALS

1.4.1 Inform the Contract Administrator in writing of the arrangements made for carrying out warranty work during the Warranty Period.

1.4.2 Provide a telephone number and address for receipt of notices relating to matters requiring action by the Contractor during the Warranty Period.

1.5 INSPECTION AND DECLARATION OF CONTRACT COMPLETION

1.5.1 Request inspection for Completion no later than ten (10) working days before the expiry of the Warranty Period.

1.5.2 Participate in a joint inspection of the Works for the purpose of establishing Completion. Arrange for, coordinate and pay for any special access required to inspect the Works.

1.5.3 Review the status of all Warranty items carried out during the Warranty Period with the Contract Administrator.

1.5.4 Complete all outstanding deficiencies, repair noted defects, complete all outstanding warranty items and obtain the Contract Administrator's written

agreement that all works are complete in accordance with the Contract Documents.

1.5.5 Apply for Completion and Final Acceptance.

1.6 WORK DURING WARRANTY PERIOD

1.6.1 Perform all warranty work required upon receipt of verbal or written notices from the Contract Administrator.

1.7 REPAIR BY OWNER

1.7.1 The Owner will, without giving notice to the Contractor, during the construction or warranty period, carry out repairs or defects that are dangerous in nature, that constitute an extreme emergency or that affect the operation of the Works. The Owner may proceed with these repairs, or other activities such as a locking out electrical equipment, with a third party.

1.7.2 The Contract Administrator will notify the Contractor of emergency work performed by the Owner.

1.7.3 The cost of labour, equipment and material to perform emergency work will be charged to the Contractor. The Owner is not obligated to utilize a competitive process for situations as described in this section.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01780
CONTRACT CLOSEOUT**

1	GENERAL.....	1
1.1	SUBMITTALS.....	1
1.2	RECORD DOCUMENTS.....	1
1.3	RELEASES FROM AGREEMENTS	2
2	PRODUCTS (NOT USED)	3
3	EXECUTION	3
3.1	MAINTENANCE OF RECORD DOCUMENTS.....	3
3.2	FINAL CLEANING	4

SECTION 01780
CONTRACT CLOSEOUT

1 GENERAL

1.1 SUBMITTALS

- 1.1.1 Quality Control Submittals: Written procedures for maintaining and markup of record documents.
- 1.1.2 Contract Closeout Submittals: Submit prior to application for final payment.
 - 1.1.2.1 Deficiency tracking list which confirms all deficiencies have been addressed to the satisfaction of the Owner and Contract Administrator.
 - 1.1.2.2 Record Documents: As required in the Contract Documents.
 - 1.1.2.3 Approved Shop Drawings and Samples: As required in the Contract Documents.
 - 1.1.2.4 Special Bonds, Special Warranties, and Service Agreements.
 - 1.1.2.5 Consent of Surety to Final Payment.
 - 1.1.2.6 Releases or Waivers of Liens and Claims.
 - 1.1.2.7 Releases from Agreements.
 - 1.1.2.8 Final Application for Payment.
 - 1.1.2.9 Spare Parts and Special Tools: As required by individual specification sections.

1.2 RECORD DOCUMENTS

- 1.2.1 Quality Assurance:
 - 1.2.1.1 Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
 - 1.2.1.2 Accuracy of Records:
 - 1.2.1.2.1 Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
 - 1.2.1.2.2 Purpose of Project record documents is to document factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed

without lengthy and expensive site measurement, investigation, and examination.

1.2.1.3 Make entries within 24 hours after receipt of information that a change in Work has occurred.

1.2.1.4 Prior to submitting each request for progress payment, request the Contract Administrator's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by the Contract Administrator to recommend the whole or any part of the Contractor's Application for Payment, either partial or final.

1.2.1.5 Comply also with requirements of subsection 3.1 hereof.

1.2.1.6 Provide all record drawings in native CAD format as well as hard copies. Shop Drawings for all manufactured Panels such as RPU panels, gas detectors, security panels etc. that have been custom built for the project shall be submitted in both native CAD format as well as hard copies.

1.3 RELEASES FROM AGREEMENTS

1.3.1 Furnish the Owner with written releases from the Township's or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Township's construction right-of-way.

1.3.2 In the event the Contractor is unable to secure written releases:

1.3.2.1 The Contractor shall inform the Owner of the reasons.

1.3.2.2 The Owner or its representatives will examine the site, and the Owner will direct the Contractor to complete Work that may be necessary to satisfy terms of the side agreement or special easement.

1.3.2.3 Should Contractor refuse to perform this Work, the Owner reserves the right to have it done by separate contract and deduct the cost of same from the Contract Price or require the Contractor to furnish a satisfactory Bond in a sum to cover legal claims for damages.

1.3.2.4 When the Owner is satisfied that Work has been completed in agreement with the Contract Documents and terms of side agreement or special easement, the right is reserved to waive the requirement for written release if: (i) Contractor's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that Contractor has failed to fulfill the terms of the side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting the grantor.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 MAINTENANCE OF RECORD DOCUMENTS

3.1.1 General:

3.1.1.1 Promptly following commencement of Contract, secure from the Contract Administrator, one complete set of Contract Documents.

3.1.1.2 Provide red-line drawings to Contract Administrator once complete.

3.1.1.3 Delete the Contract Administrator's title block and seal from all documents.

3.1.1.4 Label or stamp each document with title, "AS BUILT," in neat large, printed letters.

3.1.1.5 Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

3.1.2 Preservation:

3.1.2.1 Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

3.1.2.2 Make documents and Samples available at all times for observation by The Contract Administrator.

3.1.3 Making Entries on Drawings:

3.1.3.1 Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.

3.1.3.1.1 Color Coding:

3.1.3.1.1.1 Green when showing information deleted from Drawings.

3.1.3.1.1.2 Red when showing information added to Drawings.

3.1.3.1.1.3 Blue and circled in blue to show notes.

3.1.3.2 Date entries.

3.1.3.3 Call attention to entry by "cloud" drawn around area or areas affected.

3.1.3.4 Legibly mark to record actual changes made during construction, including, but not limited to:

3.1.3.4.1 Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.

3.1.3.4.2 Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.

3.1.3.4.3 Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.

3.1.3.4.4 Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.

3.1.3.4.5 Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and the Contract Administrator's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

3.1.3.5 Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as described in previous subparagraph above.

3.1.3.5.1 Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.

3.1.3.5.2 Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).

3.1.3.5.3 Make identification so descriptive that it may be related reliably to Specifications.

3.2 FINAL CLEANING

3.2.1 At completion of Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire site or parts thereof, as applicable, as per Section 01710, Subsection 1.4, Final Cleaning.

END OF SECTION

DIVISION 13 – INSTRUMENTATION AND CONTROL

DIVISION 13 SPECIFICATIONS

THE CORPORATION OF THE
TOWNSHIP OF CRAMAHE
REQUEST FOR TENDER-
MARCH 2025

COLBORNE WTP ELECTRICAL
AND SCADA SYSTEM UPGRADES

Section No. Section Name

13010	INSTRUMENTATION AND CONTROL GENERAL
13305	FIELD WIRING
13310	PANEL CONSTRUCTION
13311	ENCLOSURES
13312	ENCLOSURE ACCESSORIES
13320	PANEL WIRING
13340	PANEL SERVICES
13930	TESTING PROCEDURE

SECTION 13010
INSTRUMENTATION AND CONTROL GENERAL

1	GENERAL.....	1
1.1	GENERAL CONDITIONS	1
1.2	GENERAL SCOPE	1
1.3	STANDARDS	2
1.4	THE OWNER’S SPECIFICATION.....	3
1.5	SUBMITTALS.....	3
1.6	COSMETICS, PROTECTION, AND FINISHES.....	4
1.7	EXISTING EQUIPMENT.....	5
1.8	FUTURE SYSTEM EXPANSION	5
1.9	WARRANTY	5
2	PRODUCTS (NOT USED)	8
3	EXECUTION	8
3.1	SITE INSPECTION AND SCOPING.....	8
3.2	INSTALLATION	9
3.3	CABLES AND WIRING	9
3.4	IDENTIFICATION	9
3.5	TESTING	10

SECTION 13010
INSTRUMENTATION AND CONTROL GENERAL

1 GENERAL

1.1 GENERAL CONDITIONS

- 1.1.1 This section covers the general requirements for the instrumentation and control (I&C) system. Is not intended to be read as a standalone document.
- 1.1.2 Refer to all other Division Specifications for detailed scope and requirements.
- 1.1.3 Refer to the complete contract drawings for details and additional requirements.

1.2 GENERAL SCOPE

- 1.2.1 Refer to Section 01010 'Summary of Work' for all work area locations and general work description.
- 1.2.2 The work in this contract consists of SCADA system upgrades and are generally divided into the categories described below:

1.2.2.1 Control Panel PLC Retrofit/Replacement.

Remove existing PLC/RPU components and provide and install new PLC equipment and supply and install, where required, the necessary terminal blocks, relays, wires, cables, wire duct etc. for a fully functional system. Refer to contract drawings for panel modifications.

1.2.2.2 Control Panel Replacements.

Remove existing PLC Control Panels. Supply and install new PLC Control panels as indicated in contract drawings.

1.2.2.3 Electrical Services

For subsections above (1.4.3.1 to 1.4.3.2) this includes the supply and installation of any conduit, wiring, terminal blocks, blanking plates, wire duct, relays, lighting panel circuit breakers and any other electrical or controls equipment to allow for a fully functional system.

Contractor shall obtain any and all necessary permits for the works.

- 1.2.3 All PLCs will be configured by the Owner's representative.
- 1.2.4 For each facility the contractor shall perform a full survey of the scope of work and perform full site inspection of the work area before beginning any work, the contractor shall:

- 1.2.4.1 Identify any potential constructability issues and seek clarification.
- 1.2.4.2 Identify and propose alternatives where field conditions allow for more practical or economical approaches.
- 1.2.4.3 Contractor shall hold a scheduled pre-construction meeting with Contract Administrator and Client prior to ordering materials and beginning work for any of the work area packages.

The onus is on the contractor to perform a comprehensive survey of the scope and site inspection prior to beginning work. All additional costs associated with rework, or the purchase of unused equipment shall be born by the contractor.

- 1.2.5 Provide and supply all special tools or equipment required for the installation, setup, configuration and commissioning of the SCADA system including all components and subcomponents.

1.3 STANDARDS

- 1.3.1 All SCADA system devices, conduit, and other hardware relating to the SCADA system shall be installed as directed and required by the manufacturer and in accordance with the following standards and codes where applicable:
 - 1.3.1.1 Manufacturing: ISO 9003.
 - 1.3.1.2 Design: MIL 275E.
 - 1.3.1.3 Communications: IEEE RS 232C and RS485.
 - 1.3.1.4 EMI emissions: FCC part 15 .9.
 - 1.3.1.5 Electrostatic immunity: IEC 801.2 level 4.
 - 1.3.1.6 AC transients UL 964.
 - 1.3.1.7 National Building Code.
 - 1.3.1.8 Ontario Building Code.
 - 1.3.1.9 Ontario Fire Code.
 - 1.3.1.10 Electrical Standards Authority (ESA).
 - 1.3.1.11 Canadian Electrical Code (CSA).
 - 1.3.1.12 Process Control System Implementation Manual.
 - 1.3.1.13 NFPA 730 & 731.
 - 1.3.1.14 ULC 319/ S304.

1.3.1.15 UL 1981 Central Station Automation Systems.

1.3.2 Where any of the documents are in conflict, the more stringent requirement shall apply.

1.4 THE OWNER'S SPECIFICATION

1.4.1 Conform to the contract specifications and where conflict between the contract specifications or drawings occur, the contractor shall raise such conflict and allow the Owner and/or Engineer dictate which of the two shall govern at no cost impact to the project.

1.5 SUBMITTALS

.1 Shop Drawings and product literature should be submitted for the Engineer's review and approval.

1.5.1.1 Submit shop drawings in accordance with Section 01300 –Submittals.

1.5.1.2 Any variations between the contract documents and the submitted shop drawings shall be clearly marked in red pen on the contract drawings and included in the shop drawing submission. Shop drawings which are submitted without these redlines found to contain variations will be returned "revise and resubmit".

1.5.2 Manuals and As-built Drawings

1.5.2.1 Upon completion and acceptance of the SCADA Upgrades, the Owner shall receive three sets of as-builts within 30 days from the date of testing and testing sheet sign-off.

1.5.2.2 As-built drawings shall be submitted in both PDF and native CAD format. Drawings shall be submitted digitally via a secure file sharing platform. Provide the Owner and Contract Administrator with the necessary credentials for access.

1.5.2.3 Record drawing submission shall include red lines. It shall also include any variations drafted and submitted in CAD format upon completion of work. Engineer will provide the applicable contract drawings in CAD format for this purpose.

1.5.2.4 The drawings shall contain the following information:

1.5.2.4.1 All SCADA devices depicted in the drawings shall be individually labelled according to the programming on the SCADA system to ensure SCADA naming/tagging consistency.

1.5.2.4.2 All SCADA device symbols depicted shall be in conformance to the graphic standards provided by the Owner.

- 1.5.2.4.3 Electrical wiring diagrams, drawings and/or schedules for each system depicting the interconnection of all inputs and outputs for all equipment.
- 1.5.2.4.4 Fabrication/shop drawings for all equipment (including custom equipment).
- 1.5.2.4.5 As-built Package shall include all information required in the prefabrication submittals revised to reflect “as installed” conditions.
- 1.5.2.4.6 As-built Package shall also include two (2) sets of complete and current operation and maintenance manuals for all devices and equipment.

1.6 COSMETICS, PROTECTION, AND FINISHES

- 1.6.1 Complete all work in a manner that is both functional as well as aesthetically pleasing. The works must leave the panels in better condition than they were found.
- 1.6.2 Repair any scratches, cover any holes or cutouts with blanking plates as required.
- 1.6.3 Rout and tiedown all cables and wires inside cabinets neatly. Replace wire duct covers as required. Rout and tie down any cables not in wire ducts neatly.
- 1.6.4 Remaining spare conductors to be left clearly labeled and identified or removed if not deemed reusable.
- 1.6.5 The Contractor shall be responsible for all cutting, core drilling, and patching required for the installation of this work. Where alterations occur or new and existing work is required, the Contractor shall join, cut, remove, patch, repair, or finish the adjacent surfaces as required.
- 1.6.6 Any work likely to alter or detract from the original appearance must not commence without the Owner’s written consent. Changes or alterations, completed without the Owner’s consent, may be subject to restoration by the Contractor. Any additional repairs required, due to unapproved work, may be billed to the Contractor for payment.
- 1.6.7 The Contractor shall protect existing furnishings by providing and maintaining adequate temporary protective coverings.
- 1.6.8 The Contractor shall provide and maintain adequate fire safety and protection in accordance with applicable fire code and regulations.
- 1.6.9 The Contractor shall be responsible for any damage as specified (negligence) to existing structure or contents arising from a lack of adequate protection.

- 1.6.10 All work shall be performed by qualified and skilled trade's people as defined by the Occupational Health and Safety Act, Regulation 213/91 and all finishing shall be of the highest quality.
- 1.6.11 Construction and finishing techniques must preserve the original appearance of the affected areas.
- 1.6.12 Unless authorized in writing by Owner, the Contractor shall not post/affix any stickers, labels, signs, logos, or any kind of promotional or advertising material on any equipment or instruments, nor at the site. This includes decals warning of systems in use or services provided.

1.7 EXISTING EQUIPMENT

- 1.7.1 Some existing hardware may require relocation for installation of new devices. In each instance the Contractor must advise the engineer and the Owner, and the Contractor must receive written approval prior to the relocation.
- 1.7.2 All equipment and devices, removed by the Contractor for replacement or placement of a new devices shall remain the property of the Owner and shall be submitted to the Owner upon device removal.

1.8 FUTURE SYSTEM EXPANSION

- 1.8.1 The Owner reserves the right to expand or add to the system, at any time, using firm(s) other than the Contractor, provided that the expansion is done by a firm that is an authorized dealer or agent for the equipment or system being expanded.
- 1.8.2 The Owner reserves the right to make changes, alterations, additions, or deletions to any of the Owner's equipment.

1.9 WARRANTY

- 1.9.1 The Warranty conditions are applicable to all products and/or services provided by Contractor.
- 1.9.2 If, within one (1) year after the date of final acceptance of the work as determined by the Owner, or designated portion thereof, or within one (1) year of manufacturer's warranty after acceptance by the Owner of designated equipment, or within such longer period of time as may be prescribed by law, or by the terms of any applicable special warranty required by the contract, or applicable codes, any of the work found to be defective or not in accordance with the contract, the Contractor shall maintain a sufficient number of trained technicians to respond to warranty claims 24 hours per day, 7 days a week, including holidays, and shall correct or replace any defective or deficient materials and restore the SCADA systems to normal operation, at its expense, within the Response Time, as defined below, with respect to any defects or deficiencies in the materials that appear before and during the Warranty Period for materials in question. This obligation

shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition.

- 1.9.3 The Contractor shall maintain a service contact phone number, which is attended 24 hours a day, 7 days a week, including holidays, by live operators, with no telephone charges to the Owner when dialed from the Town of Colborne. The Contractor shall also maintain a service e-mail address; however, the Owner shall not rely on e-mail for contact for emergency support.
- 1.9.4 The Contractor shall provide to the Owner documentation regarding service calls in a format and at such frequencies as approved by the Owner. At no time shall the facility or the Owner of facility be left insecure due to unresolved problems related to the defective or deficient Material(s). The Contractor, at its expense, shall supply all equipment, tools, spare parts, software, and other materials as necessary to correct the defect or deficiency or replace defective or deficient Material(s) to the satisfaction of the Owner. Notwithstanding any other term in the Contract Documents, if the Contractor fails to meet the Response Time or correct or replace defective or deficient Materials at any time specified or later agreed upon, without prejudice to any other right or remedy the Owner may have, the Owner may, upon notice to the Contractor, (i) correct or replace such defective Materials and deduct the cost thereof from any payment then or thereafter due to the Contractor; and/or (ii) terminate this Agreement upon written notice.
- 1.9.5 In order to meet the Response Time, the co-operation of the Owner's information technology ("IT") personnel may be required. The Contractor shall not be liable for any failure to meet the Response Time as a result of delays in the Owner's IT personnel performing any IT work that the Owner is required. The Contractor shall not be liable for failure to meet the Response Time as a result of events beyond its control.
- 1.9.6 All new install equipment shall be subjected to its own bi-yearly preventative maintenance schedule; the schedule is to be submitted thirty (30) days after final acceptance of equipment installation. The bi-yearly preventative maintenance must be performed throughout the warranty period at no further charge/cost to the Owner.
- 1.9.7 Nothing contained in the contract shall be construed to establish a period of limitation with respect to any other obligation that the Contractor might have under the contract.
- 1.9.8 The establishment of the time period of one (1) year after the date of final acceptance, or such longer period of time as may be prescribed by law, or by the terms of any warranty required by the contract relates only to the specific obligation of the Contractor to correct the work, and has no relationship to the time within which its obligation to comply with the contract documents may be sought to be enforced, nor to the time within which proceedings may be

commenced to establish the Contractor's liability with respect to its obligations other than specifically to correct the work.

- 1.9.9 If this contract in its specifications requires that specific deliverables must perform as a system, this representation and warranty shall apply to the deliverables, individually, in combination with each other, and as a system. Where the Contractor will be providing any component of a deliverable from or through a subcontractor, the Contractor shall cause its Subcontractor to comply with this representation and warranty with respect to the component to be provided by such subcontractor.
- 1.9.10 Where the deliverable being provided by the Contractor has an interface with any other product and such interface is necessary for the functionality, operation or performance of its deliverable, the Contractor shall ensure that such product complies with this representation and warranty and such interface does not in any way impair the ability of its deliverable to comply with this representation and warranty.
- 1.9.11 At the Owner's request made in writing at any time before or within 90 days (or such other time period as designated by the Owner in writing) of its acceptance of the deliverable, the Contractor will, at no additional charge to the Owner, demonstrate the compliance techniques and test procedures to be followed by the Contractor or the Owner or its authorized agent to confirm that the deliverable complies with this representation and warranty.
- 1.9.12 Where the Contractor advises the Owner that its deliverable is not able to comply with this representation and warranty at this time but will be able to do so by a specified date, the Owner may at its sole discretion accept the deliverable on the condition that there is compliance by the specified date; however, the Owner is not obligated or liable to make payment for the deliverable until such condition is satisfied.
- 1.9.13 In the event of any breach of this warranty and representation, the remedies available to the Owner shall include but not be limited to:
 - 1.9.13.1 The Contractor restoring the deliverable to the same level of performance as represented and warranted herein.
 - 1.9.13.2 The Contractor repairing or replacing the deliverable with a deliverable conforming with this representation and warranty.
 - 1.9.13.3 The Contractor granting or securing for the Owner or its authorized agent permission to make any modifications necessary to make the deliverable compliant with this representation and warranty and arranging for any necessary waivers of moral rights or other intellectual property rights to make such modifications.

- 1.9.13.4 The Contractor granting the Owner or its authorized agent access to the source code for the information technology used in the deliverable in order to make any modifications necessary to make the deliverable compliant with this representation and warranty or securing for the Owner the necessary permission for such access and arranging for any necessary waivers of moral rights or other intellectual property rights to make such modifications, in each case, so as to minimize interruption to the Owner's ongoing business processes, with time being of the essence, and to be done at the Contractor's sole expense.
- 1.9.14 The Contractor represents and warrants that any restoration, repair or replacement made pursuant to subparagraph (a) or (b) above, will not corrupt any data of the Owner or introduce any viruses into the Owner's system. The Contractor agrees that any modification made pursuant to subparagraph (c) or (d), above, is the property of the Owner, including all copyright and other intellectual property rights pertaining thereto.
- 1.9.15 This warranty shall survive cancellation or other termination of this contract. Nothing in this representation and warranty shall be construed to limit any rights or remedies (including indemnities) otherwise available to the Owner under this contract or at law or equity; and nothing in the contract shall limit the scope of this representation and warranty and any rights or remedies set out herein, and, in particular, no waiver or disclaimer set out in such agreement (or made otherwise) shall operate to limit the Contractor's liability under this representation and warranty.
- 1.9.16 If the Contractor fails to make good such defects within a stipulated time, the Owner reserves the right to have the work done by others at the Contractor's expense.
- 1.9.17 The Contractor after the date of final acceptance of all work/orders as determined by the Owner, or designated portion thereof, provide, in addition to Warranty Certification a preventative maintenance schedule for the duration of warranty period.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 SITE INSPECTION AND SCOPING

- 3.1.1 For each work package, before beginning any work the contractor shall review the scope of work, design, specifications and perform a comprehensive field investigation.
- 3.1.2 The contractor shall identify any concerns with regards to the constructability of design and seek clarification before purchasing any equipment or beginning work.

- 3.1.3 Where more economic or practical construction alternatives exist, the contractor shall propose these alternatives prior to beginning work.
- 3.1.4 Contractor to hold pre-construction meeting to discuss any concerns or propose alternatives or the proposed design.

3.2 INSTALLATION

- 3.2.1 All system components shall be installed according to manufacturer's instructions and in a professional manner. Workmanship and care must encompass all aspects of the task being performed so the full intent of the project may be realized.

3.3 CABLES AND WIRING

- 3.3.1 All cable routing is the responsibility of the contractor. Cables and conduit shall be filed-fitted to meet the electrical code and design intent.
- 3.3.2 The Contractor shall be responsible for providing all cable, conduits, boxes and raceways.
- 3.3.3 Provide a minimum of 20% spare conductors (but no less than 2) for all cable runs between control panels and field panels or junction boxes.
- 3.3.4 All electronic modules shall be properly housed in appropriately rated metal enclosures or junction boxes as required.
- 3.3.5 All junction boxes are to be accessible and location of all boxes and access panels are to be approved by the Contract Administrator and the Owner.
- 3.3.6 The contractor shall be responsible for ensuring that all back boxes, conduit and raceways meet equipment and wiring requirements for the system. The Contractor shall inspect the raceway system during installation and shall notify the Project Manager of any problems found, prior to the finishing of the wall, ceiling or floor surface.
- 3.3.7 All cabling shall be installed to conform with the requirements of the Canadian Electrical Code and applicable Provincial Codes. Cabling shall be sized and installed in accordance with Class 2 requirements but shall be protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action.

3.4 IDENTIFICATION

- 3.4.1 All cables shall be marked, with a unique number, in common at both ends using a permanent method.
- 3.4.2 All terminals shall be permanently marked and shall agree with record drawings.

- 3.4.3 All system power supplies shall be labelled with their feed source and breaker number.
 - 3.4.4 The Contractor shall mark the mating connectors with common designations. The connector designations shall be indicated on the record of drawings.
 - 3.4.5 All visible panel and control labels shall be silk-screened, engraved and filled, or engraved plastic laminate. Labels shall be permanently attached.
 - 3.4.6 All cables, devices, must be permanently identified at each cable end and component demarcation with all information necessary for troubleshooting.
 - 3.4.7 All cables shall be color coded and individually labelled with the component's type and location, such as door number, exterior, etc.
- 3.5 TESTING
- 3.5.1 Test all cables for correct continuity and polarity.
 - 3.5.2 Testing, commissioning, verifying and programming that the complete system is fully operational and in conformity with the contract documents, manufacturers' recommendations and all other governing requirements.
 - 3.5.3 The supplier shall provide all programming and adjusting to any features or functionality to any component, to the satisfaction of the Owner's representative. Any adjustments shall be of no charge during the first 30 days after the acceptance has been given.
 - 3.5.4 The work will not be considered complete until the Owner is satisfied with the system operations, configurations, and the training of staff.

END OF SECTION

**SECTION 13305
FIELD WIRING**

1	GENERAL.....	1
1.1	FIELD WIRING.....	1
2	PRODUCTS	1
2.1	ANALOG SIGNALS	1
2.2	DC DIGITAL SIGNALS	1
2.3	AC DIGITAL SIGNALS	2
2.4	ETHENERT CABLES	2
3	INSTALLATION.....	3
3.1	GENERAL	3
3.2	SIGNAL SEPARATION.....	3
3.3	MISCELLANEOUS.....	3
3.4	WIRING IDENTIFICATION	4

SECTION 13305 FIELD WIRING

1 GENERAL

1.1 FIELD WIRING

- 1.1.1 Field Wiring is the wiring that either powers or connects the field equipment (instruments, control stations, control panels, MCC) to the Main Process Control Unit.
- 1.1.2 Use only CSA approved and labelled cables and conductors.
- 1.1.3 Provide field cables as per Division 16 – Electrical.

2 PRODUCTS

2.1 ANALOG SIGNALS

- 2.1.1 Definition: Analog signals are 4-20 mA inputs received from field instruments.
- 2.1.2 Single Pair Cable: For individual instrument circuits use single-pair, two inch lay, twisted, foil 100% shielded with drain wire, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600 volts.
- 2.1.3 Multi-Pair Cables: For multiple instrument circuits, use multi-pair cables made up of individual single pair, two inch lay, twisted, foil 100% shielded with suitable drain wire, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600 volts.
- 2.1.4 Shields: Signal shields should have one ground point located at the power source unless otherwise recommended by the instrument/equipment manufacturer. Shields should be continuous through cabinets, panels, and junction boxes.

2.2 DC DIGITAL SIGNALS

- 2.2.1 Definition: DC digital signals are at 24VDC originating from contact inputs.
- 2.2.2 Single Pair Cable: For individual contact closure circuits use single pair, two inch lay, twisted #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600V with RW90 insulation with PVC jacket.
- 2.2.3 Multi-pair Cable: For multiple contact closure circuits use multi-pair cables made up of individual single pair two inch lay, twisted, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600V with RW90 insulation with PVC jacket.

2.3 AC DIGITAL SIGNALS

- 2.3.1 Definition: AC digital signals are 120VAC and less than 15 amperes and received from contact outputs used for controlling 120V devices such as motor starters, pushbuttons, pilot lights, and the like.
- 2.3.2 Single Conductor: For single circuit use single conductor #14 AWG, 19 strand copper conductor at 600V with RW90 insulation with PVC jacket.
- 2.3.3 Multi-Conductor: For multiple circuits use multiple conductor #14 AWG, 19 strand copper conductor at 600V with RW90 insulation with PVC jacket.

2.4 ETHERNET CABLES

- 2.4.1 Provide Category 6 (CAT6) shielded twisted-pair cable, connectors and appurtenances that make up the cable.
- 2.4.2 Horizontal CAT6 cable segments shall meet the requirements of the TIA-568-C specification for CAT6 cable.
- 2.4.3 Horizontal Cable Segments shall meet or exceed the following minimum requirements:
 - 2.4.3.1 The cable shall be tested up to 500 MHz with a guaranteed performance that meets or exceeds the TIA/EIA-568-C.2 for CAT6.
 - 2.4.3.2 The cable shall be constructed from 23AWG, bare copper wire insulated. Two insulated conductors twisted together to form a pair and four pairs laid up to form the basic unit.
 - 2.4.3.3 The cable shall be jacketed in flame-retardant PVC. Cable run in conduit shall meet or exceed FT4 rating. Cable not run in conduit shall meet or exceed FT6 rating.
 - 2.4.3.4 Horizontal cable run in conduit shall be CMR/FT4 rated.
 - 2.4.3.5 Horizontal CAT6A cable run in outdoor or harsh environment shall be, General Cable 7136100, rated for Outdoor service.
 - 2.4.3.6 Horizontal cable not run in conduit shall be CMP/FT6 rated.
- 2.4.4 Contractor shall field verify required cable lengths before ordering.
- 2.4.5 Use only factory terminated (prefabricated) cables where possible.
- 2.4.6 Where field termination is necessary:
 - 2.4.6.1 All category 6 (CAT6) connectors shall be unshielded modular jacks and wired for a T586A wire-map.

2.4.6.2 CAT6 connectors shall meet or exceed the following minimum requirements:

2.4.6.2.1 Eight position modular jacks shall meet or exceed the TIA Category 6 standards.

2.4.6.2.2 The jack termination to 4 pair 23 AWG unshielded twisted pair cable shall require the use of a punch down tool.

2.4.6.2.3 The jack shall limit conductor untwist to less than 23 mm (½”).

2.4.6.2.4 The jack shall accommodate icons for network identification.

3 INSTALLATION

3.1 GENERAL

3.1.1 Avoid running cables inside or under power cable trays. Where field wiring is in power cable trays, insulation must be equal to or greater than the highest voltage in the cable tray.

3.1.2 Where power or signal cables must cross, make them cross at an angle of 90 degrees.

3.1.3 Communication cables will not be mixed with power or signal cables.

3.2 SIGNAL SEPARATION

3.2.1 Analog and 24VDC Discrete Signals: Analog 4-20 mA signals and 24VDC discrete signals should normally be in separate conduits. An exception to this standard may be made in cases where it would cause parallel conduit runs to the same device and combining signals would eliminate one conduit. In cases where the exception is used, both the analog and discrete signals should be twisted shielded pairs as described for analog signals previously. This exception will be limited to 3 meters only.

3.2.2 AC Digital and Control: AC digital signals and AC control wiring may occupy the same conduit, but all instrument power circuits should be isolated by a separate conduit from all AC digital and control circuits.

3.2.3 All conduits for signal cables shall be rigid metallic conduit unless indicated otherwise with the last meter flexible connecting to the field instrument with condensation loop.

3.3 MISCELLANEOUS

3.3.1 Thermocouple Extension Wire: Thermocouple extension circuits should be solid conductors and same gauge as the T/C of the same material as the associated

thermocouple. Thermocouple signal lines should be continuous from the thermocouple connection head to the final termination point.

- 3.3.2 Spare Conductors: Spare conductors in each conduit should be equal to 20% of the number required for both present and (defined) future conditions, but in no case less than two spare wires or one pair, should be installed. Each cable should have 10% spare conductors but not less than two conductors. Spare conductors should be terminated on a marked terminal strip or connector pin at each end.
- 3.3.3 Termination: Wire at both ends of the cable should be terminated with pre-insulated solderless spade or ring lugs for maximum physical strength and electrical conduction. Wires should not be terminated on adjacent terminal points if accidental short-circuiting could cause tripping or closing of a breaker.
- 3.3.4 Colour Coding: Cables or conductors may require colour coding to suit process requirement.

3.4 WIRING IDENTIFICATION

- 3.4.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic taped, on both ends of phase conductors of feeders and branch circuit wiring.
- 3.4.2 Maintain phase sequence and colour coding throughout.
- 3.4.3 Colour code: to applicable CSA standard:
 - 3.4.3.1 Phase A - Red: Phase B - Black: Phase C – Blue.
 - 3.4.3.2 Neutral - White Only.
- 3.4.4 Use colour codes wires in communication cables, matched throughout system.
- 3.4.5 All instrumentation and control wiring is to be identified with markers as specified. The identification is to consist of the coding as detailed on the drawings and as specified herein.
- 3.4.6 Tag field wires with the field device tag information:
 - 3.4.6.1 For devices connected to control panels, PLCs, MCCs, junction boxes, etc. show field source information and control schematic ladder diagram rung number.
 - 3.4.6.2 Label wires at both ends with the same information.
 - 3.4.6.3 Wire identifier should not change unless there is a function change in the wire runs i.e. a fuse, a relay, switch, push buttons, status lights or other physical devices. Wires passing through a junction box without a change in function would retain the same wire identifier.

3.4.7 Cable numbers

- 3.4.7.1 Field cables should be tagged with the field device tag information at both ends.
- 3.4.7.2 Where cables carry wires from multiple field devices, the cable tag should use the device tag of the junction box.
- 3.4.7.3 For cables tags, use P or C or I added to the device tag for Power, Control and Instrument respectively as some devices such as valves have all three cables.
- 3.4.7.4 Cable numbering should show the Junction Box relevant numbers in that a cable runs to a JB, but the wiring itself would not have such designation.
- 3.4.7.5 For example, in the case of a Cable from a Junction Box to an PLC, assign a unique "loop/device number" to the Junction Box and treat it as a Device.
- 3.4.7.6 A Cable schedule will be provided showing Cable I.D., Cable Type, Origin, and Destination.

3.4.8 Wire Markers

- 3.4.8.1 Wire markers available from Brady amongst others allow more than one line of characters if required but one line should be used if possible.
- 3.4.8.2 Wire markers should be kept to a minimum for ease of installation and readability. A single line of text should be used, minimizing the characters as much as possible.

END OF SECTION

SECTION 13310
PANEL CONSTRUCTION

1	STANDARD ADMINISTRATION.....	1
1.1	GENERAL	1
1.2	SHOP DRAWINGS	1
2	PRODUCTS	1
2.1	CONSTRUCTION	1
2.2	ELECTRICAL.....	3
2.3	NAMEPLATES AND LABELS	3
3	EXECUTION	4
3.1	INSTALLATION	4

SECTION 13310 PANEL CONSTRUCTION

1 STANDARD ADMINISTRATION

1.1 GENERAL

- 1.1.1 Comply with the requirements of Division 1 and Division 13.
- 1.1.2 Control panels (CP) house the control system at each of the basic levels of operator interface. Requirements apply to field panels, area control panels, PLC panels and all other panels used to house control and monitoring equipment.
- 1.1.3 This section is a specification for custom-built panels. It does not cover any control panel supplied as part of packaged equipment such as a variable frequency drive.
- 1.1.4 Use enclosures which conform to the requirements of the NEMA type specified or shown on panel drawings and requirements in Section 13311 - Enclosures.
- 1.1.5 Ensure that the panels selected are large enough to contain all required equipment, with 25% of space for expansion.

1.2 SHOP DRAWINGS

- 1.2.1 Comply with the requirements of Section 01300 - Submittals.
- 1.2.2 Provide internal and external layout drawings as part of shop drawings showing exact dimensions of the equipment provided.
- 1.2.3 The internal and external layout drawings included in the Contract Drawings are based on typical equipment and are not to be used for fabrication.
- 1.2.4 The Contract Administrator may increase panel size by up to 10% during shop drawing review.
- 1.2.5 Provide calculations for sizing the cooling fans, air conditioners, heaters and heat exchangers.
- 1.2.6 Provide colour chart for selection of the exterior colour where other than the standard colour is specified.
- 1.2.7 Provide one additional set of panels "As-Built" drawings and all PLC documents to place in the door pocket.

2 PRODUCTS

2.1 CONSTRUCTION

- 2.1.1 Panels must carry CSA/UL label.

- 2.1.2 Use enclosures that conform to the requirements of Section 13311.
- 2.1.3 Provide 304 SS screws, bolts, fasteners and wall spacers.
- 2.1.4 Place knockouts for the wiring of free-standing panels either at bottom or sides of the panel. Cover holes for future devices with plugs suitable for specified NEMA classification.
- 2.1.5 Cut, punch, or drill cut-outs for face-of-panel mounted instruments and smoothly finish with rounded edges.
- 2.1.6 Leave the space in the bottom 500mm of the panel free of equipment for future use.
- 2.1.7 Use panel fabrication techniques that allow for removal and maintenance of all equipment after installation.
- 2.1.8 Install door mounted equipment flush mounted and properly sealed. Internal mounted panels to be at least 1.6 mm sheet steel, uniform size, with spare removable panels for future use.
- 2.1.9 Fabricate panels, install instruments, plumb and wire in the factory. Arrange wiring and tubing terminations in the control panel to match floor (and or ceiling) openings. Test wiring and plumbing prior to shipment.
- 2.1.10 For NEMA type 3R and type 4/4X panels, mount face-of-panel mounted devices such as indicating meters, controllers, etc. that are not weatherproof on a hinged inner door, provide a NEMA rated viewing window on the enclosure door.
- 2.1.11 Locate face-of-panel mounted device higher than 0.8 m and lower than 2.0 m from the floor.
 - 2.1.11.1 Arrange status lights above corresponding pushbuttons or selector switches.
 - 2.1.11.2 Arrange digital and analog indicators above corresponding controls.
- 2.1.12 Arrange back-of-panel devices in a neat and orderly fashion. Allow 20% continuous space for future additions. Use mounting plate for mounting all components.
- 2.1.13 Environmental Protection
 - 2.1.13.1 See Section 13312 for detailed requirements.
 - 2.1.13.2 Provide internal condensation protection on all panels.
 - 2.1.13.3 Provide freezing protection with thermostat control on outdoor panels.

- 2.1.13.4 Provide louvers, forced ventilation, or air conditioners as required to limit temperature build-up to a maximum of 40°C to protect equipment.
- 2.1.13.5 Provide HEPA air filter to reduce dust on electrical equipment.
- 2.1.13.6 Where purge air is indicated or required, provide clean instrument air purging arrangement with filter regulator and shut-off valve, as indicated in schedule or panel drawing.
- 2.1.13.7 Provide a smoke/high temperature switch with SPDT dry contacts, mounted inside panel.

2.2 ELECTRICAL

- 2.2.1 Provide panels with switched full-length LED interior lights and mount near the top.
- 2.2.2 Provide panels with a 15A, 120VAC service outlet circuit with surge suppresser within the panel. Provide the circuit with 3 wire, duplex receptacles, one for every 1.0 m of width (one minimum per enclosure) and space evenly along the back-of-enclosure area. Provide ground fault interrupter type service outlet for outdoor panels.
- 2.2.3 Put panel services such as panel lighting, service outlets, air conditioner and heater, on separate, 120 VAC circuits supplied by a separate power feeder to the panel. Do not mix with internal panel circuits or loads.
- 2.2.4 Provide two separate 15A, 120VAC supplies to the panel. One supply to feed instruments via a fused terminal block. The other to feed panel services.
- 2.2.5 Wire in accordance with requirements of Section 13320.
 - 2.2.5.1 Use numbered terminal blocks for external connections.
 - 2.2.5.2 Provide instrument loop power supplies, mounting hardware, terminal blocks, control circuit breakers, and other items required for a fully operable panel.
 - 2.2.5.3 Furnish termination panels, if required. Include terminal blocks, interface hardware, wiring, and cabling necessary for a complete operational system.
- 2.2.6 See Section 13340 for panel services.

2.3 NAMEPLATES AND LABELS

- 2.3.1 Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Centres.

- 2.3.2 Furnish face-of-panel mounted nameplates to identify systems and equipment.
 - 2.3.2.1 Use engraved gravoply laminate nameplates having black letters on white background.
 - 2.3.2.2 Include device identification number as well as a descriptive name.
 - 2.3.2.3 Center lettering on each line.
 - 2.3.2.4 Use minimum 6 mm high characters.
 - 2.3.2.5 Mount nameplates with two (2) stainless steel self-threading screws.
 - 2.3.2.6 Name plate describing contract name and number if requested to be installed inside the panel.
- 2.3.3 In the panel interior, furnish surface mounted nameplates to identify each device mounted on the panel exterior and interior.
 - 2.3.3.1 Use engraved gravoply laminated nameplates with black letters on a white background.
 - 2.3.3.2 Place the tags above, but not on the device.
 - 2.3.3.3 Do not obstruct visibility by wire bundles or other equipment.
 - 2.3.3.4 Include device identification number as well as a descriptive name to match identification shown on drawings.
 - 2.3.3.5 Mount nameplates with two (2) stainless steel machine screws.
- 2.3.4 Label all front and internal mounted devices with the following information:
 - 2.3.4.1 Manufacturer, model and serial number.
 - 2.3.4.2 Input and output ranges.
 - 2.3.4.3 Power supply limits.
 - 2.3.4.4 Pressure rating if applicable.
 - 2.3.4.5 Enclosure classification.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Construct a 100 mm high concrete curb (house keeping pad), with dimensions as specified or noted in the schedule or panel drawing on which to install floor mounted control panels.

- 3.1.2 Where two or more enclosures are shown mounted immediately adjacent to one another, install both of them securely together with their front faces parallel.
- 3.1.3 After setting panel in place, remove the lifting rings and fill the lifting ring holes.
- 3.1.4 All wall mounted panels shall be installed with an offset or spacer away from the wall.

END OF SECTION

SECTION 13311
ENCLOSURES

1	GENERAL.....	1
1.1	GENERAL	1
2	PRODUCTS	1
2.1	ALL ENCLOSURES	1
2.2	FREE-STANDING ENCLOSURES – STEEL (PAINTED)	1
2.3	FREE-STANDING ENCLOSURES – STAINLESS STEEL	2
2.4	FREE-STANDING ENCLOSURES – FIBREGLASS	3
2.5	WALL MOUNTED ENCLOSURES – STAINLESS STEEL	3
2.6	WALL MOUNTED ENCLOSURES – FIBREGLASS	3
3	EXECUTION	4
3.1	GENERAL	4

SECTION 13311 ENCLOSURES

1 GENERAL

1.1 GENERAL

- 1.1.1 This section covers the fabrication of panel enclosures. Panel enclosures are distinct from panel cabinet construction.
- 1.1.2 See Section 13310 Panel Construction for additional general requirements and panel construction requirements.

2 PRODUCTS

2.1 ALL ENCLOSURES

- 2.1.1 Provide enclosures which conform to the requirements of the NEMA type specified in the schedule or panel drawing.
- 2.1.2 Refer to Contract Drawings for panel dimensions.
- 2.1.3 Provide each enclosure with full height, fully gasketed access doors where shown.
 - 2.1.3.1 Construction: 3.43 mm (10 gauge) thickness, single piece with edges turned back and rounded for rigidity.
 - 2.1.3.2 Latches: three-point latching mechanism.
 - 2.1.3.3 Hinge: continuous piano hinge with removable stainless-steel pin.
 - 2.1.3.4 Gasket: secured resistant neoprene gasket.
 - 2.1.3.5 Door handle: key lockable with recessed handles. Key locks alike.
- 2.1.4 Provide a 25 mm wide print pocket within each enclosure.
- 2.1.5 Use 304 SS screws, bolts, fasteners, and wall spacers.

2.2 FREE-STANDING ENCLOSURES – STEEL (PAINTED)

- 2.2.1 Fabricate enclosures from sheet steel.
 - 2.2.1.1 Provide single door enclosures with 2.67 mm (12 gauge) sides top, and back.
 - 2.2.1.2 Provide double door enclosure with a 3.43 mm (10 gauge) back with 2.67 mm (12 gauge) top and sides.

- 2.2.1.3 Provide multi-door enclosures with 3.43 mm (10 gauge) sides, top, and back.
- 2.2.2 Grind and sand exterior welds to a smooth finish free of burrs, mill scale, rust, grease, and oil. Make surfaces free of ridges, nuts, bolt heads, and similar protrusions. Fill all imperfections and sand smooth.
- 2.2.3 Prime with one coat and finish with two coats of factory finished, epoxy-based paint. Paint the exterior color ANSI/ASA61 – standard gray, unless otherwise specified. Paint the panel interior white.
- 2.2.4 Internally, supply the enclosures with a structural steel framework or bracing for equipment support and enclosure bracing. Permit lifting without racking or distortion. Provide removable lifting rings designed to facilitate rigging and lifting of the enclosure during installation. Provide steel plugs to fill the lifting ring holes after installation is complete.
- 2.2.5 Arrange rear access doors and size such that they extend no further than 600 mm beyond the enclosure when opened to the 90-degree position.
- 2.2.6 Provide enclosures with louvers as required by Section 13310. Except for enclosures mounted with their backs directly adjacent to a wall, place louvers in the rear of the enclosure, top and bottom. For enclosures mounted with their backs directly adjacent to a wall, place louvers on the sides.

2.3 FREE-STANDING ENCLOSURES – STAINLESS STEEL

- 2.3.1 Fabricate enclosures from stainless steel.
 - 2.3.1.1 Provide single door enclosures with 2.67 mm (12 gauge) sides top, and back.
 - 2.3.1.2 Provide double door enclosure with a 3.43 mm (10 gauge) back with 2.67 mm (12 gauge) top and sides.
 - 2.3.1.3 Provide multi-door enclosures with 3.43 mm (10 gauge) sides, top, and back.
- 2.3.2 Grind and sand exterior welds to a smooth finish free of burrs, mill scale, rust, grease, and oil. Make surfaces free of ridges, nuts, bolt heads, and similar protrusions. Fill all imperfections and sand smooth.
- 2.3.3 Finish exterior in brushed or matt.
- 2.3.4 Internally, supply the enclosures with a structural steel framework or bracing for equipment support and enclosure bracing. Permit lifting without racking or distortion. Provide removable lifting rings designed to facilitate rigging and

lifting of the enclosure during installation. Provide steel plugs to fill the lifting ring holes after installation is complete.

2.3.5 Arrange rear access doors and size such that they extend no further than 600 mm beyond the enclosure when opened to the 90-degree position. .

2.3.6 Provide enclosures with louvers as required by Section 13310. Except for enclosures mounted with their backs directly adjacent to a wall, place louvers in the rear of the enclosure, top and bottom. For enclosures mounted with their backs directly adjacent to a wall, place louvers on the sides.

2.4 FREE-STANDING ENCLOSURES – FIBREGLASS

2.4.1 Use NEMA type 4X fibreglass reinforced polyester enclosures. Construct the enclosures so that no metal parts are exposed.

2.4.2 Provide steel reinforced tops, bottoms, and sides. Provide an internal steel framework to support equipment, brace the enclosure, and permit lifting.

2.4.3 Provide removable lifting rings and nylon plugs to fill the lifting ring holes after installation is complete.

2.5 WALL MOUNTED ENCLOSURES – STAINLESS STEEL

2.5.1 In addition to the NEMA standard, meet the following requirements:

2.5.1.1 1.91 mm (14-gauge) minimum metal thickness.

2.5.1.2 Doors shall be 2.67 mm (12-gauge) minimum thickness, rubber-gasketed with continuous hinge.

2.5.2 Finish exterior in brushed or matt.

2.6 WALL MOUNTED ENCLOSURES – FIBREGLASS

2.6.1 In addition to the NEMA standards, meet the following requirements:

2.6.1.1 Hinge doors on the left side and equip with quick release latches.

2.6.1.2 Provide fibreglass reinforced polyester latches and hinges.

3 EXECUTION

3.1 GENERAL

3.1.1 See Section 13310 Panel Construction for general execution requirements.

END OF SECTION

SECTION 13312
ENCLOSURES ACCESSORIES

1	GENERAL.....	1
1.1	GENERAL	1
2	PRODUCTS	1
2.1	ENCLOSURE ACCESSORIES	1
3	EXECUTION	2
3.1	GENERAL	2

SECTION 13312 ENCLOSURES ACCESSORIES

1 GENERAL

1.1 GENERAL

- 1.1.1 See Section 13310 Panel Construction for additional general requirements and panel construction requirements.
- 1.1.2 Provide calculations for sizing the heaters or ventilation.

2 PRODUCTS

2.1 ENCLOSURE ACCESSORIES

2.1.1 Heaters for Condensation Control

- 2.1.1.1 Provide thermostatically controlled, fan-driven heaters for all enclosures for condensation control unless otherwise specified.
- 2.1.1.2 Meet the following requirements:
 - 2.1.1.2.1 Power: 115 VAC, 60 Hz.
 - 2.1.1.2.2 Rating:
 - 2.1.1.2.2.1 100W for panels smaller than 61 cm by 122 cm.
 - 2.1.1.2.2.2 200W for larger panels.
- 2.1.1.3 Provide thermostats that sense air temperature in the panel and are adjustable from 4 to 25°C.
- 2.1.1.4 Mount heaters near the bottom center of the enclosure. Where physical separation inside the panels is required, ensure the heaters provide adequate heat and air flow for uniform heating of the entire enclosure as needed.
- 2.1.1.5 Do not mount electronic components closer than 15 cm to the heater.

2.1.2 Heaters for Freeze Protection

- 2.1.2.1 Provide thermostatically controlled heaters for freeze protection down to -30°C for all outdoor panels or as specified in the schedule or panel drawing. Size heaters to maintain the inside temperature above 4°C.
- 2.1.2.2 Meet the following requirements:
 - 2.1.2.2.1 Power: 115 VAC, 60 Hz.

2.1.2.2.2 Minimum Rating:

2.1.2.2.2.1 100W for panels smaller than 25 cm by 41 cm.

2.1.2.2.2.2 150W for panels smaller than 31 cm by 62 cm.

2.1.2.2.2.3 250W for panels smaller than 46 cm by 76 cm.

2.1.2.2.2.4 500W for panels smaller than 61 cm by 122 cm.

2.1.3 Moisture and Corrosion Protection

2.1.3.1 Self-regenerating desiccant in heat-sealed, semi-permeable packet, Humidisorb by A+ Corporation. Provide the size and number of packets needed to protect the size of panel.

2.1.3.2 Self-regenerating desiccant with vapor corrosion inhibitor in heat-sealed, semi-permeable packet, Humidisorb Plus X-Corrode by A+ Corporation. Provide the size and number of packets needed to protect the size of panel.

3 EXECUTION

3.1 GENERAL

3.1.1 See Section 13310 Panel Construction for general execution requirements.

END OF SECTION

SECTION 13320
PANEL WIRING

1	GENERAL.....	1
1.1	GENERAL	1
2	PRODUCTS	1
2.1	INTERNAL WIRING	1
2.2	TERMINAL BLOCKS.....	2
2.3	GROUNDING	3
2.4	SIGNALS AND INTERFACES	3
3	EXECUTION (NOT USED)	4

SECTION 13320 PANEL WIRING

1 GENERAL

1.1 GENERAL

- 1.1.1 See Section 13310 Panel Construction for general requirements.

2 PRODUCTS

2.1 INTERNAL WIRING

- 2.1.1 Size and install all wire and cable in accordance with CSA, Ontario Electrical Safety Code, IEEE and other applicable electrical safety codes.
- 2.1.2 Terminate all internal panel wiring to external devices at the terminal strips. Connect all field wiring to one side of the terminal strip. Connect all panel wiring to be connected to the opposite side. Arrange terminals for external connects in consecutive order for conductors within a given cable.
- 2.1.3 Provide continuous wire between the power supply point and the load point without splices.
- 2.1.4 Use flexible, stranded, copper TEW wiring. Run wires in continuous lengths from terminal to terminal. Do not splice wires.
- 2.1.5 For analog signal wiring, use uniformly twisted shielded pairs not smaller than CSA 0.823 mm² (18 AWG) with a minimum of six twists per 300 mm (one foot). Separate analog signal wiring at least 150 mm (six inches) from power wiring. Provide continuous foil or metalized plastic shields with 100 percent coverage. Include a drain wire in continuous contact with the shield. Multiple cables must have an overall shield and individual shields for each signal cable.
- 2.1.6 Use CSA = 1.3 mm² (16 AWG) if approved under the local electrical authority or larger for control signal wiring.
- 2.1.7 Use power wiring with insulation rated at 600V. Use CSA = 3.31 mm² (12 AWG) or larger for power wiring.
- 2.1.8 Segregate signal wiring from control power wiring: group functionally and arrange neatly to facilitate tracing of circuits.
- 2.1.9 Use plastic wiring wraps to bundle wires, outside of wiring ducts. Securely fasten the bundles to the steel structure at intervals not exceeding 300 mm (12 inches). Each bundle contains 30 conductors maximum. Use Panduit, or equal wiring ducts and size to provide a minimum of 20 percent spare space not less than 5 per terminal block.

- 2.1.10 Do not intermix signals within the same bundle or duct.
- 2.1.11 Use twisted unshielded wire for other DC signals and segregate from wire conducting AC signals.
- 2.1.12 Colour code wiring as follows:
 - 2.1.12.1 Colour coding for D/C controls and Intrinsically Safe wiring are to conform to the Owner Standard.
 - 2.1.12.1.1 Line and load circuits AC or DC power: Black.
 - 2.1.12.1.2 AC control circuits: Red.
 - 2.1.12.1.3 DC control circuits: Blue.
 - 2.1.12.1.4 Interlock control circuits on the panel energized from external source: Yellow.
 - 2.1.12.1.5 DC signal grounding conductors: Green/White Stripes.
 - 2.1.12.1.6 Equipment grounding conductors: Green.
 - 2.1.12.1.7 Current carrying grounded conductor (neutral): White.
 - 2.1.12.1.8 Intrinsically safe: Blue.
- 2.1.13 Use PVC crimped sleeve type wire tag identifications with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.
- 2.1.14 In PLC panels wire each I/O module to a separate termination block strip. Rack and Slot information should be on a separate tag at the top of the respective terminal block strip.
- 2.1.15 Minimum spacing between two (2) rows of terminal blocks shall be 80 mm (3 inches).

2.2 TERMINAL BLOCKS

- 2.2.1 Provide DIN style high density, rail mount type terminal blocks.
- 2.2.2 Provide mounting rails as required with one end stop at each end of rail.
- 2.2.3 Space terminal block strips no closer than 150 mm centre to centre.
- 2.2.4 Provide a continuous marking strip with the terminals.
- 2.2.5 Provide a separate terminal for terminating each shield wire.

- 2.2.6 Provide terminal block barriers to separate 24 VDC instrument loops, 120 VAC power, 120 VAC control wiring, 24 VDC control wiring and grounding.
- 2.2.7 Reserve one side of each terminal strip for field incoming conductors. Do not make common connections and jumpers required for internal wiring on the field side of the terminal. Terminate no more than one wire at any one terminal except where jumper wires are needed for internal wiring in which case two wires may be connected.
- 2.2.8 Provide a minimum of 25 percent spare terminals on each rail, minimum four (4) spares per rail.
- 2.2.9 Provide 120 VAC cover plate for power terminals.
- 2.2.10 Provide jumper bars to connect common wires and terminals. All common terminals to have the same number.
- 2.2.11 For each instrument or piece of equipment, group all field wiring together at the terminal strip. Provide a common group marker for each set.
- 2.2.12 Provide fused terminal blocks for 120 VAC power feed to field instruments. Label the fuse voltage and amperage rating on top of the terminal block.
- 2.2.13 Provide fused terminal block for each instrument or piece of equipment, requiring 120 VAC power supply from PLC panel for DIs (digital inputs). Label the fuse voltage and amperage rating on top of the terminal block.
- 2.2.14 Manufacturers: Allen -Bradley, Phoenix, Wieland.

2.3 GROUNDING

- 2.3.1 Provide two (2) ground buses in each cabinet or panel, one for shield and cabinet grounding and one for signal grounding.
- 2.3.2 Provide grounding lugs for connection to the external grounding system.
- 2.3.3 Provide CSA 13.3 mm² (AWG 6) size stranded copper grounding for DC signals.
- 2.3.4 Connect the ground buses with a removable cross connector located near the panel ground.

2.4 SIGNALS AND INTERFACES

- 2.4.1 Analog signals are 4 to 20 mADC and conform to the compatibility requirements of ISA Standard 50.1. Provide the signal conversion necessary for compatibility with panel mounted instruments and the interface to the digital controllers.

- 2.4.2 Provide interposing relays, if required, for retransmission of isolated discrete (digital) signals to digital controllers. Relays shall be 10 A, 120 VAC, SPDT or DPDT, pin-base, plug-in style with indicator.
- 2.4.3 Supply and install timers as shown on drawings. Timers to be DPDT with 5 A and 120 VAC unless otherwise noted. Timers shall be Omron H3BA type or equal.
- 2.4.4 Furnish, mount, and wire control components such as relays, timers, and other equipment to provide the interfacing and interlocking between the motor starter and associated protective circuits, or other type of control circuit function applicable to a particular final control element. Use sealed and plug-in type components.
- 2.4.5 The Drawings show the interface for equipment. The Drawings are typical for the equipment expected to be furnished and are provided to show the intended control functions and interfaces. Provide intended panel functional interfaces.

3 EXECUTION (NOT USED)

END OF SECTION

SECTION 13340
PANEL SERVICES

1	GENERAL.....	1
1.1	GENERAL	1
2	PRODUCTS	1
2.1	PANEL SERVICE	1
2.2	FUSE	1
2.3	CIRCUIT BREAKER	1
2.4	TERMINAL BOARD	1
2.5	OVER-VOLTAGE AND OVER-CURRENT PROTECTIVE DEVICES	2
3	EXECUTION	2
3.1	GENERAL	2

SECTION 13340 PANEL SERVICES

1 GENERAL

1.1 GENERAL

- 1.1.1 See Section 13310 Panel Construction for additional general requirements.

2 PRODUCTS

2.1 PANEL SERVICE

- 2.1.1 Provide for feeder circuit conduit entry and provide a terminal board for termination of the wires.
- 2.1.2 Provide a master circuit breaker and branch circuit breakers on each individual circuit distributed from the power panel. Group the circuit breakers on a single subpanel. Place subpanel so that there is a clear view of and access to the breakers when the door is open. Use branch circuit breakers rated as required. Co-ordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker.
- 2.1.3 Place no more than 5 devices on any single circuit, as required. Avoid common mode power loss. Subject to project review.
- 2.1.4 Where multiple units perform parallel operations, do not group all devices on the same branch circuit. This will prevent failure of any single branch circuit from shutting down the entire operation.
- 2.1.5 Do not exceed 12 amperes continuous on the branch circuit.
- 2.1.6 Protect power supply from damage due to external failure.
- 2.1.7 Provide output over voltage and over current protective devices to protect instruments from damage due to power supply failure.

2.2 FUSE

- 2.2.1 Provide DIN-style fuse with LED failure indicator.

2.3 CIRCUIT BREAKER

- 2.3.1 See Division 16.

2.4 TERMINAL BOARD

- 2.4.1 See Division 16.

2.5 OVER-VOLTAGE AND OVER-CURRENT PROTECTIVE DEVICES

2.5.1 See Division 16.

3 EXECUTION

3.1 GENERAL

3.1.1 See Section 13310 Panel Construction for general execution requirements.

3.1.2 Install output fused terminal blocks, mounted alongside terminal blocks.

3.1.3 Mount fuses to be easily seen and replaced.

3.1.4 Provide 120VAC plug mold for panel components with line cords.

END OF SECTION

**SECTION 13930
TESTING PROCEDURE**

1	GENERAL.....	1
1.1	GENERAL	1
1.2	SUBMITTALS.....	1
1.3	TESTING SCHEDULE	2
2	PRODUCTS (NOT USED)	2
3	EXECUTION	2
3.1	GENERAL	2
3.2	TESTING TOOLS AND EQUIPMENT	3
	APPENDIX A - INSTALLATION CHECK SHEET	4
	APPENDIX B - WIRING AND TERMINATION CHECK SHEET.....	5
	APPENDIX C – SITE ACCEPTANCE TEST FORM.....	6

SECTION 13930 TESTING PROCEDURE

1 GENERAL

1.1 GENERAL

- 1.1.1 This document outlines the testing procedure and testing requirements of the SCADA system and SCADA system subcomponents to confirm the SCADA system and subcomponents are delivered in accordance with the Contract Documents. The testing will confirm that:
 - 1.1.1.1 All components are installed free of manufacturer defects.
 - 1.1.1.2 All components are correctly installed in accordance with Contract Documents and manufacturer requirements and recommendation.
 - 1.1.1.3 All components have been correctly calibrated and the calibration certificate or sign off sheet is available (where applicable).
 - 1.1.1.4 All components have been correctly configured or programmed (where applicable).
 - 1.1.1.5 All components have been correctly wired and terminated (point to point checks).
 - 1.1.1.6 All components have been correctly tagged and labelled.
 - 1.1.1.7 Final verification that all components are ready for Site Acceptance Testing and Commissioning.
- 1.1.2 Where it is identified that the requirements of the Contract have not been met, the Contractor shall rectify all deficiencies immediately to allow re-testing during the same test phase.
- 1.1.3 Testing will be deemed complete only when all features, functions and information required in the Contract Documents have been verified as present, functioning, and documented as accurate within the anticipated operating range for the process being monitored.

1.2 SUBMITTALS

- 1.2.1 Submit the following documents prior to conducting the SCADA System Acceptance Testing:
 - 1.2.1.1 Installation Check Sheet (see Appendix A of this Section)
 - 1.2.1.2 Wiring and Termination Check Sheet (point to point) (see Appendix B of this Section)

- 1.2.1.3 Calibration procedure(s) to be followed in the test. The calibration method and tools will not cause greater than $\pm 0.5\%$ error in any test.
- 1.2.1.4 Any special Procedure(s) to be followed in the test.
- 1.2.1.5 Identify site verification, set-up and/or calibration to be done by the equipment manufacturers and coordinate the work with the manufacturer to complete the work prior to the SCADA System Site Acceptance Testing.
- 1.2.2 Use the sample SCADA System Site Acceptance form found in Appendix C of this section to document test results.
- 1.2.3 Update working drawings, Data Sheets, calibration reports and “As Built” drawings including layouts, control schematics and electrical drawings as required to match field conditions.

1.3 TESTING SCHEDULE

- 1.3.1 Submit testing procedures and schedules of work no less than two (2) weeks prior to the projected test date for the individual component. This will include specific dates for when the various test procedures are to be carried out and identified to be witnessed by Owner’s staff.
- 1.3.2 In some cases, testing may be scheduled outside normal business hours to accommodate operational or access requirements.
- 1.3.3 Testing may be interrupted by the Owner’s staff for emergency process operation.
- 1.3.4 Submit test results to the Contract Administrator at the end of each day of testing.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 GENERAL

- 3.1.1 Provide qualified electricians and/or SCADA technicians to assist in testing and quickly repairing minor deficiencies for re-testing in the same test phase.
- 3.1.2 Have the following documents on hand prior to conducting SCADA System Acceptance Testing:
 - 3.1.2.1 Reviewed shop drawings, including data sheets, for each device installed (multiple copies for multiple installations).
 - 3.1.2.2 “For Construction” layouts, schematics, and electrical drawings.

- 3.1.2.3 Configuration and calibration certificates from the manufacturer(s) for each calibrated device.
- 3.1.2.4 Results of factory performance tests, where specified in the Contract Documents.
- 3.1.2.5 Device field calibration reports where field calibration is necessary.
- 3.1.2.6 Prepared Installation and Wiring Check Sheets complete with each device and SCADA System Component.
- 3.1.2.7 Prepared SCADA system acceptance reports with all equipment numbers and relevant details entered.
- 3.1.3 Inspect and document that each instrument matches the reviewed shop drawing. The inspection shall include, but not be limited to the following (as applicable):
 - 3.1.3.1 Verifying that device product details match shop drawings and Contract Documents.
 - 3.1.3.2 Confirming soundness of device, (i.e. free of any damage).
 - 3.1.3.3 Confirming completeness in all respects as specified for device.
 - 3.1.3.4 Confirming correctness of setting, alignment, and relative arrangement.
 - 3.1.3.5 Inspecting power, signal, and grounding wiring identified on the schematics and documenting the results. All wiring is to be verified for continuity.
 - 3.1.3.6 Confirm all labeling and tagging is affixed to the device and wiring in accordance with Contract Drawings and Owner preferences.

3.2 TESTING TOOLS AND EQUIPMENT

- 3.2.1 Contractor to provide all necessary testing equipment, this includes specialized meters, software etc. All necessary testing equipment is the responsibility of the Contractor, and all costs associated with and testing or testing equipment falls under the Contractor's scope of supply.
- 3.2.2 Protect all equipment that may be damaged by testing. If damages occur, the Contractor shall be fully responsible for replacement of damaged parts and/or components.
- 3.2.3 Use calibration tools that will not cause greater than $\pm 0.5\%$ error in any test. The accuracy of the calibration tools must be traceable to The National Institute of Standards and Technology (NIST).

END OF SECTION

APPENDIX A - INSTALLATION CHECK SHEET

Item #	Device Identification		SCADA Device Installation Check Sheet									
			Preparation			Results						
	TAG	Description	Work Status	Docs. Ready	Owner Ops. Informed	Installed Properly	Calibration Acceptable	Comm. Test and/or Signal Test OK	Functions Works as Intended	Docs Marked "As-built"	Other Test (Note in Comments)	Comments including Reasons for Non-Acceptance
1	XXX-XXX-XXX-000	Short Device Description	Complete	Yes	Yes	Yes	Yes	Yes	Yes	Pending	N/A	
2												
3												
4												
5												
6												
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APPENDIX B - WIRING AND TERMINATION CHECK SHEET

Item #	Cable Identification		SCADA Device Wiring Check Sheet									
			Preparation			Power Cables and Wires			Signal and Communications			Comments including Reasons for Non-Acceptance
	TAG	Description	Wiring Work	Pre-Sat Complete	Drawings "Redlined"	Installed	Terminated	Tagged & Labeled	Installed	Terminated	Tagged & Labeled	
1	XXX-XXX-XXX-000	Short Device Description	Complete	Initials	Yes	Yes	Yes	Yes	N/A	N/A	N/A	
2												
3												
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APPENDIX C – SITE ACCEPTANCE TEST FORM

Item #	Device Identification		SCADA Device Acceptance Test Form										
			Preparation			Test Results			Sign-Off				Comments including Reasons for Non-Acceptance
	TAG	Description	All Documentation Complete and Available	Drawings and Documents Updated "As Built"	Calibration Sheets Available	Installation per Contract Docs.	Functionality as Intended	Compliance with Standards and Codes	Contractor / Installer	Consultant	Owner	Date	
1	XXX-XXX-XXX-000	Short Device Description	Yes	Yes	Yes	Pass	Pass	Pass	Initial	Initial	Initial	1-Jan-21	
2													
3													
4													
5													
6													
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THE CORPORATION OF THE
TOWNSHIP OF CRAMAHE
REQUEST FOR TENDER
MARCH 2025

DIVISION 16 SPECIFICATIONS

COLBORNE WTP ELECTRICAL
AND SCADA SYSTEM UPGRADES

DIVISION 16 – ELECTRICAL

<u>Section No.</u>	<u>Section Name</u>
16010	ELECTRICAL GENERAL REQUIREMENTS
16013	UTILITY REQUIREMENTS
16015	ELECTRICAL SYSTEM ANALYSIS
16025	DEMOLITION OF ELECTRICAL SYSTEMS
16120	WIRES AND CABLE
16130	ELECTRICAL BOXES
16412	MOULDED CASE CIRCUIT BREAKERS
16950	ELECTRICAL TESTING

SECTION 16010

ELECTRICAL GENERAL REQUIREMENTS

1	GENERAL.....	1
1.1	INTENT OF SECTION.....	1
1.2	DEFINITIONS	1
1.3	CODES AND STANDARDS	1
1.4	SCOPE OF WORK	2
1.5	GENERAL	2
1.6	TEMPORARY UTILITY SERVICES	3
1.7	PERMITS, FEES AND INSPECTION	3
1.8	CO-ORDINATION WITH POWER SUPPLY AUTHORITY	3
1.9	CO-ORDINATION WITH OTHER TRADES.....	4
1.10	CONSTRUCTION/SHOP DRAWINGS.....	4
1.11	RECORD DRAWINGS	5
1.12	WORKMANSHIP	5
1.13	MATERIALS AND EQUIPMENT.....	6
1.14	FINISHES.....	6
1.15	WIRING IDENTIFICATION	6
1.16	CONDUIT AND CABLE IDENTIFICATION	6
1.17	WIRING TERMINATIONS	7
1.18	MANUFACTURERS AND CSA LABELS.....	7
1.19	WARNING SIGNS.....	7
1.20	SINGLE LINE ELECTRICAL DIAGRAMS (SLD).....	7
1.21	LOCATION OF OUTLETS AND LIGHT SWITCHES	8
1.22	MOUNTING HEIGHTS	8
1.23	LOAD BALANCE.....	8
1.24	CONDUIT AND CABLE INSTALLATION.....	9
1.25	INSERT, SLEEVES, FASTENINGS AND SUPPORTS	9
1.26	CUTTING, PATCHING AND WELDING.....	9
1.27	FIREPROOFING	10
1.28	FIELD QUALITY CONTROL (TESTING).....	10
1.29	CO-ORDINATION OF PROTECTIVE DEVICES.....	12
2	PRODUCTS (NOT USED)	13
3	EXECUTION (NOT USED)	13

SECTION 16010
ELECTRICAL GENERAL REQUIREMENTS

1 GENERAL

1.1 INTENT OF SECTION

- 1.1.1 This Section covers items common to Sections of Division 16 and supplements the requirements of Division 1.
- 1.1.2 In case of a discrepancy between statements and/or values in this General Requirements section and contract drawing(s), the more stringent statement and value takes precedence and shall govern.

1.2 DEFINITIONS

- 1.2.1 The following are definitions of terms and expressions used in the specification:
 - 1.2.1.1 “Inspection Department/Authority” means the agency having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project, the Inspection Departments/Authorities are the Electrical Safety Authority (ESA) and Hydro One.
 - 1.2.1.2 “Supply Authority” means electrical power company or commission responsible for delivery of electrical power to project. For this project, the Supply Authority is Hydro One.
 - 1.2.1.3 “Electrical Code” means the Ontario Electrical Safety Code latest edition, and published bulletins.
 - 1.2.1.4 “Indicated” means as shown on contract drawings or noted in contract documents.
- 1.2.2 Refer to CSA C22.2 No.0 for “Definitions and General Requirements”.
- 1.2.3 Abbreviations for electrical terms shall be in accordance with CSA Z85-1983.

1.3 CODES AND STANDARDS

- 1.3.1 All equipment and installations including temporary works shall comply with the latest editions of the Canadian Electrical Code – CSA C22.1, the Ontario Safety Electrical Code and any local codes and requirements that govern the installation. Where these regulations conflict, apply the most stringent condition.
- 1.3.2 Install overhead and underground systems in accordance with CSA C22.3 No.1-M87 and No.7-M86 except where specified otherwise.
- 1.3.3 CAN3-C23583 Preferred Voltage Level for AC Systems, 0 to 5000V.

1.4 SCOPE OF WORK

- 1.4.1 General scope of work is provided in Division 1, Section 01010 Summary of Work. Further details are indicated on contract drawings.
- 1.4.2 Provide short circuit, arc flash and protection coordination study per requirements of section 16015 prior to ordering electrical equipment. Supply and install arc flash labels on the electrical panel.
- 1.4.3 Provide support to other disciplines as necessary.
- 1.4.4 Preliminary Sequence of Construction is provided in Division 1, Section 01010 Summary of Work. Contractor to review, modify and submit for final review, prior to commencement of the work.
- 1.4.5 Test and commission all new and modified equipment, power distribution and control systems.
- 1.4.6 Clean all electrical equipment.
- 1.4.7 Provide training for all equipment supplied under this Division.
- 1.4.8 All cable routes to be finalized by Contractor on site including those not shown on drawings.

1.5 GENERAL

- 1.5.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.
- 1.5.2 The specifications are divided into Divisions of work and a Division may consist of the work of more than one (1) subcontractor. The responsibility as to which subcontractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.
- 1.5.3 Electrical equipment shop drawings will not be reviewed unless they are accompanied with a copy of the electrical protection and coordination study, where the contractor performs these studies.
- 1.5.4 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections.
- 1.5.5 Remove existing equipment made obsolete by this project and also disconnect/reconnect existing equipment either relocated or serviced from new equipment.

- 1.5.6 Visually inspect the existing site conditions, including below grade areas, prior to the project award to suit the installation of the new power and controls distribution.
- 1.5.7 Furnish, install, test and commission a complete operational electrical system as required by the drawings and as herein specified.
- 1.5.8 Remove and dispose of existing equipment made obsolete by this project

1.6 TEMPORARY UTILITY SERVICES

- 1.6.1 Provide all necessary labour and materials to install and maintain any temporary services as required.

1.7 PERMITS, FEES AND INSPECTION

- 1.7.1 Submit to Contract Administrator necessary interim and final certificates of inspection and approval required by Inspection Authorities as evidence that work installed complies with laws and regulations of governing authorities.
- 1.7.2 Submit copies of plans and specifications required by Inspection and Supply Authorities.
- 1.7.3 Notify Inspection Authorities in sufficient time to inspect work.
- 1.7.4 Contractor to submit a request to the Electrical Safety Authority to notify them of the impending assignment for review and inspection requirements.
- 1.7.5 Provide Inspection Department and Supply Authority any additional necessary number of drawings and specifications for examination and approval prior to commencement of work.
- 1.7.6 Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.
- 1.7.7 Pay all associated fees and costs. The contractor is responsible for all fees and costs including any changes, or additions in scope to the Electrical Safety Authority inspection fees.

1.8 CO-ORDINATION WITH POWER SUPPLY AUTHORITY

- 1.8.1 Co-ordinate and meet all requirements of the power supply authority.
- 1.8.2 It shall be the responsibility of the Contractor to conform to the latest utility standards and the Ontario Electrical Safety Code.
- 1.8.3 Submit to power supply authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

- 1.8.4 Ensure the availability of electrical power service to plant at all times. To minimize the facility shutdown time, contractor to maintain the supply of voltage/power to the facility from the existing stand-by diesel generator, via the Auto Transfer Switch (ATS) during the demolition of the existing Power Meter and Fused Disconnect Switch (FDS). When the new Power Meter (supplied by Hydro One) and new FDS (supplied by the contractor) are installed and tested, the utility power can be re-instated.

1.9 CO-ORDINATION WITH OTHER TRADES

- 1.9.1 Be responsible and co-ordinate other sub-trade work with electrical requirements and ensure that there is no interference with, or delay caused by such work to the electrical or other trades work.
- 1.9.2 Notify other sub-trades of all openings, inserts, anchors, sleeves, hangers, foundations, etc., necessary for electrical work, and be responsible that these are provided and correctly installed at the proper time.
- 1.9.3 Fully co-operate with all trades in the provision and maintenance of electrical power in all areas throughout the period of construction.

1.10 CONSTRUCTION/SHOP DRAWINGS

- 1.10.1 Submit shop drawings in accordance with Section 01300 – Submittals.
- 1.10.2 Submit data (drawings) for review prior to commencement of manufacturing or installing with the exception of conduit, standard conduit fittings and low voltage wiring.
- 1.10.3 Show all details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment or material.
- 1.10.4 Prepare composite construction drawings, fully dimensioned of cables, conduit, cable tray, bus duct, sleeves, clearances, pipes, ducts, etc., and equipment in mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base drawings on manufacturer's shop drawings. Drawings should be developed from consultation with and agreement of all trades involved.
- 1.10.5 Prepare drawings of equipment bases, anchors, slabs, floor and roof curbs, if needed, for the electrical work.
- 1.10.6 Include, but not necessarily limit to, the following:
 - 1.10.6.1 Single Line Diagram (SLD), site redlined.
 - 1.10.6.2 Manufacturer's bulletins, leaflets and specifications of major electrical equipment.

- 1.10.6.3 Instrumentation signal loop diagrams showing all loop devices as per ISA S5.1 and S5.4, including power supplies.
- 1.10.6.4 PLC connection and inter-connection wiring diagrams, showing wiring, cables, jacks between components including power supplies, processor, communication modules, racks, I/O modules and peripherals, etc.
- 1.10.6.5 Instrument and control panel layouts, and all auxiliary controls and indicating panels.
- 1.10.7 Indicate the number or letter used on the drawings/specifications as an identification symbol on product data for panelboards, light fixtures, instruments and other equipment submitted.
- 1.10.8 Bind one complete set of construction/shop drawings showing “as built” conditions in each operating and maintenance instruction manual.

1.11 RECORD DRAWINGS

- 1.11.1 Before commencing work, obtain two sets of electrical drawings for showing “As Built” conditions. As job progresses, mark on field set of prints to indicate accurately all installed work. At completion stage, transfer all information onto master set of drawings and indicate “Contractors Certified Approval of Accuracy” before submitting to Contract Administrator for review and record use.
- 1.11.2 Indicate on record drawings “As Built” stamp.
- 1.11.3 Indicate on record drawings, location of all buried services. This information is to be certified correct by Contract Administrator before backfilling commences.

1.12 WORKMANSHIP

- 1.12.1 Install all equipment, bus ducts, cable trays, conduit and cables in a workmanlike manner to present a neat appearance and to function properly, where applicable.
- 1.12.2 Install exposed systems and equipment neatly and grouped to present a neat appearance, without conflict to other services.
- 1.12.3 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore, in terms of space and accessibility.
- 1.12.4 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers’ installation instructions and make provision for future plant and equipment as shown.
- 1.12.5 Replace without extra cost work unsatisfactory to the Contract Administrator.

- 1.12.6 Protect all equipment from damage during delivery to the site and during installation. Make good any damage or deterioration whatsoever and have it covered by replacement guarantee.

1.13 MATERIALS AND EQUIPMENT

- 1.13.1 Equipment and material must be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department. Pay all associated fees.
- 1.13.2 Factory assemble control panels and component assemblies.
- 1.13.3 Provide Canadian manufactured equipment and materials, except where specified otherwise or where Canadian made materials or equipment do not exist.

1.14 FINISHES

- 1.14.1 Shop finish all metal enclosure surfaces by application of rust resistant primer and at least two coats of finish enamel all in accordance with the directions of the coating manufacturer.
 - 1.14.1.1 Paint free-standing VFDs, Passive Harmonic Filter, MCC and distribution enclosures light grey to ANSI #61.
- 1.14.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- 1.14.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.15 WIRING IDENTIFICATION

- 1.15.1 Identify wiring with permanent indelible identifying markings, numbered on both ends of phase conductors of feeders and branch circuit wiring.
- 1.15.2 Maintain phase sequence and colour coding throughout.
- 1.15.3 Colour code: to CSA C22.1, and other sections of the contract documents.
- 1.15.4 Use colour-coded wires in communication cables, matched throughout system.

1.16 CONDUIT AND CABLE IDENTIFICATION

- 1.16.1 Colour code conduits, boxes and metallic sheathed cables.
- 1.16.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 10 m intervals.
- 1.16.3 Apply cable tag numbers on both ends.

1.16.4 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	yellow	
up to 600 V	yellow	green
up to 5 kV	yellow	blue
up to 15 kV	yellow	red
Telephone	green	
Other communication systems	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other security systems	red	Yellow

1.17 WIRING TERMINATIONS

1.17.1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

1.18 MANUFACTURERS AND CSA LABELS

1.18.1 Visible and legible after equipment is installed.

1.19 WARNING SIGNS

1.19.1 As specified and to meet requirements of Electrical Inspection Department and Contract Administrator.

1.19.2 Decal signs, minimum size 175 x 250 mm.

1.20 SINGLE LINE ELECTRICAL DIAGRAMS (SLD)

1.20.1 Submit “as-built” SLDs based on Contract drawing to Contract Administrator for review.

1.20.2 Drawings: A1 size

1.20.3 Provide a framed SLD showing all devices.

1.20.4 Provide a second board mounted SLD (10 mm stiff board) with matte laminated finish for portable reference within the electrical room, hung in a prominent location.

1.21 LOCATION OF OUTLETS AND LIGHT SWITCHES

- 1.21.1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- 1.21.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- 1.21.3 Locate light switches on latch side of doors.

1.22 MOUNTING HEIGHTS

- 1.22.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- 1.22.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- 1.22.3 Install electrical equipment at following heights unless indicated otherwise.
 - 1.22.3.1 Local switches: 1400 mm.
 - 1.22.3.2 Wall receptacles:
 - 1.22.3.2.1 General: 1400 mm.
 - 1.22.3.3 Panelboards: as required by Code or as indicated.
 - 1.22.3.4 Telephone and interphone outlets: 300 mm.
 - 1.22.3.5 Wall mounted telephone and interphone outlets: 1500 mm.
 - 1.22.3.6 Fire alarm stations: 1500 mm.
 - 1.22.3.7 Fire alarm bells: 2100 mm.
 - 1.22.3.8 Exterior light fixtures (wall mounted): 2600 mm or directly above door.

1.23 LOAD BALANCE

- 1.23.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- 1.23.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- 1.23.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers, oil-filled transformers, and switchgear

operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.24 CONDUIT AND CABLE INSTALLATION

- 1.24.1 Install conduit and sleeves prior to pouring of concrete, where applicable. Sleeves through concrete: schedule 40 rigid PVC, sized for free passage of conduit, and protruding 50 mm.
- 1.24.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- 1.24.3 Arrange for holes through exterior walls and roof to be flashed and made weatherproof. Co-ordinate with appropriate division.
- 1.24.4 Provide fire stopping for all penetrations through fire-rated walls.

1.25 INSERT, SLEEVES, FASTENINGS AND SUPPORTS

- 1.25.1 Provide all necessary inserts, hangers, fastenings, sleeves and curbs for electrical equipment, suspended from or passing through structural walls or floors, to suit the specific location, and as approved by the Contract Administrator.
- 1.25.2 Cables must be supported using “P” clips instead of tie-wraps.
- 1.25.3 Sleeves: allow 12 mm clearance over the O.D. of all cables and conduits, 25 mm horizontally and vertically for rectangular openings.
- 1.25.4 Finish sleeves flush with wall finish (each side) or the ceiling to curb top.
- 1.25.5 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields, properly sized for the load to be carried.
- 1.25.6 Secure equipment to poured concrete with expandable inserts, properly sized for the load to be carried.
- 1.25.7 Secure equipment to hollow masonry walls or suspended ceilings with factory made threaded or toggle type inserts, properly sized for the load to be carried.

1.26 CUTTING, PATCHING AND WELDING

- 1.26.1 Where installation of equipment by this section requires cutting or patching of new or existing work, the work shall be performed by, and under direction and supervision of, this section. Make good surface finishes to satisfaction of the Contract Administrator.
- 1.26.2 No cutting or welding of beams, columns or structural surfaces is permitted without approval of the Contract Administrator and all damage to finished or

unfinished surfaces shall be made good to the satisfaction of the Contract Administrator.

- 1.26.3 Pay all costs for cutting and patching resulting from failure to co-ordinate timely installation of electrical inserts, sleeves, etc., into masonry structures.

1.27 FIREPROOFING

- 1.27.1 Where sleeves or openings are installed in walls, floors, roof or partitions to accommodate raceways, cables or bus duct, provide all necessary seals, fittings, barriers and fire-resistant materials to restore the installation to its original fire rating to the satisfaction of the governing authorities and the Owner's insurance underwriters. Minimum two (2) hour fire rating.

1.28 FIELD QUALITY CONTROL (TESTING)

1.28.1 General

- 1.28.1.1 Prior to the Owner's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Contract Administrator to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.
- 1.28.1.2 Ensure that the system and its components are ready prior to the inspection and test for acceptance.
- 1.28.1.3 Conduct all testing by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Contract Administrator. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the Owner. Submit two copies of the test certificates to the Contract Administrator.
- 1.28.1.4 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.
- 1.28.1.5 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.
- 1.28.1.6 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Contract Administrator.
- 1.28.1.7 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the

tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

1.28.1.8 Ensure circuit protection devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

1.28.1.9 Replace at no additional cost all fuses, relays, or other devices destroyed during field quality control (testing).

1.28.1.10 Supply all instruments, meters and personnel required for the tests.

1.28.1.11 Clean equipment by vacuum. Clean, wax and polish all new exterior surfaces, check and tighten all electrical connections.

1.28.2 Cable and Wire – 1000 Volt and Below

1.28.2.1 Limit all tests on cables in this voltage range to insulation resistance measurements using a megger: 500 V instrument for circuits up to 350 V systems; 1000 V instrument for 351-600 V systems.

1.28.2.2 Record all test results in a logbook and submit to the Contract Administrator for reference. Replace or repair all circuits, which do not meet minimum requirements specified in the governing Electrical Safety Code. Measure insulation resistance of the following circuits:

1.28.2.2.1 Power and lighting feeders (with equipment disconnected): phase-to-phase, and phase-to-ground.

1.28.2.2.2 Control circuits: measure to ground only.

1.28.2.3 Do not perform megger tests on control circuits containing transistorized or solid-state components.

1.28.2.4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

1.28.3 Instrumentation and Thermocouple Wiring

1.28.3.1 Check continuity of each wire using ohm meter or DC buzzer. Megger or 120 V filament lamp testing is not acceptable.

1.28.3.2 Test thermocouple wiring for continuity and polarity in accordance with manufacturer's recommendations.

1.28.4 Transformers

- 1.28.4.1 Measure primary and secondary voltages at each tap setting and verify nameplate values. No-load tap changers to be operated only when transformer is de-energized.

1.28.5 Grounding System

- 1.28.5.1 Test the ground system efficiency for compliance with CSA Standard C22.1 and Supply Authority requirements. Verify that the ohmic resistance values specified therein are not exceeded (refer to Section 16950).
- 1.28.5.2 If ohmic value of the grounding system is not satisfactory to the Contract Administrator or Supply Authority, install additional ground rods and ground conductor to rectify.
- 1.28.5.3 Notify inspection and Supply Authorities that they may be present to witness Contractor testing and provide any assistance required by these Authorities for their own testing procedures.

1.29 CO-ORDINATION OF PROTECTIVE DEVICES

- 1.29.1 Ensure all protective devices ratings and settings are properly co-ordinated to suit the actual equipment supplied and/or installed or to which it is being connected.
- 1.29.2 Record and submit to Contract Administrator all protective devices settings as left.
- 1.29.3 Provide a system co-ordination time-current curves on Log-Log paper for all protective devices. Include but not be limited to the following:
 - 1.29.3.1 All protective devices on 600 V and 208/120 V systems.
 - 1.29.3.2 Supply authority's power cables and fuse curves.
 - 1.29.3.3 Damage curves – 3 phase, phase-ground, phase-phase and inrush current point for all transformers.
 - 1.29.3.4 600 V molded case circuit breaker trips – thermal and instantaneous.
 - 1.29.3.5 Starting current of largest motor on the system including the offset of the running load.
 - 1.29.3.6 Damage curves for 1 kV and 600 V power cables.
 - 1.29.3.7 Three-phase RMS bolted fault values, phase-to-phase and phase-to-ground (include generator's values).

1.29.4 Submit all data for review sufficiently in advance of equipment ordering.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 16013
UTILITY REQUIREMENTS**

TABLE OF CONTENTS

1	GENERAL.....	1
1.1	SCOPE OF WORK	1
1.2	ELECTRICAL UTILITY REQUIREMENTS	2
1.3	MEASUREMENT AND PAYMENT.....	2
2	PRODUCTS (NOT USED)	2
3	EXECUTION	2
3.1	CONSTRUCTION	2

SECTION 16013 UTILITY REQUIREMENTS

1 GENERAL

1.1 SCOPE OF WORK

- 1.1.1 Demarcation point will be at the Hydro One owned pole.
- 1.1.2 Hydro One will provide fuses (for transformer bank) on the utility pole (new pole with 3x75kVA Y-Y transformers).
- 1.1.3 Transformer: Pole mount transformer bank will be supplied and installed by Hydro One.
 - 1.1.3.1 Contractor will provide the transformer foundation and grounding per standard details provided by Hydro One. Refer to detail drawings.
 - 1.1.3.2 Primary connections to the transformer will be made by Hydro One.
 - 1.1.3.3 Secondary terminations to be made by Contractor in coordination with Hydro One.
- 1.1.4 Power Meter: Hydro One to supply and install the power meter placed on the base. Contractor will supply the NEMA Type 3R enclosure and 16S base (and socket) for the power meter as per Hydro One requirements. All necessary conduit and wiring to location shown on the Contract drawings to be supplied and installed by Contractor.
 - 1.1.4.1 For more details see Metering Guide-Outdoor enclosure document (page 25), provided by Hydro One, and electrical Contract drawings.
 - 1.1.4.2 Utility meter to be accessible by Hydro One at all times.
- 1.1.5 A new 200A service rated Fused Disconnect Switch (FDS) to be supplied and installed by Contractor per requirements of OESC Section 84, additional Hydro One requirements, and per electrical Contract drawings. The FDS must be suitable for outdoor installation, equipped with a minimum NEMA Type 3R enclosure.
- 1.1.6 Trenching: Trenching is for the underground conduit/cable installation. Trenching and underground conduit/cable installation must meet Ontario Electrical Safety Code (OESC) and be approved by ESA.

1.2 ELECTRICAL UTILITY REQUIREMENTS

- 1.2.1 Co-ordinate and meet all requirements of the local electrical distribution utility (Hydro One).
- 1.2.2 Install cable, conduit, duct, poles, metering cabinets, protection, and any other necessary equipment to supply power to the pumping station, as required by the local electrical distribution utility and ESA, that are in addition to equipment specified in the contract documents.
- 1.2.3 Provide necessary coil at utility end (pole) for Hydro One to connect. Provide conduit/straps/bolts and weather head, as per Hydro One requirements.
- 1.2.4 Install the incoming utility services to the service entrance equipment provided in the base contract, as required by the load requirements of the pumping station, electrical safety inspector, and the local electrical distribution utility.
- 1.2.5 Provide the local electrical distribution utility with the required information for the service installation. Load list can be provided upon request.
- 1.2.6 Pay all associated connection fees/charges for local electrical distribution utility services.
- 1.2.7 Local electrical distribution utility contact information and client reference number to be provided after award of Contract.

1.3 MEASUREMENT AND PAYMENT

- 1.3.1 Payment for the work outlined in this section is included in the lump sum tender price.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 CONSTRUCTION

- 3.1.1 Contractor to coordinate with utility for installation standards, construction specifications and guides to be followed by contractor to provide utility service to the pumping station. Request all utility standards directly from Hydro One, and ESA, as required.

END OF SECTION

SECTION 16015
ELECTRICAL SYSTEMS ANALYSIS

TABLE OF CONTENTS

1	GENERAL.....	1
1.1	GENERAL CONDITIONS	1
1.2	REFERENCES.....	1
1.3	SEQUENCING AND SCHEDULING	2
1.4	SCOPE OF WORK	2
1.5	SHORT CIRCUIT STUDY	4
1.6	QUALITY ASSURANCE.....	5
1.7	COORDINATION STUDY	5
1.8	ARC FLASH HAZARD STUDY	7
1.9	HARMONIC ANALYSIS STUDY – NOT REQUIRED.....	7
1.10	TABULATIONS	7
1.11	STUDY ANALYSIS.....	9
1.12	STUDY REPORT	9
1.13	FIELD SETTINGS.....	10
1.14	SUBMITTALS.....	11
2	PRODUCTS (NOT USED)	13
3	EXECUTION.....	13
3.1	GENERAL	13
3.2	ARC FLASH TRAINING	13
3.3	FIELD QUALITY CONTROL	14

SECTION 16015
ELECTRICAL SYSTEMS ANALYSIS

1 GENERAL

1.1 GENERAL CONDITIONS

- 1.1.1 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.
- 1.1.2 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for General Electrical requirements related to this work.
- 1.1.3 Equipment and component titles used in the studies shall be identical to the equipment and component titles shown on the Drawings.
- 1.1.4 Perform studies using a personal computer with approved software for the application.
- 1.1.5 Perform complete fault calculations for each proposed and ultimate source combination.
- 1.1.6 Coordinate with the supply authority to obtain their design fault levels and protective settings.
- 1.1.7 Source combination may include present and future power company supply circuits, large motors, or generators.
- 1.1.8 The study shall provide analysis and coordination to suit all possible operational configurations of the 600 V distribution systems.
- 1.1.9 Utilize proposed load data for the study obtained from Contract Documents.
- 1.1.10 Device coordination time-current curves.

1.2 REFERENCES

- 1.2.1 The following is a list of standards which may be referenced in this section:
 - 1.2.1.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1.2.1.1.1 141 Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - 1.2.1.1.2 241 Recommended Practice for Electric Power Systems in Commercial Buildings.
 - 1.2.1.1.3 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

- 1.2.1.1.4 399 Recommended Practice for Industrial and Commercial Power System Analysis.
- 1.2.1.1.5 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- 1.2.1.1.6 1015 Recommended Practice for Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- 1.2.1.1.7 1584 Guide for Performing Arc-Flash Hazard Calculations.
- 1.2.1.2 American National Standards Institute (ANSI): C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- 1.2.1.3 American National Standards Institute (ANSI) Std.80: Guide for Safety in AC Substation Grounding.
- 1.2.1.4 American National Standards Institute (ANSI) Std.837: IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- 1.2.1.5 CSA Standard C22.41 Grounding and Bonding Equipment.
- 1.2.1.6 Ontario Electrical Safety Code, latest edition.

1.3 SEQUENCING AND SCHEDULING

- 1.3.1 An initial, complete short circuit and protective device coordination study must be submitted and reviewed before Contract Administrator will approve Shop Drawings for MCC and VFD.
- 1.3.2 The short circuit and protective device coordination studies to be updated prior to Project Substantial Completion. Utilize characteristics of as-installed equipment and materials.
- 1.3.3 The Contractor shall provide a complete short circuit and protection coordination (SCPC) study and submit copies to the Contract Administrator.
- 1.3.4 The Contractor shall prepare a complete parameter setting file based on the SCPC study and set the recommended settings of each device during construction.

1.4 SCOPE OF WORK

- 1.4.1 The Contractor shall hire an approved testing organization to provide a completed Short Circuit, Coordination, Arc flash Protection study, and Harmonic study to the Contract Administrator as part of the shop drawing submission.

- 1.4.2 The Contractor is to ensure all protective and metering device ratings and settings are properly coordinated to suit the actual equipment supplied and/or installed or to which it is being connected.
- 1.4.3 Coordination, arc flash, and harmonic analysis study shall be carried out on all electrical distribution equipment in the station, as required. The study shall also include coordination with upstream protective devices.
- 1.4.4 Investigate the existing system to gather data for the analysis.
- 1.4.5 Obtain all the required data for the coordination, and arc flash study from the Contract Specification and Drawings, supplier of the major equipment, Utility, and by site visit.
- 1.4.6 The Contractor is to provide field testing verification of all devices, including the downloaded relay settings.
- 1.4.7 Power system testing and coordination study implementation to be performed by the Electrical System Analysis Providers specified herein.
- 1.4.8 The Contractor shall provide a licensed electrician to gain access to any existing distribution equipment to suit verification of existing electrical name plate data as required.
- 1.4.9 The studies shall include all portions of the electrical distribution system installed under this contract from hydro service entry to and including the smallest adjustable trip circuit breaker.
- 1.4.10 The Contractor and Electrical System Analysis Provider shall pre-commission the MCC, ATS, and VFDs onsite, including testing of all protective relay functions,
- 1.4.11 The Contractor and Electrical System Analysis Provider shall demonstrate all protective device settings to the Contract Administrator on-site by secondary injection testing relay sensing inputs to simulate all fault conditions during the SAT.
- 1.4.12 The firm performing the studies should be currently involved in high and low voltage power system evaluation. The studies shall be performed, stamped and signed by the registered Professional Engineer in the Province of Ontario. Credentials of the individual(s) performing the studies and background of the firm shall be submitted to the Contract Administrator for approval prior to start of the work. A minimum of five years' experience in power system analysis is required for the individual in charge of the project.
- 1.4.13 The firm performing the study should demonstrate capability and experience to provide assistance during start-up as required.

- 1.4.14 Contractor shall be responsible for setting of all protective devices and application of arc flash labels on equipment. This includes field testing, inspection and verification of protective device settings.
- 1.4.15 Contractor must ensure that the short circuit, arc flash, protection coordination and harmonic study is provided and reviewed by the Contract Administrator prior to ordering new equipment.

1.5 SHORT CIRCUIT STUDY

- 1.5.1 Determine the short-circuit current available at each component of the electrical system and the ability of the component to withstand and/or interrupt the current.
- 1.5.2 The short-circuit study shall be performed in accordance with the recommended practices and procedures set forth in ANSI/IEEE 399 and the step-by-step procedures outlined in the short circuit calculation chapters of IEEE 141 and ANSI/IEEE 242.
- 1.5.3 General:
 - 1.5.3.1 Use cable impedances based on actual conductor materials.
 - 1.5.3.2 Use bus impedances based on copper bus bars.
 - 1.5.3.3 Use cable and bus resistances calculated at 25°C.
 - 1.5.3.4 Use 600-volt cable reactance based on use of typical dimensions of RW90, Teck conductors.
 - 1.5.3.5 Use actual transformer impedances.
- 1.5.4 Provide:
 - 1.5.4.1 Calculation methods and assumptions.
 - 1.5.4.2 Selected base per unit quantities.
 - 1.5.4.3 One-line diagrams.
 - 1.5.4.4 Source impedance data, including electric utility system and motor fault contribution characteristics.
 - 1.5.4.5 Impedance diagrams.
 - 1.5.4.6 Zero sequence impedance diagrams.
 - 1.5.4.7 Typical calculation.
 - 1.5.4.8 Tabulations of calculated quantities.

- 1.5.4.9 Results, conclusions, and recommendations.
- 1.5.5 Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:
 - 1.5.5.1 Electric utility's supply termination point.
 - 1.5.5.2 Outdoor substation transformer primary and secondary terminals.
 - 1.5.5.3 Main MCC breaker, on normal power
 - 1.5.5.4 ATS and motor control centres on both normal power and generator power.
 - 1.5.5.5 All 600V branch circuit panel-boards.
 - 1.5.5.6 Other significant locations throughout the system.
 - 1.5.5.7 Future load contributions as shown on one-line diagram.
- 1.5.6 Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.
- 1.5.7 Provide bolted line-to-line fault current study for areas as defined for three-phase bolted fault short circuit study.
- 1.5.8 Verify:
 - 1.5.8.1 Equipment and protective devices are applied within their ratings.
 - 1.5.8.2 Adequacy of switchgear and motor control centre bus bars to withstand short circuit stresses.
 - 1.5.8.3 Adequacy of transformer windings to withstand short circuit stresses. (Based on proposed new transformers)
 - 1.5.8.4 Cable and busway sizes for ability to withstand short circuit heating, besides normal load currents.

1.6 QUALITY ASSURANCE

- 1.6.1 Short Circuit and Protective Device Coordination, Arc Flash Protection and Harmonics Studies shall be prepared by a professional electrical engineer registered in the Province of Ontario.

1.7 COORDINATION STUDY

- 1.7.1 Determine protective device characteristics, settings, or sizes that provide a balance between equipment protection and selective device operation that is optimum for the electrical system.

- 1.7.2 The coordination study shall be performed in accordance with the recommended practices and procedures set forth in ANSI/IEEE 399 and ANSI/IEEE 242.
- 1.7.3 Proposed protective device coordination time-current curves for distribution system including main MCC breaker, ATS, 600V MCCs and branch circuit panel-boards, graphically displayed on conventional log-log curve sheets.
- 1.7.4 Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet.
- 1.7.5 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- 1.7.6 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- 1.7.7 Plot Characteristics on Curve Sheets:
 - 1.7.7.1 breakers and fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 1.7.7.2 Low voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
 - 1.7.7.3 Pertinent transformer full-load currents at 100 and 600 per cent.
 - 1.7.7.4 Transformer magnetizing inrush currents.
 - 1.7.7.5 Transformer damage curves.
 - 1.7.7.6 ANSI transformer withstand parameters.
 - 1.7.7.7 Significant symmetrical and asymmetrical fault currents.
 - 1.7.7.8 Ground fault protective device settings.
 - 1.7.7.9 Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control centre.
- 1.7.8 Primary Protective Device Settings for Delta-Wye Connected Transformer:
 - 1.7.8.1 Secondary Line-to-Ground Fault Protection: Primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 per cent of ANSI C57.12.00 withstand point (for delta-wye systems).
 - 1.7.8.2 Secondary Line-To-Line Faults: 16 per cent current margin between primary protective device and associated secondary device characteristic curves.

1.8 ARC FLASH HAZARD STUDY

- 1.8.1 The arc flash hazard study shall be performed in accordance with latest revision of CSA Z462 and IEEE 1584.
- 1.8.2 After short-circuit and coordination studies have been performed, provide a detailed engineering analysis to determine worst case arc-flash hazards and associated incident energy conditions.
- 1.8.3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model. Alternative methods shall be presented in the proposal.
- 1.8.4 The arc flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (motor control centres, ATS, panel-board, busways and splitters) where work could be performed on energized parts. Arc flash hazard labels shall be prepared as part of the study and shall be attached to the electrical panels.
- 1.8.5 The Arc Flash Hazard Analysis shall include all significant locations in 600 V, 240 V and 208 V systems.
- 1.8.6 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- 1.8.7 The Arc Flash Hazard Analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full load conditions.
- 1.8.8 Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- 1.8.9 Arc flash calculation shall be based on actual overcurrent protective device clearing time. Maximum clearing time will capped at 2 seconds based on IEEE 1584-2018 section 6.9.1.

1.9 HARMONIC ANALYSIS STUDY – NOT REQUIRED

1.10 TABULATIONS

1.10.1 General Data:

1.10.1.1 Short circuit reactance of rotating machines.

1.10.1.2 Cable and conduit material data.

- 1.10.1.3 Bus data.
- 1.10.1.4 Transformer data.
- 1.10.1.5 Circuit resistance and reactance values.
- 1.10.2 Short Circuit Data:
 - 1.10.2.1 Fault impedances.
 - 1.10.2.2 X to R ratios.
 - 1.10.2.3 Asymmetry factors.
 - 1.10.2.4 Motor contributions.
 - 1.10.2.5 Short circuit kVA.
 - 1.10.2.6 Symmetrical and asymmetrical fault currents.
- 1.10.3 Recommended Protective Device Settings:
 - 1.10.3.1 Solid State Relays:
 - 1.10.3.1.1 Adjustable pickup.
 - 1.10.3.1.2 Adjustable time current characteristics.
 - 1.10.3.1.3 Curve slope and type.
 - 1.10.3.1.4 Current tap.
 - 1.10.3.1.5 Time dial.
 - 1.10.3.1.6 Instantaneous pickup.
 - 1.10.3.1.7 Overvoltage and under voltage alarms.
 - 1.10.3.1.8 Reverse current settings.
 - 1.10.3.1.9 Metering and c communication settings.
 - 1.10.3.2 Circuit Breakers:
 - 1.10.3.2.1 Adjustable pickup.
 - 1.10.3.2.2 Adjustable time-current characteristic.
 - 1.10.3.2.3 Adjustable instantaneous pickup.

1.11 STUDY ANALYSIS

1.11.1 Written Summary:

1.11.1.1 Scope of studies performed.

1.11.1.2 Explanation of bus and branch numbering system.

1.11.1.3 Prevailing conditions.

1.11.1.4 Selected equipment deficiencies.

1.11.1.5 Results of short circuit and coordination studies.

1.11.1.6 Comments or suggestions.

1.11.2 Suggest changes and additions to equipment rating and/or characteristics.

1.11.3 Notify Contract Administrator in writing of existing circuit protective devices improperly rated for new fault conditions.

1.12 STUDY REPORT

1.12.1 The results of the power system study shall be summarized in a final report. Three bound copies of the final report shall be submitted.

1.12.2 The report shall include the following sections:

1.12.2.1 Descriptions, purpose, basis and scope of the study.

1.12.2.2 Tabulations of circuit breaker, fuse and other protective devices ratings versus calculated short circuit duties, and commentary, and commentary regarding same.

1.12.2.3 Tabulations of all protection and configuration settings for each microprocessor based protection relays including multifunction protection relays for branch feeders and motor protection relays.

1.12.2.4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection and commentary regarding same.

1.12.2.5 Fault current calculation including a definition of terms and guide for interpretation of computer printout.

1.12.3 Arc Flash Warning Labels

1.12.3.1 The Contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

- 1.12.3.2 The label shall be an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:
 - 1.12.3.2.1 Location designation
 - 1.12.3.2.2 Nominal voltage
 - 1.12.3.2.3 Flash protection boundary
 - 1.12.3.2.4 Hazard risk category
 - 1.12.3.2.5 Incident energy
 - 1.12.3.2.6 Working distance
 - 1.12.3.2.7 Engineering report number, revision number and issue date
- 1.12.3.3 Labels shall be machine printed, with no field markings.
- 1.12.3.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1.12.3.4.1 For each 600, and applicable 208 volt panel-boards, one arc flash label shall be provided.
 - 1.12.3.4.2 For each motor control center, one arc flash label shall be provided.
 - 1.12.3.4.3 For MCC main breaker, one arc flash label shall be provided.
 - 1.12.3.4.4 For ATS, one arc flash label shall be provided.
 - 1.12.3.4.5 For each VFD, one arc flash label shall be provided.
- 1.12.3.5 Labels shall be field installed by the Electrical Systems Analysis Provider, or by the equipment manufacturer under the Start-up and Acceptance Testing contract portion.
- 1.12.4 Authority Approval: Copies of the final report shall be submitted to the Supply and Inspection Authorities for their review and approval. Approved copies of the report shall be submitted to the Contract Administrator.

1.13 FIELD SETTINGS

- 1.13.1 The Contractor shall perform all field adjustments of the new and existing protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device evaluation and coordination study.

- 1.13.2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

1.14 SUBMITTALS

- 1.14.1 Shop Drawings: Provide three copies of study in hard cover, three-ring binders, to include:
 - 1.14.1.1 Short Circuit Study
 - 1.14.1.2 Protective Device Coordination Study
 - 1.14.1.3 Arc Flash Protection Study
 - 1.14.1.4 Harmonics Study
- 1.14.2 Results of the short-circuit, coordination, arc flash hazard, and harmonic analysis study shall be summarized in a final report, in accordance with Section 01300, containing the following items:
 - 1.14.2.1 Basis, description, method of hazard assessment, purpose, and scope of the study.
 - 1.14.2.2 Tabulations of the data used to model the system components and a corresponding single line diagram.
 - 1.14.2.3 Descriptions of the scenarios evaluated and the basis for each.
- 1.14.3 Tabulations of equipment short-circuit ratings versus available fault duties. The tabulation shall identify percentage of rated short circuit and clearly note equipment with insufficient ratings.
- 1.14.4 Time-current curves demonstrating the coordination of time-overcurrent protective devices. Show damage curves of transformers and cables.
- 1.14.5 Tabulations of protective devices identifying circuit location, manufacturer, type, range of adjustment, IEEE device number, current transformer ratios, recommended settings or device size, and referenced time-current curve.
- 1.14.6 Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
- 1.14.7 Required arc-flash labeling for each equipment. Labels shall be similar to the example of the detailed arc flash hazard analysis label shown in Annex Q, Figure Q.3 of the CSA Z462-08 standard.

- 1.14.8 Tabulations of rms voltages, peak voltages, rms currents, and total capacitor bank loading versus associated equipment ratings. Equipment with insufficient ratings shall be clearly identified for each of the scenarios evaluated.
- 1.14.9 Tabulations of calculated voltage-distortion factors, current-distortion factors, and individual harmonics versus the limits specified by ANSI/IEEE 519. Calculated values exceeding the limits specified in the standard shall be clearly noted.
- 1.14.10 Plots of impedance versus frequency showing resonant frequencies to be avoided.
- 1.14.11 Tabulations of the system transformer capabilities based on the calculated no sinusoidal load current and the procedures set forth in ANSI/IEEE C57.110. Overloaded transformers shall be clearly noted.
- 1.14.12 Conclusions and recommendations.
 - 1.14.12.1 Submit report for review by Contract Administrator. Time Current Curves shall be plotted in colour. After review of the report, one copy will be returned to the Contractor to implement comments, revise, and resubmit three final copies of a typewritten report sealed by a Professional Engineer licensed in Ontario.
- 1.14.13 Submit all data for review sufficiently in advance of equipment ordering.
- 1.14.14 Warning Labels
 - 1.14.14.1 Provide warning labels to cover both normal power and emergency power scenarios.
 - 1.14.14.2 Provide and affix Arc Flash Hazard Warning Labels on each equipment prior to electrical equipment energization and after implementing the Contract Administrator's comments in the reviewed report. Submit to Contract Administrator a spare label for each label supplied neatly bound and protected from damage.
- 1.14.15 Field Settings
 - 1.14.15.1 The Contractor is to ensure all protective and metering devices are set-up as per the coordination study settings.
- 1.14.16 The Contractor is to provide field testing verification of all devices on compact disk.
- 1.14.17 The Contractor shall perform all field adjustments of the new and existing protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device evaluation study and protective device coordination study.

- 1.14.18 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 GENERAL

- 3.1.1 Adjust protective device settings according to values established by the approved coordination study and provide test sheets.
- 3.1.2 Provide detailed data sheets for all programmable meters, relays and monitors within the scope of this study, including all multifunction relays, feeder protection relays, motor protection relays and power monitors.
- 3.1.2.1 Detailed data sheets to include all
- 3.1.2.1.1 Protective device settings
 - 3.1.2.1.2 Setting Ranges.
 - 3.1.2.1.3 Output relay functions
 - 3.1.2.1.4 Parameters for input devices
 - 3.1.2.1.5 Addressing
 - 3.1.2.1.6 Communication settings
- 3.1.2.2 Data sheets to be in electronic format and in hardcopy format for review and inclusion in the final Operation and Maintenance Manual.
- 3.1.3 Make minor modifications (device setting changes, fuse changes) to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.
- 3.1.4 Notify Contract Administrator in writing of any required major equipment modifications.
- 3.1.5 Install arc flash & hazard labels.

3.2 ARC FLASH TRAINING

- 3.2.1 The contractor of the Arc Flash Hazard Analysis shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of four (4) hours).

3.3 FIELD QUALITY CONTROL

- 3.3.1 Test relay settings by secondary current and voltage injection.
- 3.3.2 Test ground continuity and resistance prior to energizing electrical systems.
- 3.3.3 Test grounding system efficiency for compliance with Ontario Electrical Safety Code requirements.
- 3.3.4 Test breaker trip functions and verify trip settings.
- 3.3.5 Notify Inspection and Supply Authorities so they may witness testing. Provide assistance, including labour and equipment required by Authorities, for their testing procedures.

END OF SECTION

SECTION 16025
DEMOLITION OF ELECTRICAL SYSTEMS

1	GENERAL.....	1
1.1	GENERAL CONDITIONS	1
1.2	SCOPE OF DEMOLITION OF ELECTRICAL SYSTEMS WORK	1
1.3	SUBMITTALS	1
1.4	PROCEDURES AND STAGES.....	1
2	PRODUCTS	2
2.1	GENERAL.....	2
3	EXECUTION	2
3.1	GENERAL.....	2

SECTION 16025
DEMOLITION OF ELECTRICAL SYSTEMS

1 GENERAL

1.1 GENERAL CONDITIONS

- 1.1.1 Comply with Division 1 - General Requirements and Section 16010 - General Electrical Requirements.
- 1.1.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.
- 1.1.3 Treat the demolishing equipment containing designated substances (e.g. PCBs, asbestos, etc.) in accordance with the Designated Substances Plan and all applicable regulations and codes.

1.2 SCOPE OF DEMOLITION OF ELECTRICAL SYSTEMS WORK

- 1.2.1 Furnish all labour, materials, equipment, transportation, services, facilities and supervision necessary to demolish all equipment, systems and materials specified herein and on the contract drawings.
- 1.2.2 Furnish all labour, materials, equipment, transportation, services, facilities and supervision necessary to dispose of all equipment, systems and materials listed for removal from site herein and on the drawings

1.3 SUBMITTALS

- 1.3.1 Provide a written procedure for all lifting operations involving the existing facility crane. Include weights and dimensions of items to be lifted and details of slings or other lifting tackle required.

1.4 PROCEDURES AND STAGES

- 1.4.1 Demolition and removal of the existing electrical equipment, cables and conduit, as specified on contract drawings.
- 1.4.2 Demolition and/or removal of equipment must follow the approved sequencing schedules.
- 1.4.3 Perform the demolition of electrical systems such that availability and continuity of supply, monitoring and control of the common systems and auxiliaries are kept and secured.

2 PRODUCTS

2.1 GENERAL

- 2.1.1 Supply and install the necessary temporary bracing, supporting structures, guards, warning signs, etc. necessary to complete the project safely and in accordance with all regulations and/or codes.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Organize the work and provided sufficient labour and equipment to ensure safety at all times.
- 3.1.2 All workers shall be competent in, and trained to perform, the tasks that they perform. Where applicable, workers shall be licensed or otherwise qualified for the tasks that they perform.
- 3.1.3 Prior to starting demolition, the contractor shall inspect with the Owner all facilities described to ascertain the limits of the works.
- 3.1.4 Do not commence any demolition work inside all pumping stations and PRV chambers until the designated substance survey (DSS) is performed on any equipment to be removed that is not covered in the existing DSS report and the Engineer has provided one (1) copy of the DSS report.
- 3.1.5 The DSS will be completed following the de-energization of live equipment. There will be a period following de-energization where no work on the electrical equipment, existing or new, will be permitted. During this period, work may continue on ancillary equipment and/or process.
- 3.1.6 Perform all demolition work in accordance with the requirements of the DSS plan.
- 3.1.7 All the demolition work shall be done in systematic and in such a manner as not to damage other services and equipment and not to affect the use and function of any process equipment and any services (electrical power, lighting, communication, heating, process pumps) for the remaining facilities.
- 3.1.8 There shall be no additional compensation for carrying out any condition embodied by the requirements stipulated under this section.
- 3.1.9 Co-ordination of work
 - 3.1.9.1 Co-ordinate demolition work with the Contract Administrator, other disciplines and Owner staff to ensure no disruption of station operation.

3.1.9.2 Refer to section 01040 of Division 1 for co-ordination with all other trades.

3.1.10 Demolition and disposal

3.1.10.1 Remove equipment and material indicated for demolition from site and dispose in accordance with all applicable regulations and codes.
Contractor to pay all associated fees for disposal.

3.1.10.2 During the demolition work, refrain from unnecessary damage to electrical equipment and building and hand over to the Owner, when requested to do so by the Engineer or indicated in the Contract Specifications and/or Drawings, all removed electrical equipment in good order and place the removed equipment into the areas as directed by the Owner's representative.

3.1.10.3 Remove and return in good working order, all equipment belonging to Owner as requested.

3.1.10.4 The contractor shall take all reasonable steps to ensure that equipment removed from site is reused or recycled.

END OF SECTION

SECTION 16120
WIRES AND CABLES

1	GENERAL.....	1
1.1	INTENT OF SECTION.....	1
1.2	REFERENCES.....	1
1.3	DESIGN REQUIREMENTS.....	1
1.4	STORAGE.....	3
2	PRODUCTS	3
2.1	MANUFACTURED PRODUCTS.....	3
3	EXECUTION	8
3.1	COORDINATION	8
3.2	INSTALLATION	8
3.3	UNDERGROUND INSTALLATION	9
3.4	WIRING TERMINATIONS	9
3.5	INSPECTION AND TESTING	10
3.6	WIRING IDENTIFICATION	10

SECTION 16120 WIRES AND CABLES

1 GENERAL

1.1 INTENT OF SECTION

- 1.1.1 This section describes the requirements for wire and cable up to 1000V for power, control and communications circuits.
- 1.1.2 This section does not apply to special-application wiring such as festoon cables, wiring provided by manufacturers to run between parts of packaged systems, or to wiring inside equipment and panels. Refer to the individual equipment specifications.
- 1.1.3 Refer to Division 13 for wiring associated with SCADA systems and for communications wiring.

1.2 REFERENCES

- 1.2.1 CSA C22.2 No. 131 Type TECK 90 Cables.
- 1.2.2 CSA C22.2 No. 38 Thermoset Insulated Wires and Cables.
- 1.2.3 CSA C22.2 No. 174 Cables and Cable Glands for use in Hazardous Locations.
- 1.2.4 CSA C68.3 Power Cables with Thermoset Insulation.
- 1.2.5 CSA C21.1 600 V Control Cable.
- 1.2.6 CSA C21.2 300 V Control Cable.
- 1.2.7 ICEA S-66-524.
- 1.2.8 All power cables must be CSA approved for application.

1.3 DESIGN REQUIREMENTS

- 1.3.1 Number and sizes of wires (and associated raceways) indicated are a guide only and are not necessarily the exact number and sizes required. Wire or cable sizes smaller than indicated are not acceptable.
- 1.3.2 Unless otherwise indicated, every cable/wire run from a source to a load is to include an appropriately sized separate ground wire, and the ground wire properly bonded and grounded. The following designations are used within the specifications and drawings:
 - 1.3.2.1 All cables designed as “3#, +G-C” infers three conductor cable plus ground conductor, within conduit this may be equivalent to “4#”.

- 1.3.2.2 All cables designed in a 3-phase, 3-wire system designated as “4#”, infers three branch conductors and one ground conductor of equal size as branch conductors.
- 1.3.2.3 All cables designed in a 3-phase, 4-wire system designated as “4#, +G-C”, infers three branch conductors, one neutral conductor and one ground conductor, within conduit this may be equivalent to “5#”.
- 1.3.2.4 All cables designed in a 3-phase, 4-wire system designated as “5#”, infers three branch conductors, one neutral conductor and one ground conductor, all conductors sized as the branch conductors.
- 1.3.3 Supply spare conductors in control, communication and instrumentation cable circuits as follows:
 - 1.3.3.1 Two to eight utilized conductors in one conduit or cable: two spare conductors.
 - 1.3.3.2 Nine or more utilized conductors: 20% or three spare conductors, whichever is greater.
- 1.3.4 No loose wiring or wire ends are accepted. Use manufacturer recommended connectors when installing cables. Use TECK cable connectors terminated in grounded metal plate for all TECK cable terminations. Grounding and attachment to unistrut not acceptable.
- 1.3.5 All necessary power and control wiring to all equipment shall be supplied and installed to suit the power and control requirements noted on the drawings. It shall be noted that the drawings do not necessarily indicate the locations of each individual feeder, but these shall be located to best suit the site conditions.
- 1.3.6 Where cable constructions are shown on drawings, the drawings shall take precedence.
- 1.3.7 All cables to be sized and installed in accordance with the OESC.
- 1.3.8 All conductors shall be stranded copper unless otherwise noted.
- 1.3.9 All exposed wiring should have flame test rating FT4 unless otherwise indicated.
- 1.3.10 All wiring in plenums including areas above drop ceilings acting as plenums shall have flame test rating FT6.
- 1.3.11 Wire and cable for all applications shall meet the equipment suppliers’ requirements and the OESC. Where this section does not contain specific requirements, refer to the manufacturer’s instructions and the OESC.

1.4 STORAGE

- 1.4.1 Cap or seal cable ends to prevent water penetration into cable. Reseal after cutting length of cable.
- 1.4.2 Cables stored with ends unsealed will be immediately removed from site at Contractor's cost. At no extra cost to the Owner, replace cables to the satisfaction of the Contract Administrator.

2 PRODUCTS

2.1 MANUFACTURED PRODUCTS

- 2.1.1 Comply with standards listed in 1.2, References.
- 2.1.2 Low Voltage Unarmoured Wire and Cable (1000 V and Below)
 - 2.1.2.1 Construction: Stranded, annealed copper conductors, 600 V minimum rating for conductors #10 AWG and smaller and 1000 V rating for conductors larger than #10 AWG, RW90 cross-linked polyethylene (XLPE) insulation, suitable for handling at minus 40°C ambient, 90°C maximum conductor temperature, limited flame spread FT4, jacketed.
 - 2.1.2.2 Direct buried installations or installations in direct buried PVC conduit: Cross-linked polyethylene (XLPE), RWU90 insulation, 1000 V minimum rating, jacketed.
 - 2.1.2.3 Minimum conductor sizes: Unless otherwise indicated, #12 AWG for power and current transformer circuits; #14 AWG for control circuits.
 - 2.1.2.4 Multi-conductor cables: PVC flame retardant black jacket overall, suitable for handling at minus 40°C, flame test rated FT4.
 - 2.1.2.5 Lighting wiring: GTF wire, 600 volt, 125°C, flexible copper conductor for connections between luminaire and outlet boxes.
 - 2.1.2.6 Colour coding: For insulated conductors, conform to the following:
 - 2.1.2.6.1 Line and load circuits AC or DC power: Black.
 - 2.1.2.6.2 AC control circuits: Red.
 - 2.1.2.6.3 DC control circuits: Blue.
 - 2.1.2.6.4 Interlock control circuits on the panel energized from external source: Yellow.
 - 2.1.2.6.5 DC signal grounding conductors: Green/White Stripes.

- 2.1.2.6.6 Equipment grounding conductors: Green.
- 2.1.2.6.7 Current carrying grounded conductor (neutral): White.
- 2.1.2.6.8 Intrinsically safe: Blue.
- 2.1.2.7 Insulated ground conductors forming part of a multi-conductor cable assembly: Inspection Authority colour coding.
- 2.1.3 Low Voltage Armoured Wire and Cable (1000 V and Below)
 - 2.1.3.1 Construction: Stranded, annealed copper conductors, 1000 V rating, RW90 cross-linked polyethylene (XLPE) insulation, suitable for handling at minus 40°C ambient, 90°C maximum conductor temperature, flame test rated FT4.
 - 2.1.3.2 Power cabling: TECK construction.
 - 2.1.3.3 Control cabling: TECK construction.
 - 2.1.3.4 Hazardous location: HL TECK construction.
 - 2.1.3.5 Minimum conductor size: Unless otherwise indicated, #12 AWG for power and current transformer circuits and #14 AWG for control.
 - 2.1.3.6 Grounding conductor: Stranded, soft, bare copper conductor in multiconductor cables, concentric copper wires over insulation in single conductor cable.
 - 2.1.3.7 Multi-conductor cables: With inner jacket of suitable PVC (minus 40°C).
 - 2.1.3.8 Interlocking armour: Flexible, galvanized steel or aluminum for multi-conductor cables and aluminum for single conductors, spirally wound over inner jacket.
 - 2.1.3.9 Outer jacket: PVC (minus 40°C), flame-retardant, FT4 flame test rated, low acid gas evolution, black outer jacket extruded over the armour.
 - 2.1.3.10 Colour coding: For insulated conductors, conform to the following:
 - 2.1.3.10.1 Line and load circuits AC or DC power: Black.
 - 2.1.3.10.2 AC control circuits: Red.
 - 2.1.3.10.3 DC control circuits: Blue.
 - 2.1.3.10.4 Interlock control circuits on the panel energized from external source: Yellow.

2.1.3.10.5 DC signal grounding conductors: Green/White Stripes.

2.1.3.10.6 Equipment grounding conductors: Green.

2.1.3.10.7 Current carrying grounded conductor (neutral): White.

2.1.3.10.8 Intrinsically safe: Blue.

2.1.4 Control Wiring

2.1.4.1 Size and install all wire and cable in accordance with CSA, Ontario Electrical Safety Code, IEEE and other applicable electrical safety codes.

2.1.4.2 Terminate all internal panel wiring to external devices at the terminal strips. Connect all field wiring to one side of the terminal strip. All panel wiring to be connected to the opposite side. Arrange terminals for external connects in consecutive order for conductors within a given cable.

2.1.4.3 Use flexible, stranded, copper TEW wiring. Run wires in continuous lengths from terminal to terminal. Do not splice wires.

2.1.4.4 For analog signal wiring, use uniformly twisted shielded pairs not smaller than CSA 0.823 mm² (18 AWG) with a minimum of six twists per 300 mm (one foot). Separate analog signal wiring at least 150 mm (six inches) from power wiring. Provide continuous foil or metalized plastic shields with 100 percent coverage. Include a drain wire in continuous contact with the shield. Multiple cables must have an overall shield and individual shields for each signal cable.

2.1.4.5 Use CSA 2.5 mm² (14 AWG) if approved under the local electrical authority or larger for control signal wiring.

2.1.4.6 Segregate signal wiring from control power wiring: group functionally and arrange neatly to facilitate tracing of circuits. Arrange wiring, respective terminals and 25% spare in separate mounting rails according to the following categories: 120Vac, 24Vdc signal, 24 Vdc control, communication wiring.

2.1.4.7 Use plastic wiring wraps to bundle wires, outside of wiring ducts. Securely fasten the bundles to the steel structure at intervals not exceeding 300 mm (12 inches). Each bundle contains 30 conductors maximum. Use Panduit, or equal wiring ducts and size to provide a minimum of 20 percent spare space not less than 5 per terminal block.

2.1.4.8 Do not intermix signals within the same bundle or duct.

2.1.4.9 Use twisted unshielded wire for other DC signals and segregate from wire conducting AC signals.

2.1.4.10 Colour code wiring as follows:

2.1.4.10.1 Line and load circuits AC or DC power: Black.

2.1.4.10.2 AC control circuits: Red.

2.1.4.10.3 DC control circuits: Blue.

2.1.4.10.4 Interlock control circuits on the panel energized from external source: Yellow.

2.1.4.10.5 DC signal grounding conductors: Green/White Stripes.

2.1.4.10.6 Equipment grounding conductors: Green.

2.1.4.10.7 Current carrying grounded conductor (neutral): White.

2.1.4.10.8 Intrinsically safe: Blue.

2.1.4.11 Use PVC crimped sleeve type wire tag identifications with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

2.1.5 Minimum Conductor Sizing

2.1.5.1 The minimum conductor sizing shall be as follows:

2.1.5.1.1 Motor or branch circuit feeders: 12 AWG.

2.1.5.1.2 Remote DC emergency fixtures: 10 AWG.

2.1.5.1.3 Digital control wiring, 24 to 120 VAC/VDC: 14 AWG

2.1.5.1.4 Minimum current transformer wiring conductor: #10 AWG.

2.1.5.1.5 Minimum fire alarm circuits conductor size: #14 AWG

2.1.5.1.6 Minimum PA circuit conductor size: #16 AWG

2.1.5.1.7 Telephone wiring conductors sized in accordance with telephone utility standards.

2.1.5.1.8 Use #10 AWG minimum for home runs to lighting panels exceeding 25 m.

2.1.6 Identification

2.1.6.1 Identify all wiring with wire markers at both ends.

2.1.6.2 All branch circuit wiring and all systems wiring shall be identified at all panels and terminal boxes.

2.1.6.3 All wiring shall be identified at junction boxes and termination points.

2.1.7 Terminations

2.1.7.1 All wiring connections shall be made with T & B Sta-Kon crimp connector, or approved equal, applied with a pressure tool.

2.1.7.2 Wiring connections, where required, shall be made with CSA approved compression tool with a nylon cap equal to Buchanan "Pres Sure".

2.1.7.3 All wiring shall be sized so that voltage drop between the panel board and the furthest outlet shall not exceed 2% when the circuit has a full load.

2.1.8 Wiring Accessories

2.1.8.1 Wire markers: Plastic slip-on, black letters on white background. Shur-Code by Thomas & Betts Ltd., Z-Type by Wieland Electric Inc.

2.1.8.2 Cable markers: For cables or conductors greater than 13 mm diameter, strap-on type, semi rigid PVC carrier strip. Type K by Wieland Electric Inc.

2.1.8.3 Terminal blocks: 600 V, 25 A minimum rating, modular, 35 mm DIN rail mounted, provision for circuit number labelling, individually removable, sized to accommodate conductor size and circuit current. Sak Series by Weidmuller Ltd., UK Series by Phoenix Terminal Blocks Ltd., WK Series by Wieland Electric Inc., Entrelec.

2.1.8.4 Field wiring terminations: Where screw-type terminal blocks are provided, supply insulated fork tongue terminals. Sta-Kon by Thomas & Betts Ltd., Scotchlok by 3M Canada Inc.

2.1.8.5 Splice connectors for equipment pig-tail, lighting and receptacle circuits: For wire sizes #12 and #10 AWG inclusive, twist-on compression spring type. Wing-Nut by Ideal, Marrette Type II by Marr Electric Ltd.

2.1.8.6 Moisture and waterproofing: In wet locations, with Liquid Tape by Ideal.

2.1.8.7 Equipment pig-tail power circuit connections: For wire sizes #8 AWG minimum, split-bolt type, sized to suit number and size of conductors. Servit Type KS by Burndy Inc.

2.1.8.8 TECK cable connectors in hazardous locations: Approved for application.

2.1.8.9 TECK cable connectors in wet or outdoor areas: Watertight type.

3 EXECUTION

3.1 COORDINATION

3.1.1 Prior to installation of wiring, compare Contract Drawings with latest issue of Vendor shop drawings.

3.1.2 Report discrepancies promptly to Contract Administrator.

3.2 INSTALLATION

3.2.1 Provide wires of number and size (including corresponding raceways) required, with spare conductors as indicated. Provide adequate wiring for actual equipment installed.

3.2.2 Provide wire and cable according to the Drawings and electrical system requirements.

3.2.3 Pull cable into conduits and cable trays in accordance with cable manufacturer's recommendations. Use patented cable grips suitable for cable type, or pulling eyes fastened directly onto cable conductors.

3.2.4 Limit pulling tension and minimum bending radii to those recommended by manufacturer.

3.2.5 Prevent damage to cable jackets by utilizing adequate lubricant when pulling cables through ducts and conduits.

3.2.6 Arrange cables in parallel rows on cable trays. Maintain cable spacing by fastening cables, with "P" clips, every 2000 mm minimum on straight horizontal runs and to each rung at bends, including two rungs of adjoining straight sections. Fasten cables on vertical tray runs every 1000 mm maximum.

3.2.7 Connect cables to electrical boxes and equipment enclosures located in wet or sprinkled areas with watertight cable connectors.

3.2.8 Provide cable grips for vertical suspension installations to reduce cable tension at connectors and at cable bends.

3.2.9 Install through wiring in junction and pull boxes having no connection within the box. Leave 150 mm minimum of slack inside box.

3.2.10 Facilitate making of joints and connections by leaving sufficient slack in each conductor at panelboards, outlet boxes and other devices.

3.2.11 Do not connect more than three lighting circuits for three phase panels and two lighting circuits for single phase panels to a common neutral.

- 3.2.12 Install instrumentation signal and thermocouple extension wires in separate raceways from power and control wiring.
- 3.2.13 Provide mechanical protection for cables within 1500 mm of the floor in buildings and within 2000 mm above grade outdoors.
- 3.2.14 Identify each cable by attaching a cable marker at each end, in all intermediate manholes, junction boxes and pull boxes.

3.3 UNDERGROUND INSTALLATION

- 3.3.1 Install direct buried cables in 75mm layers sifted sand, free of rock, stone and other sharp objects, above and below.
- 3.3.2 Where indicated, protect direct buried cables with 50mm thick concrete protection tiles. Extend protection 50mm minimum on either side of cabling.
- 3.3.3 Install direct buried cable at depth of 600mm minimum. Where rock is encountered and minimum depth cannot be attained, install cables in concrete encased ducts.
- 3.3.4 Install in suitably sized concrete encased duct where cables pass under roadway or area subject to vehicular traffic or heavy loads.

3.4 WIRING TERMINATIONS

- 3.4.1 Insulate equipment pig-tail power circuit connections with wire sizes #8 AWG and larger, with heat shrink sleeving termination kits.
- 3.4.2 Terminate armoured cables with accepted connectors suitable for application, size and type of cable.
- 3.4.3 Except where pulling tensions exceed allowable cable limits or where tap connections are required, only install splices in power, control and instrumentation cable runs with written permission of Contract Administrator. Where unavoidable, install splices in junction boxes only.
- 3.4.4 Make power (1000 V and below), control and instrumentation wiring taps, splices and terminations in junction boxes with labelled terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Terminate lighting circuits and 120 V convenience receptacle circuits with twist on or split-bolt type connectors and insulating tape.
- 3.4.5 Terminate control, signal and instrumentation circuit conductors, including spares, on terminal blocks. Label terminal blocks with unique alphanumeric designation or as indicated.

- 3.4.6 Identify each conductor, including spares, by wire markers at each termination. Indicate circuit designation or unique wire number. Identify spare conductors as 'SP1', 'SP2', etc.

3.5 INSPECTION AND TESTING

3.5.1 Cable and Wire - 1000 Volt and Below

- 3.5.1.1 Conduct insulation resistance measurements using a "Megger" (500 V instrument for circuit up to 350 V systems, 1000 V instrument for 351-600 V systems).
- 3.5.1.2 Record test results in a logbook and submit to Contract Administrator for reference. Replace or repair circuits which do not meet Inspection Authority requirements. With equipment disconnected, measure insulation resistance of the following circuits:
 - 3.5.1.2.1 Power, lighting, heater and motor feeders: Phase-to-phase, phase-to-ground.
 - 3.5.1.2.2 Control circuits: To ground only.
- 3.5.1.3 Do not perform "Megger" tests on equipment containing solid-state components.
- 3.5.1.4 Disconnect power factor correction capacitors from system prior to testing.

3.6 WIRING IDENTIFICATION

- 3.6.1 Identify wiring with wire markers.
- 3.6.2 Colour code power, feeder and branch conductors at both ends with coloured plastic tapes. Tapes are not required where conductors are identified by jacket colour. Maintain phase and colour sequence throughout.
- 3.6.3 Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance.
- 3.6.4 Identify PLC wiring at terminal blocks and connection points with PLC terminal (I/O) address numbers.

END OF SECTION

**SECTION 16130
ELECTRICAL BOXES**

1	GENERAL.....	1
1.1	INTENT OF SECTION.....	1
1.2	SCOPE.....	1
2	PRODUCTS	1
2.1	ENCLOSURE RATINGS FOR ALL EQUIPMENT LISTED HEREIN	1
2.2	SPLITTERS.....	1
2.3	JUNCTION AND PULL BOXES.....	1
2.4	OUTLET AND CONDUIT BOXES GENERAL	2
2.5	SHEET STEEL OUTLET BOXES	2
2.6	CONDUIT BOXES	3
2.7	FITTINGS – GENERAL.....	3
3	EXECUTION	3
3.1	INSTALLATION	3

SECTION 16130 ELECTRICAL BOXES

1 GENERAL

1.1 INTENT OF SECTION

- 1.1.1 This section describes the requirements for the various electrical boxes required for splicing, connecting, and pulling conductors and cables.

1.2 SCOPE

- 1.2.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install all electrical boxes specified herein and on the drawings.

2 PRODUCTS

2.1 ENCLOSURE RATINGS FOR ALL EQUIPMENT LISTED HEREIN

- 2.1.1 Indoor and dry locations: NEMA/EEMAC 12, unless otherwise noted on drawings.
- 2.1.2 Below grade, damp, subject to splashing, corrosive or outdoor locations: NEMA/EEMAC 4X, unless otherwise noted.
 - 2.1.2.1 The new fused disconnect switch (FDS) to be of lockable type.

2.2 SPLITTERS

- 2.2.1 Reference: CAN Canadian Standards Association (CSA) C22.2 Number 76-M92.
- 2.2.2 Galvanize steel enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- 2.2.3 Main, branch and ground lugs to match required size and number of incoming and outgoing conductors as indicated.
- 2.2.4 At least three spare terminals on each set of lugs in splitters less than 400A.
- 2.2.5 Lugs: insulator-copper construction.
- 2.2.6 Ampacity size as specified on drawings.

2.3 JUNCTION AND PULL BOXES

- 2.3.1 Reference: CAN CSA C22.2 No. 40-M1989.
- 2.3.2 Welded galvanize steel construction with screw-on flat covers for surface mounting and captive non-corroding chain.

- 2.3.3 Covers with neoprene gasket and 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- 2.3.4 Piano type hinges on boxes larger than 300 x 300 mm.
- 2.3.5 Junction boxes to be located in convenient accessible locations for maintenance and servicing.
- 2.3.6 Submersible Junction Boxes:
 - 2.3.6.1 Submersible junction boxes shall be suitable for TECK cable and conduit termination.
 - 2.3.6.2 Submersible junction boxes shall have cast iron and cast aluminum construction with minimum protection rating NEMA 6P (IP67 or higher) and be tested to withstand prolonged submersion under a 1.83 m (6 feet) head of water for 24 hours.
 - 2.3.6.3 Submersible junction boxes shall be complete with mounting lugs suitable for Class 1, Zone 1 or 2 classified area.

2.4 OUTLET AND CONDUIT BOXES GENERAL

- 2.4.1 Reference: CAN CSA C22.2 No. 18-M1987.
- 2.4.2 Size boxes in accordance with CSA C22.1.
- 2.4.3 102 mm square or larger outlet boxes as required for special devices.
- 2.4.4 Boxes in hazardous areas: suitable for Class 1 Zone 1 or Zone 2, Groups C-D areas as per area classification.
- 2.4.5 Gang boxes where wiring devices are grouped.
- 2.4.6 Blank cover plates for boxes without wiring devices.
- 2.4.7 Combination boxes with barriers where outlets for more than one system are grouped.

2.5 SHEET STEEL OUTLET BOXES

- 2.5.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- 2.5.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- 2.5.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.6 CONDUIT BOXES

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

2.7 FITTINGS – GENERAL

- 2.7.1 Bushing and connectors with nylon insulated throats.
- 2.7.2 Knock-out fillers to prevent entry of debris.
- 2.7.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- 2.7.4 Double locknuts and insulated bushings on sheet metal boxes.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install pull boxes in inconspicuous but accessible locations.
- 3.1.2 Mount cabinets with top not higher than 2 m above finished floor.
- 3.1.3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- 3.1.4 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.
- 3.1.5 Install boxes to clear all building and mechanical services equipment. Where two or more devices are shown at one location, utilize multi-gang boxes. Supply all outlet boxes with covers or plaster rings as required.
- 3.1.6 Size all boxes to accommodate the number of conduits, conductors and terminal blocks. Provide junction boxes with 20% spare terminal blocks.
- 3.1.7 Securely fasten surface-mounted boxes to the building or mounting structure and support independently of the conduits entering the box.
- 3.1.8 Install junction and pull boxes mounted on brick, concrete or block walls with 3 mm thick lead or nylon washers between box and wall face.
- 3.1.9 Provide all boxes sized to the Electrical Code requirements, in all conduit raceway systems to limit length of straight conduit runs to 60 m. Reduce this length by 15 m for each 90 degrees bend or 8 m for each 45 degrees bend or offset.
- 3.1.10 Mark location and size of all pull boxes on the record drawings.

- 3.1.11 Install boxes in hazardous locations as required and shown on the drawings. Provide conduit seals for all conduits entering enclosure.
- 3.1.12 Support boxes independently of connecting conduits.
- 3.1.13 Fill outlet and conduit boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- 3.1.14 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- 3.1.15 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

SECTION 16412
MOULDED CASE CIRCUIT BREAKERS

1	GENERAL.....	1
1.1	DESCRIPTION	1
1.2	RELATED SECTIONS.....	1
1.3	REFERENCES.....	1
2	PRODUCTS	1
2.1	BREAKERS GENERAL	1
2.2	VISUAL VERIFICATION	2
2.3	THERMAL MAGNETIC BREAKERS.....	2
2.4	MAGNETIC BREAKERS	2
2.5	THERMAL MAGNETIC BREAKERS WITH CURRENT LIMITING.....	3
2.6	SOLID STATE TRIP BREAKERS	3
2.7	ENCLOSURE	3
3	EXECUTION	3
3.1	INSTALLATION	3

SECTION 16412
MOULDED CASE CIRCUIT BREAKERS

1 GENERAL

1.1 DESCRIPTION

- 1.1.1 The section describes the requirements for moulded case breakers supplied under the contract as stand-alone devices in enclosures or as part of a panelboards, MCC or other equipment.
- 1.1.2 This section shall apply to starters supplied with or as part of equipment supplied by all divisions except that:
 - 1.1.2.1 This section does not apply to breakers in SCADA panels supplied under Division 13.

1.2 RELATED SECTIONS

- 1.2.1 Section 16010 – Electrical General Requirements

1.3 REFERENCES

- 1.3.1 CSA C22.2 No.5-02 Moulded Case Circuit Breakers

2 PRODUCTS

2.1 BREAKERS GENERAL

- 2.1.1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- 2.1.2 Plug-in moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- 2.1.3 Common-trip breakers: with single handle for multi-pole applications.
- 2.1.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- 2.1.5 Circuit breakers with interchangeable trips as indicated.
- 2.1.6 EEMAC/NEMA equipment only.
- 2.1.7 All breakers shall be CSA listed for applications at 100% of their continuous ampere rating in their intended enclosure.
- 2.1.8 Protective devices shall be moulded case circuit breakers with inverse time and instantaneous tripping characteristics.

- 2.1.9 Circuit breakers shall be operated by a toggle type handle and shall have a quick make, quick break over centre switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- 2.1.10 Circuit breakers shall have a minimum symmetrical interrupting capacity of 35,000A or as indicated on the drawings whichever is greater.
- 2.1.11 Circuit breakers 600 ampere frame and below shall be equipped with thermal magnetic trip units and inverse time current characteristics.
- 2.1.12 Circuit breakers 800 ampere through 1200 ampere frame shall be equipped with solid state based RMS sensing trip units including ground fault protection.

2.2 VISUAL VERIFICATION

- 2.2.1 Where indicated on the drawings and/or any breakers that are key interlocked, provide a clear viewing window in the front of the breaker case to suit visual verification of contact positions as required to suit Ontario Electrical Safety Code. Contacts are to be painted with a bright colour to enhance the contracts and contact positions.
- 2.2.2 Provide a clear window in the respective MCC and/or Panelboard to allow for breaker contact visual verification

2.3 THERMAL MAGNETIC BREAKERS

- 2.3.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.4 MAGNETIC BREAKERS

- 2.4.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.
- 2.4.2 Provide a solid state electronic tripping module for timed and instantaneous overcurrent protection as indicated on the drawings.
- 2.4.3 Include a solid state electronic tripping module for timed and instantaneous overcurrent and ground overcurrent protection for all breakers rated 1000A or greater.

2.5 THERMAL MAGNETIC BREAKERS WITH CURRENT LIMITING

- 2.5.1 Where available short circuit currents exceed rating of standard thermal magnetic breakers range, provide a current limiter.

2.6 SOLID STATE TRIP BREAKERS

- 2.6.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault short circuit protection.

2.7 ENCLOSURE

- 2.7.1 Breakers to be installed in the existing panelboard or MCC.
- 2.7.2 Individual wall mounted breakers to be installed in a NEMA 12 enclosure complete with a hinged door and a lockable external breaker handle.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install circuit breakers as indicated on the drawings.

END OF SECTION

**SECTION 16950
ELECTRICAL TESTING**

TABLE OF CONTENTS

1	GENERAL	1
1.1	SUMMARY	1
1.2	REFERENCES.....	1
1.3	SUBMITTALS.....	3
1.4	QUALITY ASSURANCE.....	3
1.5	SEQUENCING AND SCHEDULING	3
2	PRODUCTS (NOT USED).....	4
3	EXECUTION.....	4
3.1	GENERAL	4
3.2	DRY TYPE TRANSFORMERS	6
3.3	LOW VOLTAGE CABLES, 1000V CABLE, MAXIMUM	6
3.4	SAFETY SWITCHES, 600 VOLTS MAXIMUM.....	7
3.5	MOULDED AND INSULATED CASE CIRCUIT BREAKERS	8
3.6	LOW VOLTAGE POWER CIRCUIT BREAKERS	9
3.7	PROTECTIVE RELAYS	10
3.8	INSTRUMENT TRANSFORMERS.....	11
3.9	METERING	11
3.10	GROUNDING SYSTEMS	12
3.11	AC INDUCTION MOTORS.....	12
3.12	LOW VOLTAGE MOTOR CONTROL	13
3.13	LOW VOLTAGE SURGE ARRESTORS	14
3.14	THERMOGRAPHIC SURVEY	14

SECTION 16950 ELECTRICAL TESTING

1 GENERAL

1.1 SUMMARY

- 1.1.1 Comply with Division 1 - General Requirements and Section 16010 – Basic Electrical Requirements.

1.2 REFERENCES

- 1.2.1 The following is a list of standards which may be referenced in this section:

- 1.2.1.1 American National Standards Institute (ANSI):

- 1.2.1.1.1 450, Recommended Practice for Maintenance, Testing, and Replacement of Large lead Storage Batteries for Generator Stations and Substations.
- 1.2.1.1.2 C37.20.1, Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
- 1.2.1.1.3 C37.20.2, Metal-Clad and Station-Type Cubicle Switchgear.
- 1.2.1.1.4 C37.20.3, Metal-Enclosed Interrupter Switchgear.
- 1.2.1.1.5 C62.33, Standard Test Specifications for Varistor Surge-Protective Devices.

- 1.2.1.2 American Society for Testing and Materials (ASTM):

- 1.2.1.2.1 D665, Standard Test Method for Rust Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.
- 1.2.1.2.2 D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
- 1.2.1.2.3 D923, Standard Test Method for Sampling Electrical Insulating Liquids.
- 1.2.1.2.4 D924, Standard Test Methods for A-Class Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
- 1.2.1.2.5 D971, Standard Test Method for Interfacial Tension of 0.1 Against Water by the Ring Method.

- 1.2.1.2.6 D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
- 1.2.1.2.7 D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
- 1.2.1.2.8 D1500, Standard Test Method for ASTM Color of Petroleum Products.
- 1.2.1.2.9 D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
- 1.2.1.2.10 D1533, Standard Test Methods for Water in Insulating Liquids.
- 1.2.1.2.11 D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
- 1.2.1.2.12 D2285, Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop- Weight Method.
- 1.2.1.3 Institute of Electrical and Electronics Engineers (IEEE):
 - 1.2.1.3.1 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
 - 1.2.1.3.2 48, Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminators.
 - 1.2.1.3.3 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - 1.2.1.3.4 95, Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage.
 - 1.2.1.3.5 118, Standard Test Code for Resistance Measurement.
 - 1.2.1.3.6 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.
- 1.2.1.4 National Electrical Manufacturers Association (NEMA):
 - 1.2.1.4.1 AB 4, Guideline for Inspection and Preventive Maintenance of Moulded Case Circuit Breakers used in Commercial and Industrial Applications.
 - 1.2.1.4.2 PB 2, Deadfront Distribution Switchboards.

1.2.1.4.3 WC 7, Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.2.1.4.4 WC 8, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.2.1.5 International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.2.1.6 Electrical Codes:

1.2.1.6.1 Ontario Electrical Safety Code (OESC) - Latest Edition

1.3 SUBMITTALS

1.3.1 Information Submittals:

1.3.1.1 Submit 30 days prior to performing inspections or tests:

1.3.1.1.1 Schedule for performing inspection and tests.

1.3.1.1.2 Sample copy of individual device test form.

1.3.1.2 Submit within 30 days after completion of test:

1.3.1.2.1 Test or inspection reports and certificates for each electrical item tested.

1.3.1.3 Operation and Maintenance Data:

1.3.1.3.1 After test or inspection reports and certificates have been reviewed by Contract Administrator and returned, insert a copy of each in operation and maintenance manual.

1.4 QUALITY ASSURANCE

1.4.1 Testing Firm Qualifications:

1.4.1.1 Wilson High Voltage

1.4.1.2 Siemens Canada Ltd.

1.4.1.3 Eaton Electrical Services

1.5 SEQUENCING AND SCHEDULING

1.5.1 Perform inspection and electrical tests after equipment has been installed.

- 1.5.2 Perform tests with apparatus de-energized whenever feasible.
- 1.5.3 Inspection and electrical tests on energized equipment are to be:
 - 1.5.3.1 Scheduled with engineer prior to de-energization.
 - 1.5.3.2 Minimized to avoid extended period of interruption to the operating plant equipment.
- 1.5.4 Notify Contract Administrator at least 72 hours prior to performing tests on energized electrical equipment.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 GENERAL

- 3.1.1 Tests specified in this section are to be performed in accordance with the requirements of Section 16010 Electrical General Requirements.
- 3.1.2 Tests and inspection shall establish that:
 - 3.1.2.1 Electrical equipment is operational within industry and manufacturer's tolerances.
 - 3.1.2.2 Installation operates properly.
 - 3.1.2.3 Equipment is suitable for energization.
 - 3.1.2.4 Installation conforms to requirements of Contract Documents and OESC.
- 3.1.3 Set, test, and calibrate protective relays, circuit breakers, fuses, and other applicable devices in accordance with values established by the short circuit and coordination study as specified in Section 16015, Electrical Systems Analysis.
- 3.1.4 Adjust mechanisms and moving parts for free mechanical movement.
- 3.1.5 Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- 3.1.6 Verify nameplate data for conformance to Contract Documents.
- 3.1.7 Realign equipment not properly aligned.
- 3.1.8 Properly anchor electrical equipment found to be inadequately anchored.
- 3.1.9 Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

- 3.1.10 Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- 3.1.11 Provide proper lubrication of applicable moving parts.
- 3.1.12 Inform engineer of working clearances not in accordance with OESC.
- 3.1.13 Investigate and repair or replace:
 - 3.1.13.1 Electrical items that fail tests.
 - 3.1.13.2 Active components not operating in accordance with manufacturer's instructions.
 - 3.1.13.3 Damaged electrical equipment.
- 3.1.14 Electrical Enclosures:
 - 3.1.14.1 Remove foreign material and moisture from enclosure interior.
 - 3.1.14.2 Vacuum and wipe clean enclosure interior.
 - 3.1.14.3 Remove corrosion found on metal surfaces.
 - 3.1.14.4 Repair or replace, as determined by engineer, door and panel sections having dented surfaces.
 - 3.1.14.5 Repair or replace, as determined by engineer, poor fitting doors and panel sections.
 - 3.1.14.6 Repair or replace improperly operating latching, locking, or interlocking devices.
 - 3.1.14.7 Replace missing or damaged hardware.
 - 3.1.14.8 Finish:
 - 3.1.14.8.1 Provide matching paint and touch up scratches and mars.
 - 3.1.14.8.2 If required due to extensive damage, as determined by Contract Administrator, refinish the entire assembly.
- 3.1.15 Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents.
- 3.1.16 Replace transformer insulating oil not in compliance with ASTM D923.

3.2 DRY TYPE TRANSFORMERS

3.2.1 Visual and Mechanical Inspection

- 3.2.1.1 Physical and insulator damage.
- 3.2.1.2 Proper winding connections.
- 3.2.1.3 Defective wiring.
- 3.2.1.4 Proper operation of fans, indicators, and auxiliary devices.
- 3.2.1.5 Removal of shipping brackets, fixtures, or bracing.
- 3.2.1.6 Free and properly installed resilient mounts.
- 3.2.1.7 Cleanliness and improper blockage of ventilation passages.
- 3.2.1.8 Verify that tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
- 3.2.1.9 Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

3.2.2 Electrical Tests:

3.2.2.1 Insulation Resistance Tests:

3.2.2.1.1 Applied megohmmeter dc voltage for each:

3.2.2.1.1.1 Winding-to-winding.

3.2.2.1.1.2 Winding-to-ground.

3.2.2.1.2 Results temperature corrected to 20 degrees C.

3.2.2.1.3 Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

3.2.2.1.4 Insulation resistance test results to compare within 1 percent of adjacent windings.

3.2.2.2 Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.3 LOW VOLTAGE CABLES, 1000V CABLE, MAXIMUM

3.3.1 Visual and Mechanical Inspection:

3.3.1.1 Inspect Each Individual Exposed Power Cable AWG No. 2 and larger for:

3.3.1.1.1 Physical damage.

3.3.1.1.2 Proper connections in accordance with single-line diagram.

3.3.1.2 Shielded Instrumentation Cables For:

3.3.1.2.1 Proper shield grounding.

3.3.1.3 Cables Terminated Through Window Type CTs:

3.3.1.3.1 Verify that neutrals and grounds are terminated for correct operation of protective devices.

3.3.2 Electrical Tests for Conductors AWG No. 1 and Larger:

3.3.2.1 Insulation Resistance Tests:

3.3.2.1.1 Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors

3.3.2.1.2 Test each conductor with respect to ground and to adjacent conductors.

3.3.2.1.3 Evaluate ohmic values by comparison with conductors of same length and type.

3.3.2.1.4 Investigate values less than 50 megohms.

3.3.2.2 Continuity test by ohmmeter method to ensure proper cable connections.

3.4 SAFETY SWITCHES, 600 VOLTS MAXIMUM

3.4.1 Visual and Mechanical Inspection:

3.4.1.1 Proper blade pressure and alignment.

3.4.1.2 Proper operation of switch operating handle.

3.4.1.3 Adequate mechanical support for each fuse.

3.4.1.4 Proper contact-to-contact tightness between fuse clip and fuse.

3.4.1.5 Proper phase barrier material and installation.

3.4.1.6 Verify that fuse sizes and types correspond to one-line diagram.

3.4.2 Electrical Tests:

3.4.2.1 Insulation Resistance Tests:

3.4.2.1.1 Applied megohmmeter dc voltage

3.4.2.1.2 Phase-to-phase and phase-to-ground.

3.4.2.1.3 Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

3.4.2.2 Contact Resistance Tests:

3.4.2.2.1 Contact resistance in microhms across each switch blade and fuse holder.

3.4.2.2.2 Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.5 MOULDED AND INSULATED CASE CIRCUIT BREAKERS

3.5.1 General: Inspection and testing limited to circuit breakers rated 200 amperes and larger and to motor circuit protector breakers rated 150 amperes and larger.

3.5.2 Visual and Mechanical Inspection:

3.5.2.1 Proper mounting.

3.5.2.2 Proper conductor size.

3.5.2.3 Feeder designation according to nameplate and one-line diagram.

3.5.2.4 Cracked casings.

3.5.2.5 Operate breaker to verify smooth operation.

3.5.2.6 Compare frame size and trip setting with circuit breaker schedules or one-line diagram.

3.5.2.7 Verify that terminals are suitable for 75 degrees C rated insulated conductors.

3.5.3 Electrical Tests:

3.5.3.1 Insulation Resistance Tests:

3.5.3.1.1 Utilize 1,000-volt dc megohmmeter for 600-volt circuit breakers

3.5.3.1.2 Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

3.5.3.2 Contact Resistance Tests:

3.5.3.2.1 Contact resistance in microhms across each pole.

3.5.3.2.2 Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

3.6 LOW VOLTAGE POWER CIRCUIT BREAKERS

3.6.1 Visual and Mechanical Inspection:

3.6.1.1 Proper mounting, cell fit, and element alignment.

3.6.1.2 Proper operation of racking interlocks.

3.6.1.3 Check for damaged arc chutes.

3.6.1.4 Proper contact condition.

3.6.1.5 Check operation of closing and tripping functions of trip devices by activating ground fault relays, undervoltage shunt relays, and other auxiliary protective devices.

3.6.1.6 Check charging motor, motor brushes, associated mechanism, and limit switches for proper operation and condition.

3.6.1.7 Check operation of electrically operated breakers in accordance with manufacturer's instructions.

3.6.1.8 Check for adequate lubrication on contact, moving, and sliding surfaces.

3.6.2 Electrical Tests:

3.6.2.1 Insulation Resistance Tests:

3.6.2.1.1 Utilize 1,000-volt dc megohmmeter for 600-volt circuit breakers.

3.6.2.1.2 Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

3.6.2.2 Contact Resistance Tests:

3.6.2.2.1 Contact resistance in microhms across each pole.

3.6.2.2.2 Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

3.6.2.3 Secondary Current Injection Test to Verify:

- 3.6.2.3.1 Long-time minimum pickup and delay.
- 3.6.2.3.2 Short-time pickup and delay.
- 3.6.2.3.3 Ground fault pickup and delay.
- 3.6.2.3.4 Instantaneous pickup.
- 3.6.2.3.5 Trip characteristic when adjusted to setting sheet parameters shall be within manufacturer's published time-current tolerance band

3.7 PROTECTIVE RELAYS

3.7.1 Visual and Mechanical Inspection:

3.7.1.1 Visually Check Each Relay For:

- 3.7.1.1.1 Tight cover gasket and proper seal.
- 3.7.1.1.2 Unbroken cover glass.
- 3.7.1.1.3 Condition of spiral spring and contacts.
- 3.7.1.1.4 Disc clearance.
- 3.7.1.1.5 Condition of case shorting contacts if present.

3.7.1.2 Mechanically Check Each Relay For:

- 3.7.1.2.1 Freedom of movement.
- 3.7.1.2.2 Proper travel and alignment.

3.7.1.3 Verify That Each Relay:

- 3.7.1.3.1 Complies with Contract Documents and application.
- 3.7.1.3.2 Is set in accordance with recommended settings.

3.7.2 Electrical Tests:

3.7.2.1 Insulation resistance test on each circuit to frame except for solid state devices.

3.7.2.2 Tests on Nominal Recommended Setting For:

- 3.7.2.2.1 Pickup parameters on each operating element.
- 3.7.2.2.2 Timing at three points on time-current curve.

3.7.2.2.3 Pickup target and seal-in units.

3.7.2.3 Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.

3.7.2.4 Current Injection Tests:

3.7.2.4.1 For entire current circuit in each section.

3.7.2.4.2 Secondary injection for current flow of 5 ampere.

3.7.2.4.3 Test current at each device.

3.7.3 Programming Tests:

3.7.3.1 Verify relay has been fully programmed.

3.7.3.2 Verify communications network functioning correctly.

3.8 INSTRUMENT TRANSFORMERS

3.8.1 Visual and Mechanical Inspection:

3.8.1.1 Visually Check Current, Potential, and Control Transformers.

3.8.1.2 Verify proper primary and secondary fuse sizes for potential transformers.

3.8.2 Electrical Tests:

3.8.2.1 Current Transformer Tests:

3.8.2.1.1 Polarity test.

3.8.2.2 Potential Transformer Tests:

3.8.2.2.1 Polarity test to verify polarity marks or H1-X1 relationship as applicable.

3.9 METERING

3.9.1 Visual and Mechanical Inspection:

3.9.1.1 Verify meter connections in accordance with appropriate diagrams.

3.9.1.2 Verify meter multipliers.

3.9.1.3 Verify that meter types and scales conform to Contract Documents.

3.9.1.4 Verify all programming has been completed.

3.9.1.5 Verify communications.

3.10 GROUNDING SYSTEMS

3.10.1 Visual and Mechanical Inspection:

3.10.1.1 Equipment and circuit grounds in motor control center, switchboard, and switchgear assemblies for proper connection and tightness.

3.10.1.2 Ground bus connections in motor control center, switchboard, and switchgear assemblies for proper termination and tightness.

3.10.1.3 Effective transformer core and equipment grounding.

3.10.1.4 Accessible connections to grounding electrodes for proper fit and tightness.

3.10.1.5 Accessible exothermic-weld grounding connections to verify that moulds were fully filled and proper bonding was obtained.

3.10.2 Electrical Tests:

3.10.2.1 Fall-Of-Potential Test:

3.10.2.1.1 In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.

3.10.2.1.2 Main ground electrode system resistance to ground to be no greater than 1 ohms.

3.10.2.2 Two-Point Direct Method Test:

3.10.2.2.1 In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.

3.10.2.2.2 Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

3.11 AC INDUCTION MOTORS

3.11.1 General: Inspection and testing limited to motors rated 25 hp and larger.

3.11.2 Visual and Mechanical Inspection:

3.11.2.1 Proper electrical and grounding connections.

3.11.2.2 2. Shaft alignment.

3.11.2.3 Blockage of ventilating air passageways.

3.11.2.4 Operate Motor and Check For:

3.11.2.4.1 Excessive mechanical and electrical noise.

3.11.2.4.2 Overheating.

3.11.2.4.3 Correct rotation.

3.11.2.4.4 Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionality and proper operation.

3.11.2.4.5 Excessive vibration.

3.11.2.5 Check operation of space heaters.

3.11.3 Electrical Tests:

3.11.3.1 Insulation Resistance Tests:

3.11.3.1.1 In accordance with IEEE 43 at test voltages established by NETA ATS, Table 10.2 for 1-minute duration with resistances tabulated at 30 and 60 seconds.

3.11.3.1.2 Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.

3.11.3.2 Calculate polarization index ratios for motors above 200 hp.

3.11.3.3 Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.

3.12 LOW VOLTAGE MOTOR CONTROL

3.12.1 Visual and Mechanical Inspection:

3.12.1.1 Proper operation of indicating and monitoring devices.

3.12.1.2 Proper overload protection for each motor.

3.12.1.3 Integrity and contamination of bus insulation system.

3.12.1.4 Check Door and Device Interlocking System.

3.12.1.5 Check Key Interlocking Systems.

3.12.1.6 Check Nameplates for Proper Identification.

3.12.1.7 Verify that fuse and circuit breaker sizes and types conform to Contract Documents.

3.12.1.8 Exercise active components.

3.12.1.9 Compare overload heater rating with full-load current for proper size.

3.12.2 Electrical Tests:

3.12.2.1 Insulation Resistance Tests:

3.12.2.1.1 Applied megohmmeter dc voltage.

3.12.2.1.2 Bus section phase-to-phase and phase-to-ground for 30 seconds on each phase.

3.12.2.2 Operational test by initiating control devices to affect proper operation.

3.13 LOW VOLTAGE SURGE ARRESTORS

3.13.1 Visual and Mechanical Inspection:

3.13.1.1 Adequate clearances between arrestors and enclosures.

3.13.1.2 Ground connections to ground bus.

3.14 THERMOGRAPHIC SURVEY

3.14.1 Provide a thermographic survey of connections associated with incoming service conductors, bus work, and branch feeder conductors AWG No. 2 and larger at each:

3.14.1.1 Unit substation.

3.14.1.2 low voltage motor control center.

3.14.2 Provide a thermographic survey of feeder conductors No. 2 and larger terminating at:

3.14.2.1 Motors rated 100 hp and larger.

3.14.3 Remove necessary enclosure metal panels and covers prior to performing survey.

3.14.4 Perform with equipment energized during periods of maximum possible loading.

3.14.5 Do not perform survey on equipment operating at less than 20 percent of rated connected operating load.

3.14.6 Utilize Thermographic Equipment Capable of:

3.14.6.1 Detecting emitted radiation.

3.14.6.2 Converting detected radiation to visual signal.

3.14.6.3 Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.

3.14.7 Provide Written Report Of:

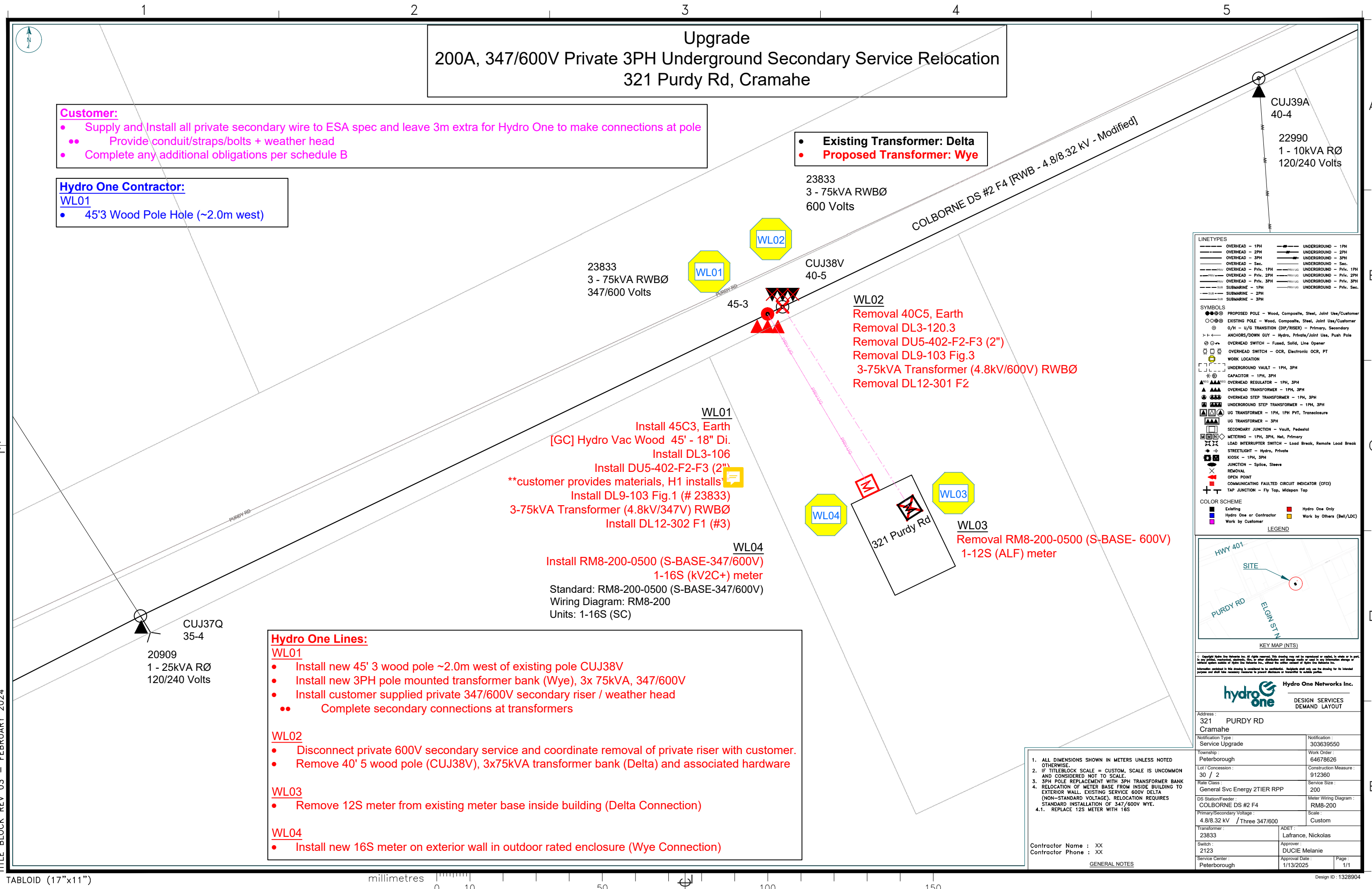
3.14.7.1 Areas surveyed and the resultant temperature gradients.

3.14.7.2 Locations of areas having temperature gradients of 3 degrees C or greater.

3.14.7.3 Cause of heat rise, and actions taken to correct the cause of heat rise.

3.14.7.4 Detected phase unbalance.

END OF SECTION



Contractor Name : XX
Contractor Phone : XX

GENERAL NOTES

- ALL DIMENSIONS SHOWN IN METERS UNLESS NOTED OTHERWISE.
- IF TITLEBLOCK SCALE = CUSTOM, SCALE IS UNCOMMON AND CONSIDERED NOT TO SCALE.
- 3PH POLE REPLACEMENT WITH 3PH TRANSFORMER BANK
- RELOCATION OF METER BASE FROM INSIDE BUILDING TO EXTERIOR WALL. EXISTING SERVICE 600V DELTA (NON-STANDARD VOLTAGE). RELOCATION REQUIRES STANDARD INSTALLATION OF 347/600V WYE.
- REPLACE 12S METER WITH 16S

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Hydro One Networks Inc.
DESIGN SERVICES
DEMAND LAYOUT

Address : 321 PURDY RD Cramahe	
Notification Type : Service Upgrade	Notification : 303639550
Township : Peterborough	Work Order : 64678626
Lat/Concession : 30 / 2	Construction Measure : 912360
Rate Class : General Svc Energy 2TIER RPP	Service Size : 200
DS Station/Feeder : COLBORNE DS #2 F4	Meter Wiring Diagram : RM8-200
Primary/Secondary Voltage : 4.8/8.32 kV /Three 347/600	Scale : Custom
Transformer : 23833	ADET : Lafrance, Nickolas
Switch : 2123	Approver : DUCIE Melanie
Service Center : Peterborough	Approval Date : 1/13/2025
	Page : 1/1

Schedule B

Customer Obligations Letter

Project Type: Upgrade

Customer: Village of Colborne

Required Execution Date of Contract: Jul 07, 2025

SECTION 1: Contact Information

Distributor:	Hydro One Networks Inc. HST # 870865821 RT001 ECRA/ESA Licence No. 7002572	Hydro One's Field Business Centre Address:	913 Crawford Dr Peterborough, ON K9J 3X1
Hydro One's Field Business Centre Hours of Operation:	Monday to Friday 7:00 a.m. to 4:30 p.m.	Hydro One's Field Business Centre: Phone Number:	1-888-871-3514
Hydro One's Field Business Centre: E-mail Address:	FBCPeterborough@HydroOne.com	Hydro One's Field Business Centre: Fax Number	1-705-743-0471
Customer ("you or your"):	Village of Colborne	Customer's Billing Address:	Colborne ON K0K 1S0

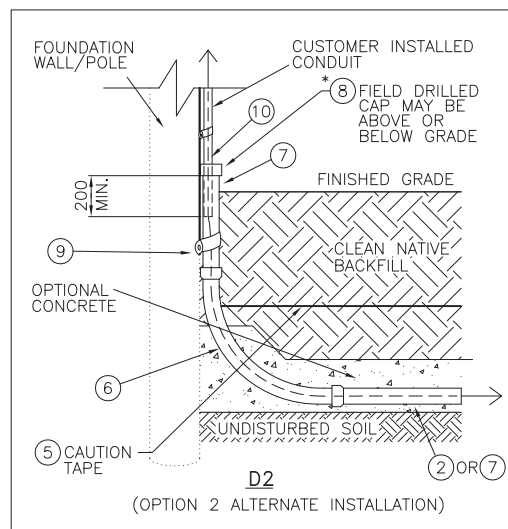
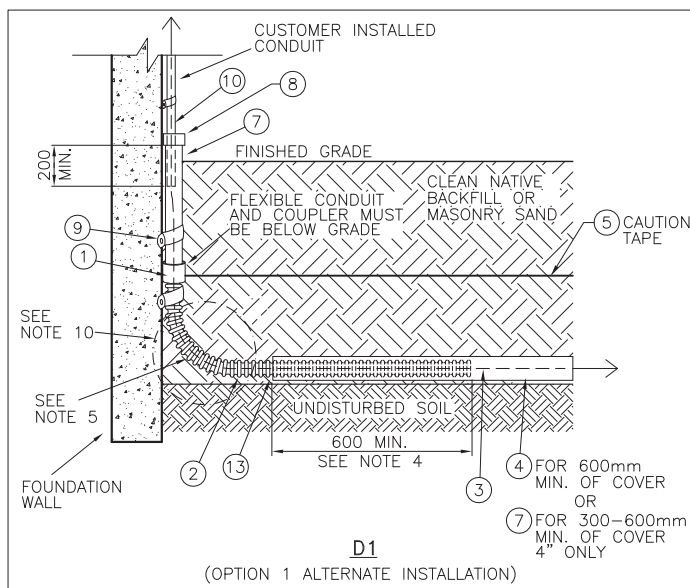
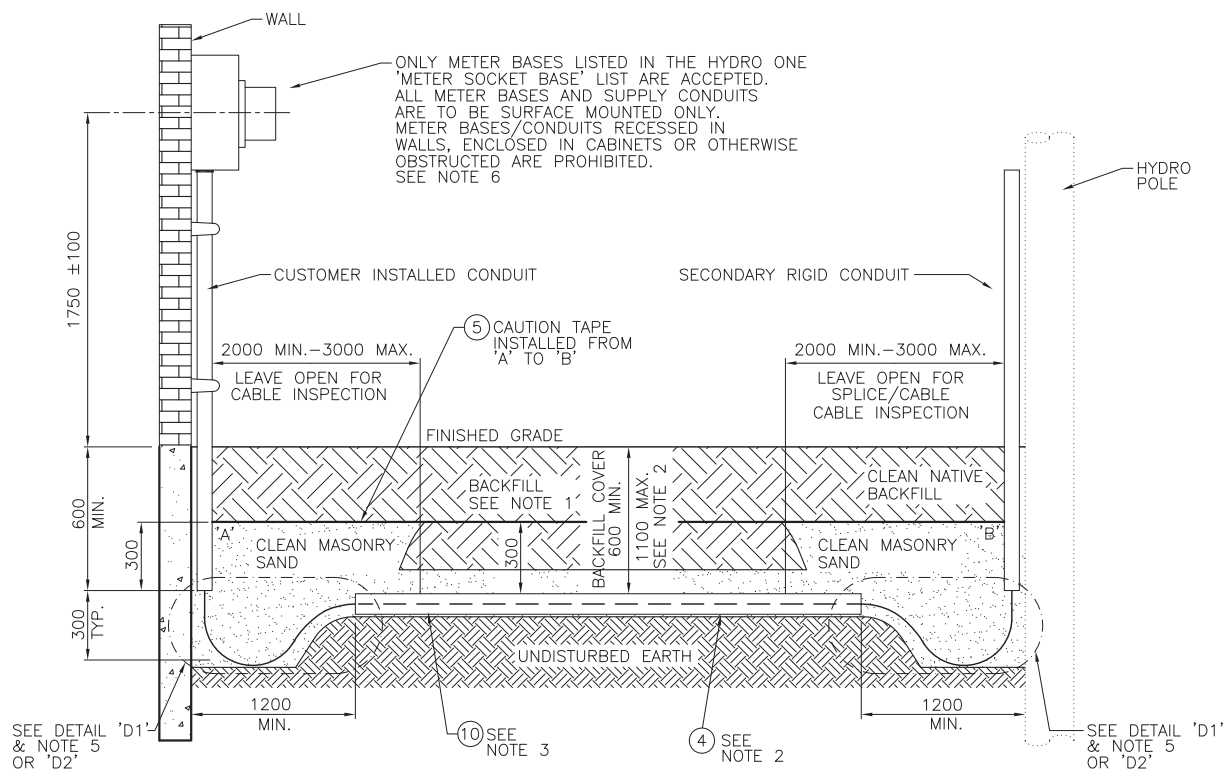
SECTION 2: Work Order Details

Notification Number:	303639550	Concession:	2
Work Order Number:	64678626	Lot:	30
Construction Measure Number:	912360	Township:	Cramahe
		Address:	321 PURDY RD Cramahe K0K 1S0

SECTION 3: Customer Obligations

Schedule B Customer Work:

- Provide all secondary wire to current ESA specifications. Provide necessary coil at utility end (pole/padmount) for Hydro One to connect.
- (UG-PRIVATE) Supply & install private wire and terminate in meter base. Provide sufficient coil at utility end for Hydro One to run up pole. Provide conduit/straps/bolts + weather head.
- Meter base to be mounted so mid-point of socket is 1.75m above FINISHED grade.
- Any changes to the original scope of work must be communicated with Hydro One.
- Minimum of 3 m from the valve on a propane tank with a capacity between 475-3000 L or 7.5 m from the valve on a propane tank with a capacity greater than 3800 L.
- Refer to the Retail Revenue Metering Standards Guide:
[https://www.hydroone.com/businessservices/Documents/Retail%20Metering%20Standards%20Guide%20\(2019Ed\).pdf](https://www.hydroone.com/businessservices/Documents/Retail%20Metering%20Standards%20Guide%20(2019Ed).pdf).
- Provide Field Business Centre with access/key requirements for new meter room.
- Customer to; provide access to site, unlock gates, remove debris, prior to Hydro One accessing equipment for construction.
- All poles/wire/anchors/trenching on private property is your responsibility. To be built to current OESC and is subject to ESA approval.
- Supply & install meter base (see list of currently approved meter bases on Hydro One website).
- 200A and below install main disconnect inside with meterbase on LOAD side.



FOR SHEET 2 OF THIS DRAWING SEE DU-03-209.1-0501
FOR SHEET 3 OF THIS DRAWING SEE DU-03-209.1-0502

ALL DIMENSIONS IN MILLIMETRES
UNLESS OTHERWISE STATED

03	SEP 2018	GENERAL UPDATES. CHANGED TO NEW DWG. & NUMBERING FORMAT. FOR PREVIOUS REVISIONS REFER TO DU-03-209.1-R2.	SO	PC	AS	PS	Drawn By: L.SEQUEIRA	Checked By:	Designed By:	Design Approved By:
02	AUG 2013	D2 UPDATED WITH SWEEP, ALTERNATE METHODS ADDED	GJ	PC			Scale: N.T.S.	Date: (yyyy/mm/dd) 2012/08/30	Pole ID:	
Rev No.	Date	Revision Particulars	dwn	ckd	des	app	Title: TRENCH DETAIL – SECONDARY SERVICE CABLE FROM DIP POLE TO METER BASE			
							Drawing No. DU-03-209.1-0500			
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NOTES:

1. BACKFILL: ENSURE DB2 IS ENVELOPED WITH MASONRY SAND UPON INSTALLATION (75mm MINIMUM BELOW AND 150mm MINIMUM ABOVE). REMAINDER OF BACKFILL MUST BE CLEAN AND FREE OF DEBRIS TO PREVENT DAMAGE TO THE DUCT. BACKFILL SHALL BE WELL TAMPED.
2. STRAIGHT DUCT SHALL BE EMPLOYED IN THE TRENCH TO HOUSE THE CABLE. IT SHALL BE 100mm (4") DIAMETER PVC TYPE DB2. THE ENDS OF THE DUCT SHALL BE CAPPED OR BAGGED TO PREVENT DEBRIS AND MOISTURE FROM ENTERING THE DUCT PRIOR TO CABLE INSTALLATION. IF OPEN TRENCH ENDS MUST BE LEFT UNATTENDED AFTER CABLE INSTALLATION, SEE DU-03-209.1-0500 OPTION 1, WITH A LENGTH OF FLEXIBLE CONDUIT TO MAKE 90° TRANSITION.
SEE OPTION 2 FOR ALTERNATE METHODS.
3. PULL TAPE: A 1/2" WIDE POLYESTER PULLING TAPE MUST BE INSTALLED THROUGH THE ENTIRE LENGTH OF THE DUCT.
4. INSERT FLEXIBLE CONDUIT 600mm IN THE DB2. THE CONDUIT WILL VARY IN SIZE DEPENDING ON CONDUCTOR SIZE. INSTALL 2" DIAMETER FOR 3/0 AWG AND 3" DIAMETER FOR 250Kcmil OR 500Kcmil.
5. RADIUS MUST BE GREATER THAN THE SPECIFIED CABLE MINIMUM BENDING RADIUS.
6. INSTALL METER COMPARTMENT AS PER ELECTRICAL SAFETY CODE RULES, USE ONLY HYDRO ONE APPROVED METER BASES LISTED IN THE HYDRO ONE 'METER SOCKET BASE' LIST. METER BASE TO MAINTAIN 1 METER MINIMUM CLEARANCE FROM DISCHARGE OF ANY COMBUSTIBLE GAS RELIEF DEVICE OR VENT.
7. TELECOMMUNICATION PLANT MAY SHARE SERVICE TRENCH BUT MUST BE INSTALLED IN ITS OWN CONDUIT.
8. PREFERRED ROUTING FOR GAS SERVICE SHALL BE ON OPPOSITE SIDE OF THE BUILDING THAN THAT OF THE ELECTRICAL SERVICE. IF COMMON TRENCHING IS UNAVOIDABLE, 300mm MINIMUM CLEAR SEPARATION SHALL BE MAINTAINED IN ALL DIRECTIONS BETWEEN GAS SERVICE AND ELECTRICAL SUPPLY CABLE.
9. CLEARANCES, DEPTHS, SEPARATIONS AND FORMS OF MECHANICAL PROTECTION OF THE CABLE ARE MINIMUM REQUIREMENTS. INCREASED CLEARANCES AND OR ADDITIONAL FORMS OF MECHANICAL PROTECTION ARE CONSIDERED POSITIVE DEVIATIONS AND ARE ALLOWED.
10. IF FURTHER TRENCHING ALONG ROAD ALLOWANCE IS REQUIRED, IT SHALL BE CONSTRUCTED PER HYDRO ONE STANDARD TRENCH PROFILES.
11. RISER CONDUIT TO BE EASILY REMOVED BY HONI FOR CABLE INSTALLATION PURPOSES.

PARTS LIST

PART No.	MM No.	DESCRIPTION	QTY.
1	30030348	COUPLER KIT, 2" FLEX TO 2" RIGID	A/R
	30031161	COUPLER KIT, 3" FLEX TO 2" RIGID	
	30030236	COUPLER KIT, 3" FLEX TO 3" RIGID	
	30031918	COUPLER KIT, 4" FLEX TO 4" RIGID	
2	30030366	CONDUIT, FLEX, 2"	A/R
	30030235	CONDUIT, FLEX, 3"	
	30031917	CONDUIT, FLEX, 4"	
3	30005908	SERVICE CABLE, 3/0 AWG, 3-COND., AL.	A/R
	30005915	SERVICE CABLE, 250Kcmil, 3-COND., AL.	
	30005959	SERVICE CABLE, 500Kcmil, 3-COND., AL.	
4	30007710	CONDUIT, PVC, 4", DB2	A/R
5	20002181	CAUTION TAPE, BURIED ELECTRIC LINE	A/R
6	30007687	SWEEP, 4" x 16" RADIUS, RIGID PVC	A/R
7	30007583	CONDUIT, 4", RIGID PVC	A/R
8	*	CAP, 4", SCHEDULE 40, PVC	A/R
9	30000744	STRAP, CABLE, 60mm, AL. OR GALV. STEEL	A/R
	30008426	STRAP, CABLE, 80mm, AL. OR GALV. STEEL	
	30000905	STRAP, CABLE, 100mm, AL. OR GALV. STEEL	
10	20000007	TAPE, PULLING, 1/2" WIDE, POLYESTER	A/R
MM# = REFER TO SECTION 16 ONLY		A/R = AS REQUIRED	
* = SUPPLIED BY CUSTOMER			

FOR SHEET 1 OF THIS DRAWING SEE DU-03-209.1-0500
FOR SHEET 3 OF THIS DRAWING SEE DU-03-209.1-0502

ALL DIMENSIONS IN MILLIMETRES
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03	SEP 2018	GENERAL UPDATES. CHANGED TO NEW DWG. & NUMBERING FORMAT. FOR PREVIOUS REVISIONS REFER TO DU-03-209.1-R2.	SO	PC	AS	PS
02	AUG 2013	D2 UPDATED WITH SWEEP, ALTERNATE METHODS ADDED	GJ	PC		
Rev No.	Date	Revision Particulars	dwn	ckd	des	app



Hydro One Networks Inc.

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Drawn By: L.SQUEIRA	Checked By:	Designed By:	Design Approved By:
Scale: N.T.S.	Date: (yyyy/mm/dd) 2012/08/30	Pole ID:	

Title:
TRENCH DETAIL – SECONDARY SERVICE CABLE
FROM DIP POLE TO METER BASE

Drawing No.

DU-03-209.1-0501

Rev. No.

03

A4 (210 x 297)

millimetres

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Sheet Number: **2 / 3**

Hydro One trenching guidelines:

Secondary service trench with supply taken from dip pole
per Hydro One Networks Inc. standard drawing DU-03-209.1-0500

The installation options listed below explain Hydro One Networks' Standard (DU-03-209.1-0500) for the installation of Hydro One owned single phase secondary underground cables. Regardless of who installs the cable, the trench **must** be constructed per DU-03-209.1-0500/0501. **Note: Options described below will allow the cable installer crew to perform their work without a coordinated site visit with the trench installer.**

For most installations, either Option 1 or Option 2 can be selected by the customer (Option 2 calls for increased mechanical protection via more rigorous conduit); however Option 2 must be selected for installations where a minimum cover of 600 mm is not possible.

Option 1 (requires minimum cover of 600 mm): Direct buried cable encapsulated in masonry sand at trench ends as shown in DU-03-209.1-0500

- The trench can be backfilled excluding open pit area at either end of trench, prior to cable installation.
- The trench must be backfilled with clean masonry sand in areas indicated in DU-03-209.1-0500 and clean native backfill to finished grade immediately after installation of cable.
- If the trench end(s) is(are) temporarily left open (i.e. if backfilling cannot occur immediately after cable installation), a length of flexible conduit (specified by Hydro One and listed in DU-03-209.1-0500) shall be applied between the horizontal DB2 duct and the vertical rigid conduits at both the meter base and the source pole to provide temporary protection of the cable. See detail D1 in DU-03-209.1-0500. The flexible conduit shall be inserted inside the 100mm DB2 duct a minimum of 600mm. The meter base and dip pole conduits will vary in size depending on conductor size (i.e. 2" diameter for 3/0 AWG and 3" diameter for 250 kcmil or 500 kcmil cable) as will the associated flexible conduit. Appropriately sized couplers (shown and listed in the parts list) shall be used to connect the rigid conduits to the flexible conduits.

Option 2 (reduced cover): Rigid PVC / flexible conduit, and sweeps

- In areas of poor soil conditions (e.g. rocky) and where installing straight lengths of rigid PVC (Schedule 40) conduit is impossible, flexible conduit can be installed at the sole discretion of Hydro One. This flexible conduit, as listed in DU-03-209.1-0500, shall be 100mm diameter electrical grade corrugated flexible conduit. Flexible drainage pipe or thin wall conduit is **NOT** acceptable.
- In a case where 600mm of cover is not possible, the secondary cable may be installed in rigid conduit (Schedule 40 PVC) or in a continuous length of flexible conduit (see above for details on flexible conduit) at a minimum cover of 300mm.
- In a case where 300 mm of cover is not possible, such as on bald rock, the rigid PVC conduit (or alternatively the flexible conduit as mentioned above) will be covered in a minimum thickness of 3" (75mm) of concrete wherever reduced cover is encountered. The concrete shall cover the conduit at all points until the vertical component of the sweep is reached. If flexible conduit is employed, it shall not permanently extend beyond the concrete and be left exposed.
- Rigid PVC (Schedule 40) sweeps shall be used at the trench ends to make the transition to the meter base and dip pole conduits. See detail D2 in DU-03-209.1-0500.

NOTE: If any discrepancies between this document and the referenced standard are found, the standard shall prevail. It is the customer's responsibility to ensure compliance to the standard. Not complying with the standard will result in Hydro One not completing their work and an "extra trip charge" being applied.

FOR SHEET 1 OF THIS DRAWING SEE DU-03-209.1-0500
FOR SHEET 2 OF THIS DRAWING SEE DU-03-209.1-0501

ALL DIMENSIONS IN MILLIMETRES
UNLESS OTHERWISE STATED

03	SEP 2018	GENERAL UPDATES. CHANGED TO NEW DWG. & NUMBERING FORMAT. FOR PREVIOUS REVISIONS REFER TO DU-03-209.1-R2.	SO	PC	AS	PS	Drawn By: L.SEQUEIRA	Checked By:	Designed By:	Design Approved By:	
02	AUG 2013	D2 UPDATED WITH SWEEP, ALTERNATE METHODS ADDED	GJ	PC			Scale: N.T.S.	Date: (yyyy/mm/dd) 2012/08/30	Pole ID:		
Rev No.	Date	Revision Particulars	dwn	ckd	des	app	Title: TRENCH DETAIL – SECONDARY SERVICE CABLE FROM DIP POLE TO METER BASE				
 Hydro One Networks Inc.							Drawing No. DU-03-209.1-0502				Rev. No. 03

A4 (210 x 297)

millimetres

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Sheet Number: **3 / 3**

HYDRO ONE RETAIL METERING GUIDE

2024 EDITION



The Hydro One Retail Revenue Metering Standards Guide – 2024 Edition, provides direction for Customers, consultants, and electrical contractors modifying or installing an electrical service that will be energized by Hydro One. This Guide (as defined below) provides policies and specifications for retail metering configurations for low voltage electrical services from 120V up to 750V and medium voltage from 2.4kV up to 44kV.

This Guide is governed by, without limitation, applicable CSA/ULC Standards, the Electricity and Gas Inspection Act, the Electricity and Gas Inspection Regulations, the safety standards of Ontario Regulation 22/04: Electrical Distribution Safety and the Ontario Electrical Safety Code.

Hydro One does not assume any responsibility for the application of this Guide by anyone other than Hydro One staff or Hydro One authorized contractors.

Where the information in this Guide conflicts with any of the documents listed in Section 1.1 of this Guide, the documents in Section 1.1 shall take precedence.

NOTWITHSTANDING ANYTHING CONTAINED IN THIS GUIDE TO THE CONTRARY, NOTHING CONTAINED IN THIS GUIDE SHALL AFFECT IN ANY WAY WHATSOEVER THE RESPECTIVE LIABILITIES AND LIMITATIONS OF LIABILITY OF HYDRO ONE, AND THE CUSTOMER, THAT ARE SET OUT IN SECTION 1.9 OF THE CONDITIONS OF SERVICE.

Table of Contents

- 1. Introduction 6
 - 1.1 Preface 6
 - 1.2 Scope..... 6
 - 1.3 Purpose..... 6
 - 1.4 Intent..... 7
 - 1.5 Compliance with Hydro One Rules..... 7
- 2. General Information..... 8
 - 2.1 Application for New Connections or Upgrades..... 8
 - 2.1.1 Early Consultation 8
 - 2.1.2 Obtain Consent Prior to Installation 8
 - 2.1.3 Complete Construction..... 9
 - 2.1.4 Service Connection..... 9
 - 2.2 Hydro One Distribution Standards 9
 - 2.3 General Requirements..... 9
 - 2.3.1 Metering Installation Accessibility..... 9
 - 2.3.1.1 Space & Access 9
 - 2.3.1.2 Meter Location..... 10
 - 2.3.1.3 Working Space 11
 - 2.3.1.4 Entrance To, or Exit From, Working Space 11
 - 2.3.1.5 Illumination 11
 - 2.3.2 Mobile Homes, Trailer Parks & Campgrounds..... 12
 - 2.3.3 Un-Metered Service Connections..... 12
 - 2.3.4 Metering Output for Load Management..... 12
 - 2.3.5 Totalized Metering..... 12
 - 2.3.6 Protective Bollards for Metering Equipment 12
 - 2.3.7 Meter-Mounting Devices 12
 - 2.3.8 Transformer-Rated Meter-Mounting Enclosure..... 13
 - 2.3.9 Suite Metering..... 13
 - 2.3.10 Neutral Grounding Resistors..... 14
 - 2.3.10.1 Responsibilities 14
 - 2.3.11 Arc-Flash Incident Energy Calculations 15

3. Service Connection Types	16
3.1 Services Metered Under 750V – Secondary Metering	16
3.1.1 Services Metered Up To 200A – Self-Contained Metering	17
3.1.1.1 Self-Contained Metering Configurations	17
3.1.1.1.1 Single-Position Meter-Mounting Device (MMD)	23
3.1.1.1.2 Self-Contained Metering Installation Installed on a Wooden Post	26
3.1.1.1.3 Multiple-Occupancy Metering	27
3.1.2 Services Metered Over 200A & Up To 4000A – Transformer-Rated Metering	30
3.1.2.1 T/R MMD with Integrated CT's	34
3.1.2.1.1 Construction Guidelines	34
3.1.2.1.2 Responsibilities	35
3.1.2.2 Central Metering	35
3.1.2.2.1 Construction Guidelines - Central Metering – Pole-Mounted	36
3.1.2.2.2 Construction Guidelines - Central Metering – Pad-Mounted	36
3.1.2.2.3 Responsibilities	37
3.1.2.3 T/R Meter-Mounting Enclosure & Instrument Transformer Enclosure	37
3.1.2.3.1 Construction Guidelines	38
3.1.2.3.2 Responsibilities	39
3.1.2.4 T/R Meter-Mounting Enclosure & Low-Voltage Switchgear with Utility Metering Compartment (UMC)	40
3.1.2.4.1 Construction Guidelines	40
3.1.2.4.2 Responsibilities	40
3.2 Services Metered Over 750V – Primary Metering	41
3.2.1 General Requirements	41
3.2.1.1 Primary Metering Requirements	42
3.2.2 Primary Metering – Pole-Mounted	42
3.2.2.1 Construction Guidelines	42
3.2.2.2 Responsibilities	42
3.2.3 Primary Metering – Pad-Mounted	43
3.2.3.1 Construction Guidelines	43
3.2.3.2 Responsibilities	43
4. Embedded Generation	45
4.1 Governing Principles	45
4.2 General Requirements	45

4.3 Embedded Generation Classes	47
4.3.1 Net Metering.....	47
4.3.2 Load Displacement Generators	47
4.3.3 Energy Storage Facilities	47
4.3.4 Emergency Back-Up Generation.....	48
5. Appendix	49
5.1 Units of Measurements.....	49
5.2 Definitions & Abbreviations	49

1. Introduction

1.1 Preface

This Guide is governed by:

- Hydro One's Conditions of Service.
- The Ontario Energy Board's Distribution System Code and Retail Settlement Code.
- The Ontario Electrical Safety Code.
- Ontario Regulation 22/04: Electrical Distribution Safety and Ontario Regulation 332/12: Building Code; and
- Electricity and Gas Inspection Act and Electricity and Gas Inspection Regulations.

Hydro One's services are subject to all laws and regulations that are applicable in its service territories. Where this Guide exceeds the requirements (i.e., allows greater flexibility) of the documents above, this Guide shall take precedence.

Note: Some of the requirements identified by the latest edition of the Ontario Electrical Safety Code have been included in this Guide for convenience and reference purposes only, even though they may be under the Electrical Safety Authority (ESA) jurisdiction.

1.2 Scope

This Guide applies to all existing, new, and upgraded retail Meter Installations and shall apply to all retail billed Customers, including Customers acquired through acquisitions.

1.3 Purpose

This Guide is intended for Hydro One Customers and their agents to provide the requirements for the design preparation, planning, and construction of, a proposed electrical service installation regarding retail revenue metering. The requirements apply to all existing, new, and upgraded services, both permanent and temporary, and are intended to provide an efficient and safe supply of electrical energy regarding retail revenue metering.

It shall be the responsibility of the Customer to conform to the latest editions of this Guide, the Conditions of Service, and all applicable laws and regulations including without limitation, the Ontario Electrical Safety Code.

The objective of this Guide is to help:

1. Ensure uniform safety requirements that comply with Hydro One Distribution Standards.
2. Provide uniform system reliability.

3. Support uniformity in installation practices.

1.4 Intent

The words “shall” or “will” indicate provisions that are mandatory.

The word “should” indicates provisions that are normally and generally practical for the specified conditions.

1.5 Compliance with Hydro One Rules

Hydro One reserves the right to refuse to energize the Customer’s Meter Installation if, in its sole discretion, it is deemed to not meet Hydro One’s requirements stated herein.

2. General Information

The following section outlines general requirements additional to the Hydro One Conditions of Service.

2.1 Application for New Connections or Upgrades

Load Customers requesting a service upgrade or a new connection may contact the Customer Communications Centre at 1-888-664-9376. Customer inquiries for new Net Generation projects or Load Displacement applications, including Backup Generators, may contact the DX Generation Department at 1-877-447-4412. Existing large contracts may contact the Business Customer Centre at 1-866-922-2466.

Application for service should be submitted early in the planning stage of the project for Hydro One to meet the Customer's needs, to determine the best service arrangement, and to obtain necessary equipment.

Note: Customers shall only be connected to the Hydro One distribution system when meeting Hydro One's retail metering requirements stated herein. There will be further non-metering requirements that are not covered in this guide and the Customer should refer to Hydro One's Conditions of Service for more information.

Before a service is connected, the Customer shall:

1. Complete an Early Consultation.
2. Obtain Consent prior to Installation.
3. Complete Construction.

2.1.1 Early Consultation

Hydro One requires information to prepare Meter Installation drawings and complete an electrical layout. For commercial and industrial Customers and residential Customers with service sizes above 400A, a New Customer Connection Information (NCCI) form must be completed.

2.1.2 Obtain Consent Prior to Installation

The Customer shall use equipment that meets the build and construction standards of Hydro One. For general requirements and examples of Meter-Mounting Devices (MMD) that meet Hydro One requirements, please refer to the [CSA-Approved Meter-Mounting Devices](#). If the Customer is procuring switchgear or switchboards as service entrance equipment, the Utility Metering Compartment (UMC) housing metering equipment, shall meet Hydro One requirements stated within this guide. In addition, these materials should be obtained in a timely fashion to

avoid any unnecessary delays. If primary metering is required, the Customer should co-ordinate in-service dates with Hydro One well in advance to ensure long lead-time equipment can be delivered on time. Work associated with the installation of equipment should start only after the metering design has been reviewed and accepted by Hydro One. Hydro One will provide Customers with an electrical service layout that refers to the Hydro One approved distribution standards and the installation shall be constructed to the defined standards. The electrical service layout provides details on how to construct the service connection and outlines Customer responsibilities.

2.1.3 Complete Construction

Where Hydro One requires the Customer to perform specific work on the Customer's premises, the Customer will do so as a prerequisite to Connection. For more information on approved construction standards refer to section on [Hydro One Distribution Standards](#).

2.1.4 Service Connection

After construction, and once ESA has provided connection authorization, Hydro One will connect the Customer's service on the condition that the installation meets Hydro One requirements.

2.2 Hydro One Distribution Standards

Hydro One uses standard materials and drawings to construct distribution systems. The focus of this document is on the metering installation portion of the distribution standards.

Hydro One provides access to these standards drawings and can be viewed on the external webpage: [Hydro One - Builders and Contractors Webpage](#).

Each Standard document available (the "Standard"), and all information and any other standards referenced or linked therein, is provided as a public service by Hydro One Networks Inc. ("Hydro One"). Information and material contained within the Standard carries no representation, warranty or guarantee of any kind, express or implied.

2.3 General Requirements

2.3.1 Metering Installation Accessibility

To facilitate the access and maintenance of Metering Installations by Hydro One employees, equipment shall be installed in a safe location subject to approval by Hydro One based on standards established by the OESC, the Conditions of Service, the Ontario Building Code, and the layout and/or subdivision design drawings.

2.3.1.1 Space & Access

Please see Space & Access in the [Hydro One Conditions of Service](#).

2.3.1.2 Meter Location

Please see Location of Metering Installations in the [Hydro One Conditions of Service](#).

Metering Installations shall:

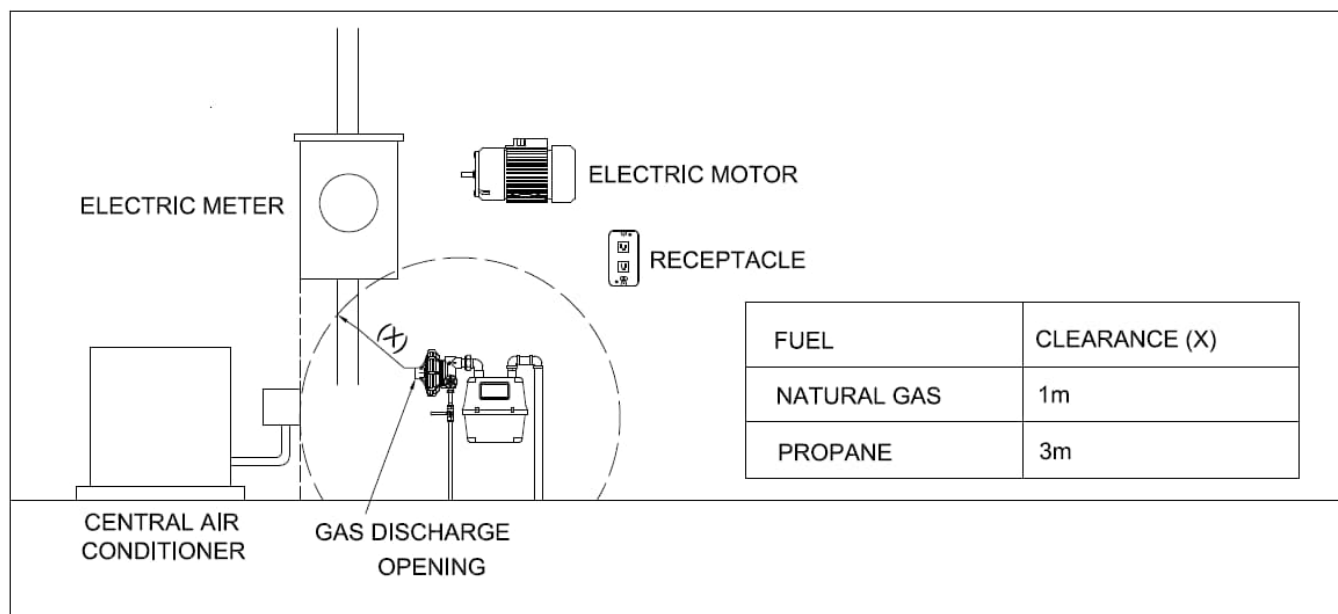
1. Be accessible to Hydro One 24/7.
2. Be installed in a clean, readily accessible location free from tripping or slipping hazards (e.g., snow, ice, or overgrown vegetation).
3. Not be installed in locations which may be hazardous to persons installing, testing, reading, or maintaining the equipment. This includes any area where moving machinery, dust, vibration, fumes, falling debris, corrosive vapours, water, and/or moisture will be present.
 - a. If installed indoors, installed in a dedicated electrical room.
 - b. If installed in a location with moving vehicles or machinery, mechanical protection is required, refer to [Protective Bollards for Metering Equipment](#).
4. Be easily and safely accessible (i.e., there shall be a safe entrance path).
5. Be free from obstructions or hinderance to maintain or service.
 - a. Meter-Mounting Device (MMD) shall be mounted on a wall free from any obstruction that may hinder the ability to replace or maintain the installation.
 - i. If MMD is recessed there shall be at least 100mm clearance on all sides and the meter-sealing ring shall at a minimum be flush with the mounting surface.
 - b. No obstructions that hinder the ability for the meter to communicate consistently over the AMI network.
 - i. Covers, cloaks, plates, or shields installed over meter or Meter-Mounting Device is not permitted.
 - c. Instrument Transformer Enclosure or Switchgear Enclosure doors shall not hinder the workers ability to perform maintenance on Metering equipment.
 - i. See 2.3.1.3 Working Space requirements.
6. If installed indoors:
 - a. Have adequate illumination and ventilation to carry out all work safely as per the OESC.
 - b. Be installed in a dedicated electrical room.
 - i. Continuous access, by key or other appropriate means, provided to Hydro One or its authorized agent.
 - c. For details on who may install a Meter Installations indoors, please refer to Hydro One Conditions of Service.
7. Have poles installed, owned, and maintained by the Customer when Meter Installations are located on poles on the Customer's property.

8. Have the centre of the meter display be at 1750mm $\pm$ 100mm, above finished grade. The exceptions to this requirement are:
 - a. Meters mounted on a 6x6 post as per [DU11-201](#) (1500mm-1600mm above finished grade)
 - b. Meter Centres
9. Meter installation shall have a permanent label detailing the service disconnect (including disconnect nomenclature, location, and service voltage) on the front panel of the service main box.

2.3.1.3 Working Space

The Customer shall meet the latest amendments of OESC Rule 2-308 Working space around electrical equipment, 2-314 Accessibility for Maintenance and 2-328 Electrical Equipment near combustible gas equipment. All meters shall adhere to the working space requirement around electrical equipment demonstrated in Figure 1.

Figure 1. OESC Rule 2-308 Working Space Requirements



2.3.1.4 Entrance To, or Exit From, Working Space

The Customer shall meet the latest amendments of OESC Rule 2-310 Entrance to, and exit from, working space requirements around meters and metering equipment.

2.3.1.5 Illumination

When installed indoors (e.g., service room, power shed, service closet, etc.), the metering equipment shall be installed in a location with a minimum illumination of:

- 100 to 200 lux horizontal at 750 mm above grade; and
- 100 lux vertical at the front face of the meter.

Lighting in spaces containing metering equipment shall be controlled by a wall switch at the room entrance.

2.3.2 Mobile Homes, Trailer Parks & Campgrounds

Please see Mobile Homes, Trailer Park & Campgrounds in the [Hydro One Conditions of Service](#).

2.3.3 Un-Metered Service Connections

For more information please see Unmetered Connections in the [Hydro One Conditions of Service](#).

2.3.4 Metering Output for Load Management

Please see Metering Pulses in the [Hydro One Conditions of Service](#).

Metering interface for Customer monitoring equipment which uses pulse outputs shall meet the following additional requirements:

- Wetting voltage shall be a maximum of 120V DC or 120V RMS AC
- Current shall not exceed 100 mA DC.

2.3.5 Totalized Metering

Please see Totalized Metering in the [Hydro One Conditions of Service](#).

2.3.6 Protective Bollards for Metering Equipment

Where metering is installed in a location with moving vehicles or machinery the Customer shall supply, install, and maintain protective bollards around the metering equipment to act as mechanical protection for Hydro One personnel against passing vehicles or machinery.

Bollards shall be required if the Metering Installation:

1. Is in an area that can be accessed by motor vehicles easily achieving speeds more than 20km/hr, regardless of posted speed limits.
2. Is in an area that will be subject to grounds maintenance equipment operating within 1m of the metering equipment such as snow clearing equipment and riding lawn mowers.

Table 1 - Construction Drawings - Protective Bollards

Drawing	Description
<u>DU6-107-0500</u>	PROTECTIVE BOLLARDS INSTALLATION

2.3.7 Meter-Mounting Devices

Hydro One requires the use of Meter-Mounting Devices (MMD) that meet build and construction standards for use in Hydro One service territory. For general requirements and examples of

MMD that meet Hydro One requirements, please refer to [CSA-Approved Meter-Mounting Devices](#).

2.3.8 Transformer-Rated Meter-Mounting Enclosure

Hydro One supplies a NEMA Type 3R Transformer-Rated (T/R) Meter-Mounting Enclosure that houses a T/R Meter, fusing, test switches, a modem, and a receptacle. This meter enclosure is often referred to as a “P-Base” enclosure.

The T/R Meter-Mounting Enclosure shall be:

1. Supplied, owned, and maintained by Hydro One.
2. When used for Secondary Metering <750V:
 - Installed by the Customer as per [Metering Installation Accessibility](#).
 - All conduit connected to the T/R Meter-Mounting Enclosure shall be supplied, owned, and maintained by the Customer.
 - No elbows with covers or pull boxes for conduits between the IT Enclosure and the Meter-Mounting Enclosure.
 - No knockouts above the test switch.
 - Be installed to Hydro One standard, visible, and accessible from all sides along with all conduits.
 - Be installed in a location approved by Hydro One within 10m of the IT Enclosure or UMC.
3. When used for [Primary Metering](#) >750V:
 - Installed by Hydro One.

2.3.9 Suite Metering

In March 2006, the Ontario Government passed Bill 21, the Energy Conservation Responsibility Act, which enables implementation of the smart metering initiative in Ontario homes and small businesses. As part of the review of its energy policies, the government implemented additional measures to enable installation of AMI meters in condominiums. Thus, under the Distribution System Code 5.1.9, Hydro One shall install suite metering that meet the specifications stated by Ontario Regulation 389/10 to all multi-unit complexes when it is requested. This may include metering after second stage of transformation.

To allow Hydro One to meter individual units downstream of Customer owned transformation:

1. The installation shall use conventional ANSI style meters installed in Meter Centre's and which abide by Hydro One Distribution Standards and this Guide.
2. The existing rate structure shall be sufficient for this installation and a transformer loss adjustment factor will not be considered.

3. A CSA approved transformer that meets the efficiency standard of CSA C802.1 shall be installed by the Customer and approved by ESA. The Customer will not be entitled to a Customer supplied transformation allowance.
4. Hydro One does not provide unit sub-metering service for the Customer (i.e., metering devices in-line with a bulk meter and a breakdown of costs/metering for individual units). Customers have the option to hire a unit sub-metering contractor to provide this service
5. A review of a single line diagram by Hydro One may be required to ensure this option is the best solution for the Customer and Hydro One. A second supply of the desired voltage to the Customer may be appropriate.

2.3.10 Neutral Grounding Resistors

Customers wishing to install or remove Neutral Ground Resistors (NGR) on the secondary side of the Customer owned service transformer shall obtain Hydro One's permission before proceeding, including obtaining approval for the metering configuration. Customers will cover all costs associated with ensuring that metering complies with Hydro One Distribution Standards. For systems with an NGR installed at a voltage above 750V, Hydro One will review the request for connection and determine next steps.

2.3.10.1 Responsibilities

If an NGR is present on a system under 750V, 3 Element Metering is required. The Customer will be required to pull an insulated neutral into the Switchgear Utility Metering Compartment or into the Metering IT Enclosure Compartment.

The Customer shall:

1. Pull insulated neutral from X0 of interface transformer and terminate on an insulated neutral terminal block inside the Switchgear Utility Metering Compartment (UMC) or IT Enclosure
 - Neutral must be insulated the entire length.
 - Sized as required in the OESC.
 - Must be white or taped white.
2. Ensure the Switchgear UMC or IT Enclosure are specified to house 3 VT's and 3 CT's (3 Element Metering) along with a neutral terminal block.
 - If field modifications are required to accommodate 3 Element Metering, the Customer shall complete a CSA SPE-1000 inspection.
3. A permanent legible sign shall be posted on the IT Enclosure or UMC stating NGR is installed.
4. Meet requirements of the OESC for installing an NGR.

2.3.11 Arc-Flash Incident Energy Calculations

Customers may be required to provide Arc-Flash Incident energy calculations (CSA Z462 standard) at the IT Enclosure or Utility Metering Enclosure within Switchgear for services where Transformer-Rated metering is required.

3. Service Connection Types

This section is divided into two types of services – “Secondary Metered” below 750V and “Primary Metered” above 750V. Services metered below 750V with a service size less than 200A are described as “Self-Contained” (S/C) Metering Installations. A S/C meter is connected directly to the supply voltage and is in series with the Customer load. Services metered below 750V with load or generation above 200A are described as “Transformer-Rated” Metering Installations. A T/R Metering Installation unlike a S/C Metering Installation requires external instrument transformer(s) to isolate and step down the current and, if necessary, the voltage. If the secondary service size is larger than 4000A, the installation may be primary metered at a service voltage above 750V. The section requirements apply to both load and generation Customers eligible for Hydro One’s secondary metering for over-head & under-ground connections after a single stage of transformation, where the interface transformers shall be designed to meet the energy efficiency standards in CSA C802.1 Minimum Efficiency Values for Power Transformers. For additional requirements pertaining to generation connections, see section on [Embedded Generation](#).

Note: Hydro One may choose to install a T/R Metering Installation for services under 200A.

Hydro One supports a variety of metering configurations to meter Customer services. The configuration used to meter a Customer service will be determined by Hydro One. The metering configuration Hydro One chooses may depend on the following:

- Service Voltage (V)
- Service Size (A)
- Number of Metering points on a property
- Electrical Room Equipment:
 - a. Switchgear
 - b. Meter-Centres, Meter Stacks

3.1 Services Metered Under 750V – Secondary Metering

A service is “secondary metered” when the metering installation is located on the secondary side of a distribution transformer. Secondary metering is Hydro One’s preferred metering arrangement. Hydro One will supply a single stage of transformation to the Customer’s utilization voltage at standard voltages only. Hydro One will determine how the installation shall be metered.

Table 2 - Standard Secondary Voltages

Hydro One Standard Secondary Voltages	Service Configuration	Number of Phases and Wires
120/240V	-	1 Phase, 3W
120/208V(Network)	-	2 Phase, 3W
120/208V	Wye	3 Phase, 4W
*277/480V	Wye	3 Phase, 4W
347/600V	Wye	3 Phase, 4W
*600V (TR only)	Delta	3 Phase, 3W

*Although Hydro One can meter at these voltages, these are non-standard secondary voltages where the interface transformers are supplied by the Customer.

The Customer shall contact Hydro One prior to commencing work or buying equipment, to ensure the installation in its entirety shall be built in accordance with Hydro One Distribution Standards. In addition, the location of metering shall be such that it is safe and capable of being reached quickly for operation, maintenance, renewal, or inspection. For more details, refer to [**Metering Installation Accessibility**](#).

3.1.1 Services Metered Up To 200A – Self-Contained Metering

This section refers to S/C metering for all single and three-phase Customers where the metering point does not exceed 200A. Services exceeding these requirements shall require T/R metering. For typical S/C meter configurations, refer to [**Self-Contained Metering Configurations**](#).

3.1.1.1 Self-Contained Metering Configurations

This section outlines construction guidelines for different types of Hydro One approved single and three-phase S/C Metering configurations and outlines the responsibilities of the Customer as well as Hydro One. For Meter-Mounting Devices (MMD) requirements see [**CSA Approved Meter-Mounting Device**](#). For details on ownership and demarcation, please see the [**Hydro One Conditions of Service**](#).

S/C MMD's may be configured with single-position (individual) or multiple-positions that have a grouped supply. Generally, properties with a single tenant or dwelling, require one metering point whereas a property with multiple tenants requires multiple metering points. A single-position MMD may be used for services with one metering point and a multi-position MMD may be used for services with multiple metering points.

Elbows with covers, pull boxes or splitters for conduits between the Service Transformer and the MMD are not permitted.

Table 3 - Typical S/C Metering Installation Configurations

Service Configuration	Meter Jaws (ANSI Form Factor)	Single or Multiple Position MMD	Service Size (A)	MMD Install Location from Main Service Box	Metering Configuration	Figure
120/240V (1PH, 3W)	4-Jaw (2S)	Single	≤ 200	Line	<u>Single-Position MMD</u>	2.A
		Multiple	≤ 200	Line/ Load*	<u>Multiple-Position MMD</u>	2.B
		Multiple	> 200	Load		2.C 2.D
120/208V (3PH, 4W)	5-Jaw (12S Network)	Single	≤ 200	Load**	<u>Single-Position MMD</u>	3.A
		Multiple	> 200	Load**	<u>Multiple-Position MMD</u>	3.B 3.C
120/208V, 277/480V, 347/600V (3PH, 4W)	7-Jaw (16S)	Single	≤ 200	Load	<u>Single-Position MMD</u>	4.A
		Multiple	> 200		<u>Multiple-Position MMD</u>	4.B 4.C

*200A per position max rating and dependent on ESA approval of the MMD location with respect to the Main Service Box.

**Hydro One standard is for the neutral jaw to be at the 9 o'clock position

Three-phase S/C MMD shall be installed on load side of service box. Additionally, multiple-position MMD such as meter-centres, or meter stacks must have meters installed on load side of sub-service disconnecting device.

Figure 2A – Typical 120/240V Single-position Self-Contained Metering Installations

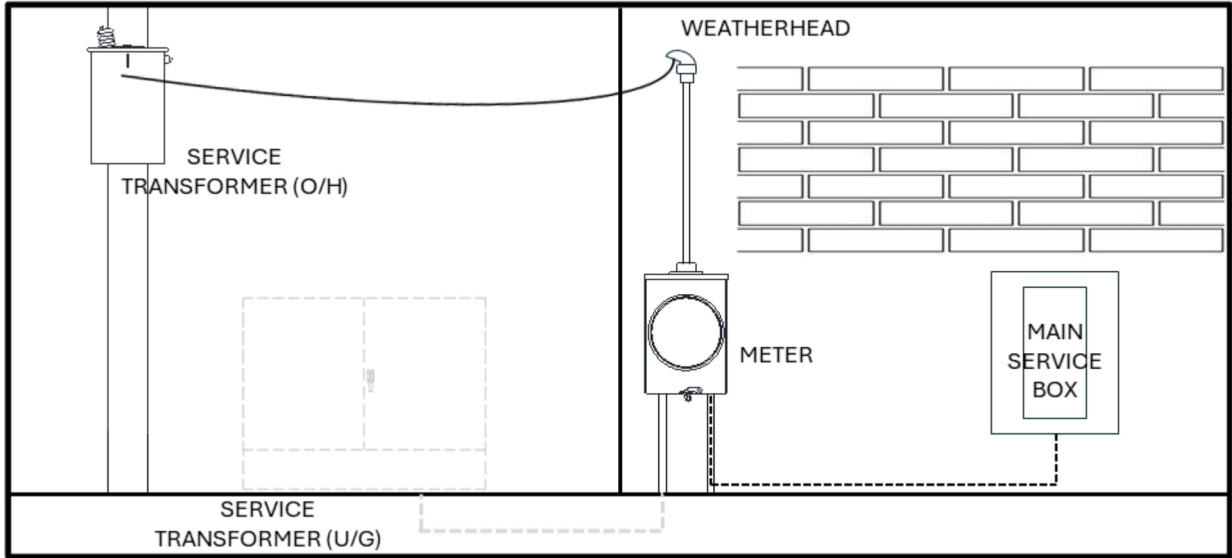


Figure 2B – Typical 120/240V Multiple-position, ≤ 200 MMD Self-Contained Metering Installations

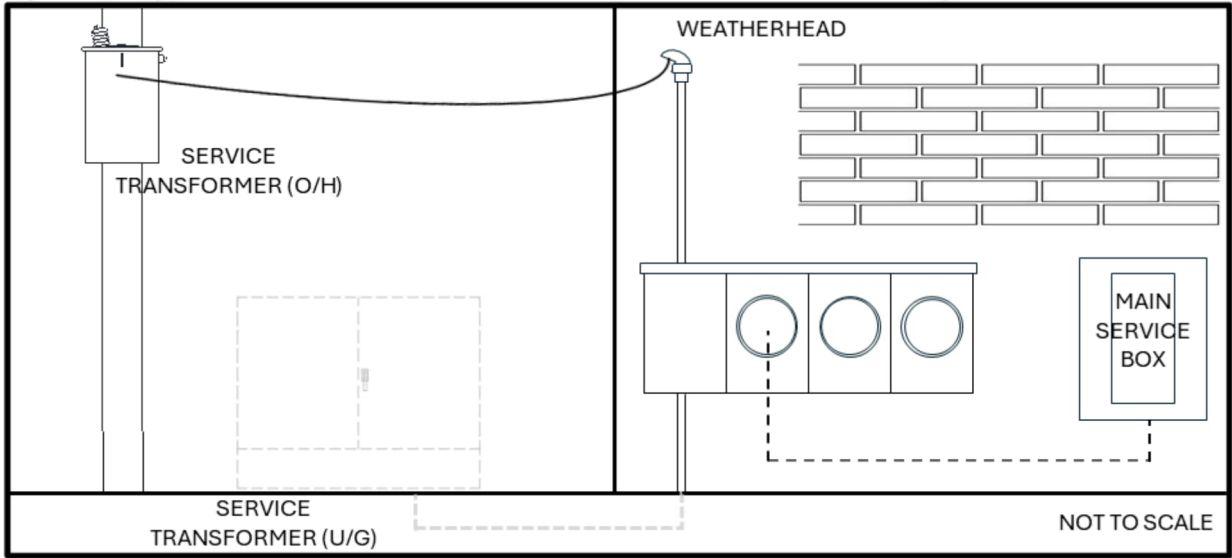


Figure 2C – Typical 120/240V, Multi-Position (>400A Main) MMD Self-Contained Metering Installations

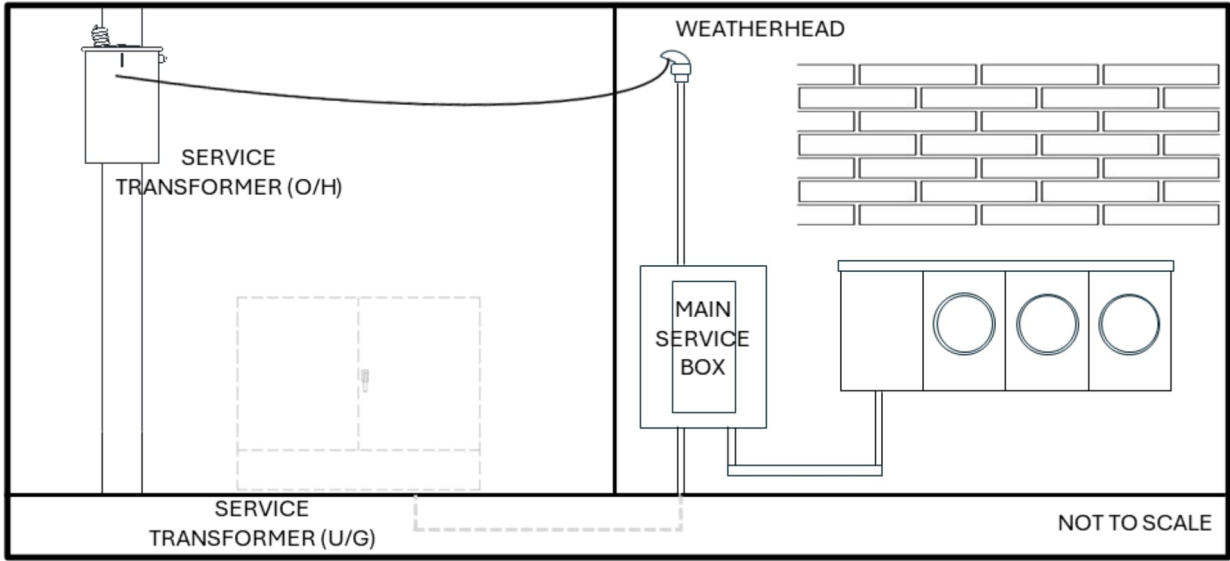


Figure 2D – Typical 120/240V Multi-Position MMD Self-Contained Metering Installations

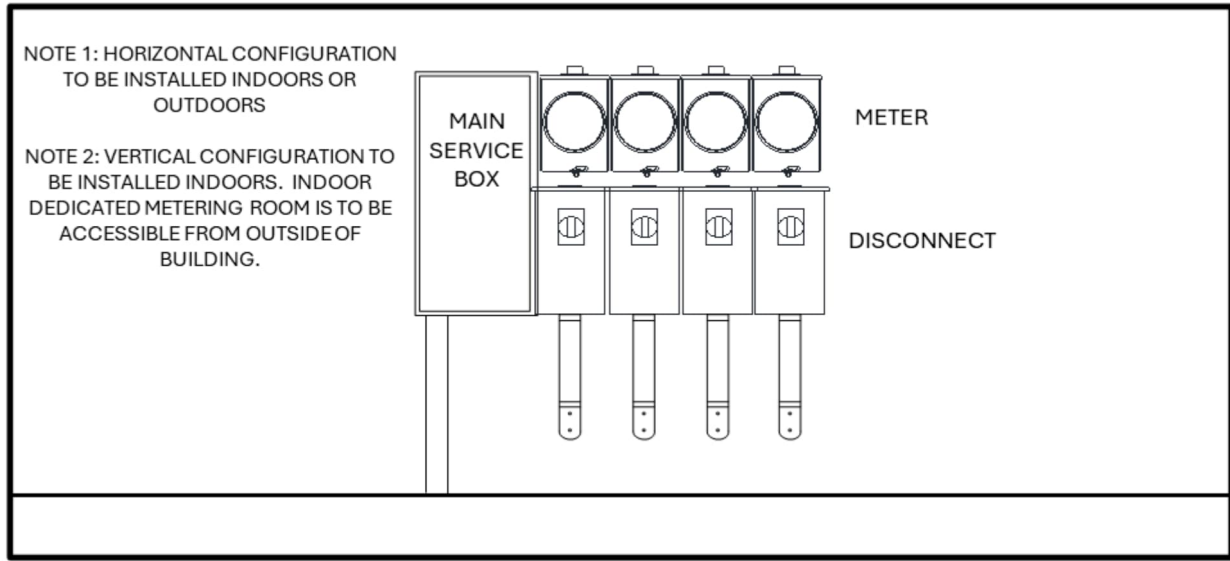


Figure 3A – Typical 120/208V Single-Position MMD Self-Contained Metering Installations

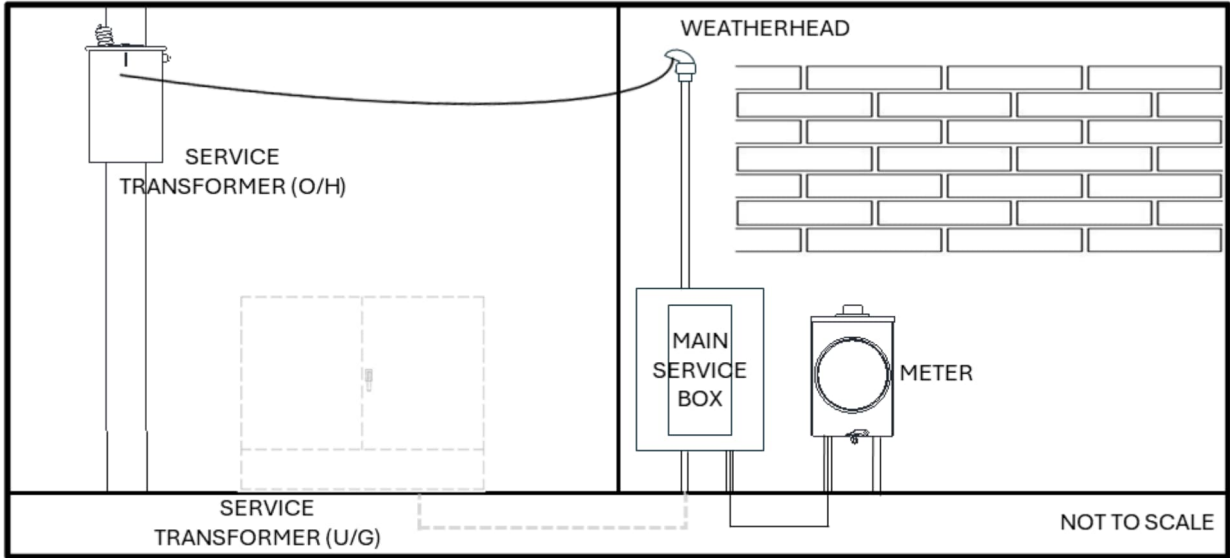


Figure 3B – Typical 120/208V Multi-Position, Grouped Supply MMD Self-Contained Metering Installations

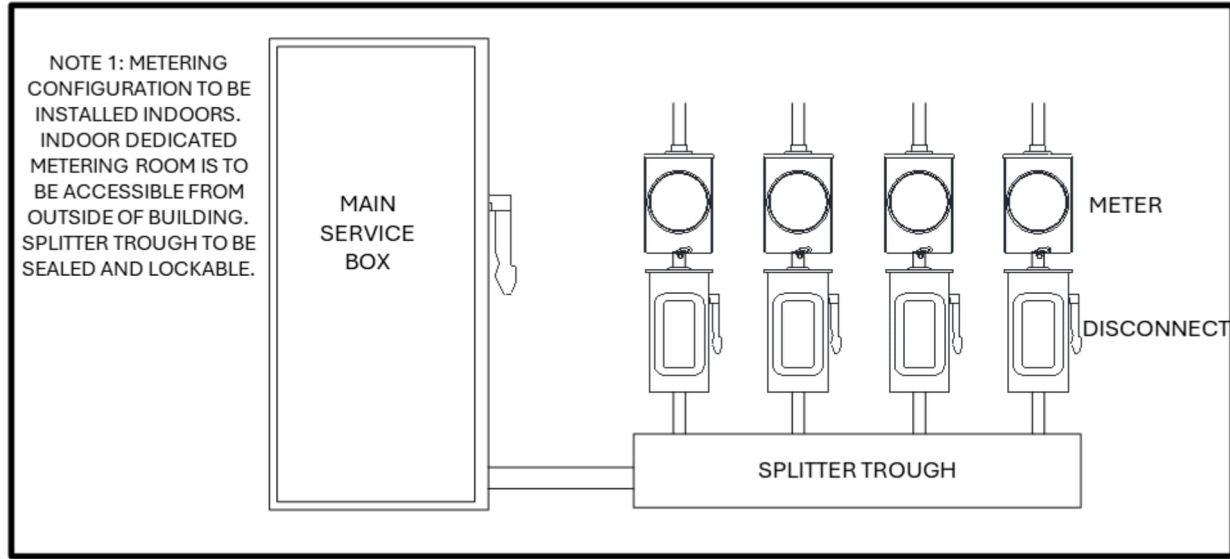


Figure 3C – Typical 120/208V Multi-Position MMD, Meter Centre, Self-Contained Metering Installations

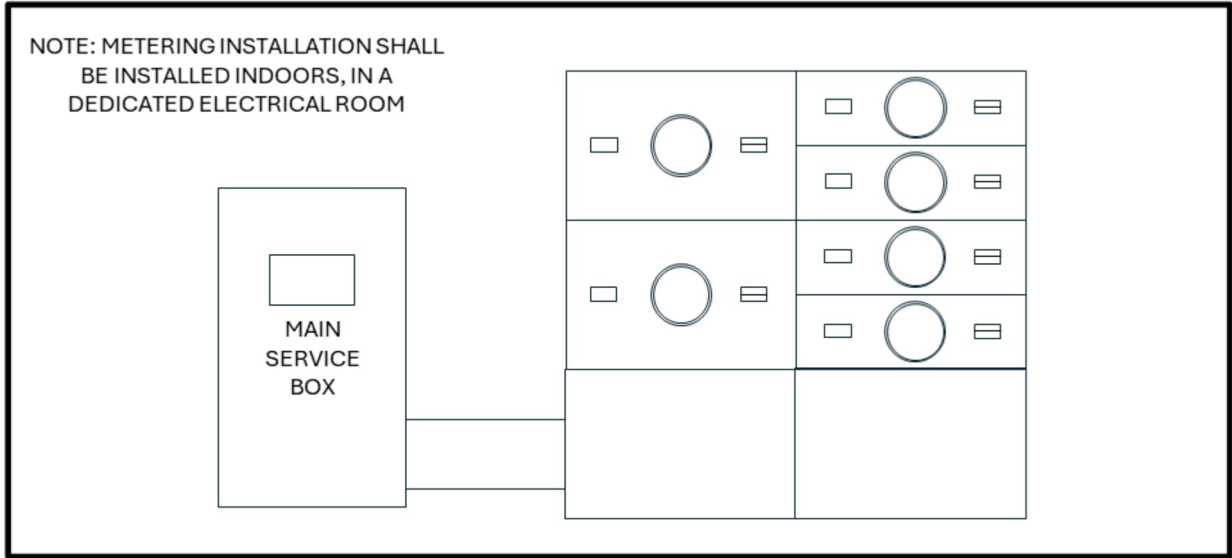


Figure 4A – Typical 120/208V, 277/480V, 347/600V Single-Position MMD, Self-Contained Metering Installations

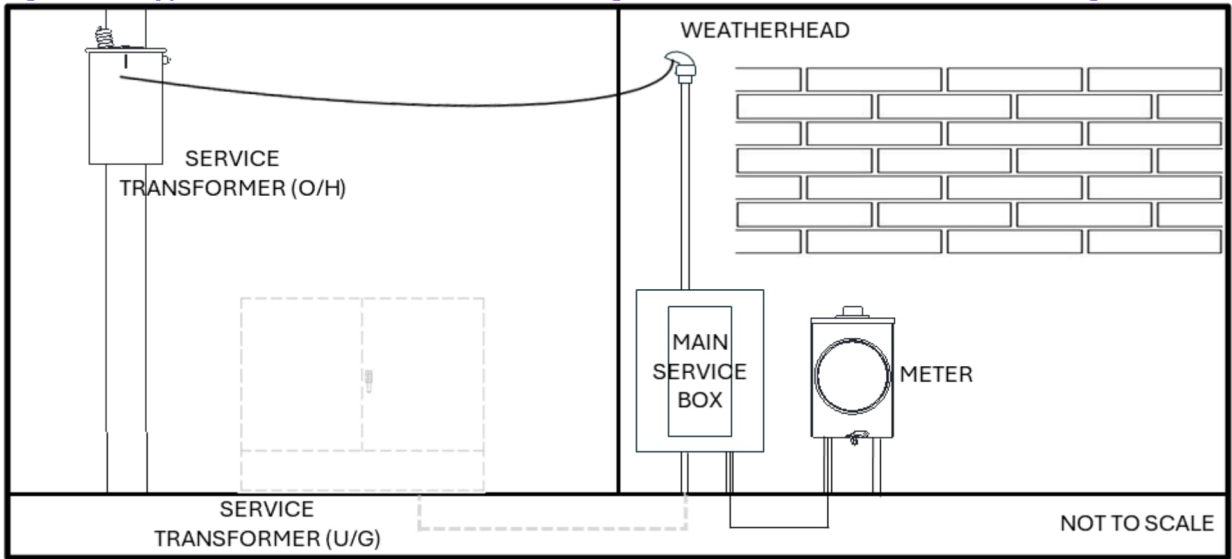


Figure 4B – Typical 120/208V, 277/480V, 347/600V Multiple-Position MMD, Self-Contained Metering Installations

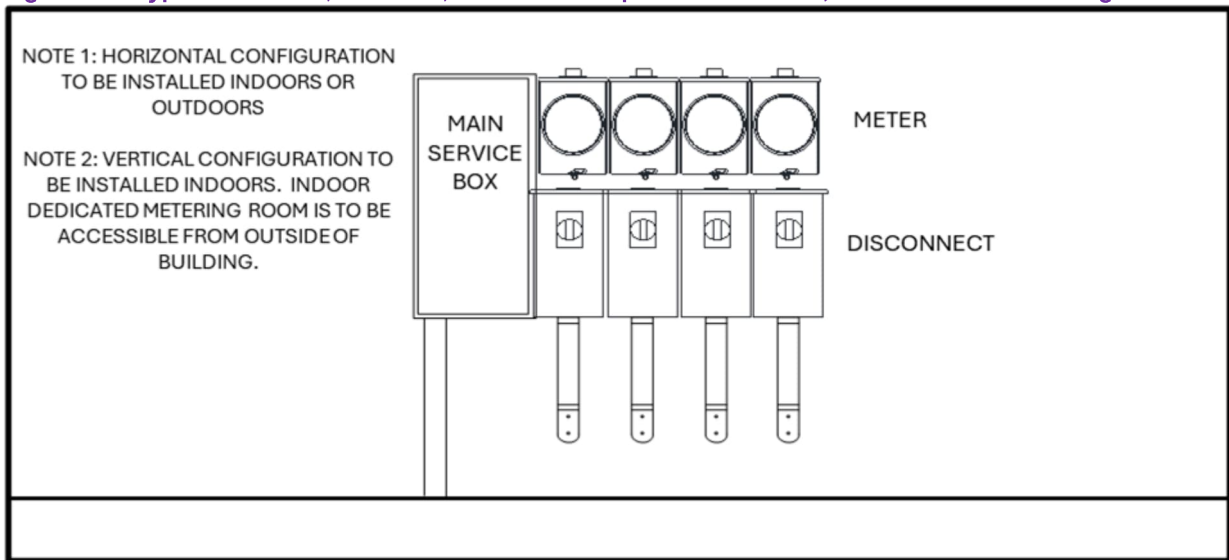
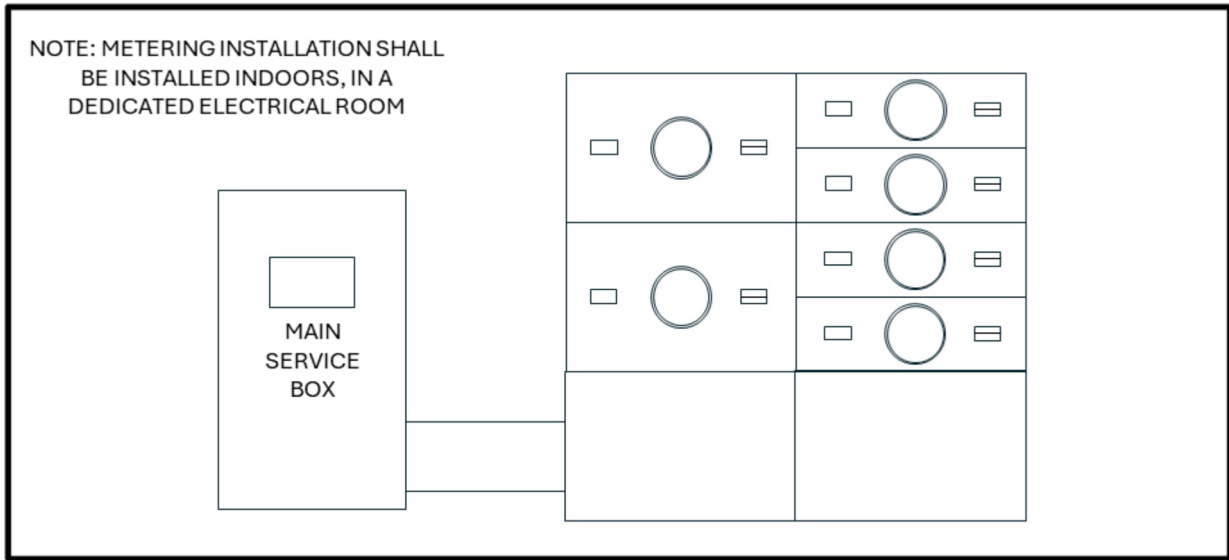


Figure 4C – Typical 120/208V, 277/480V, 347/600V Multi-Position MMD, Meter Centre Self-Contained Metering Installations



3.1.1.1.1 Single-Position Meter-Mounting Device (MMD)

Where the Customer service does not exceed 200A, a Single-Position MMD may be mounted on a building or a pole. Where a Customer has a combination MMD & circuit breaker unit, the Customer's responsibility includes the breaker. In all cases, regardless of any labels, stickers, or nameplates identifying otherwise, the Customer owns and is responsible for repairs and maintenance of the MMD and circuit breaker.

For single and three-phase services metered with a single-position MMD (i.e., up to 200A main service), the Customer shall provide equipment to comply with the following arrangements, and in a location acceptable to Hydro One.

Table 4 - Construction Drawings - Single Position Meter-Mounting Device (MMD)

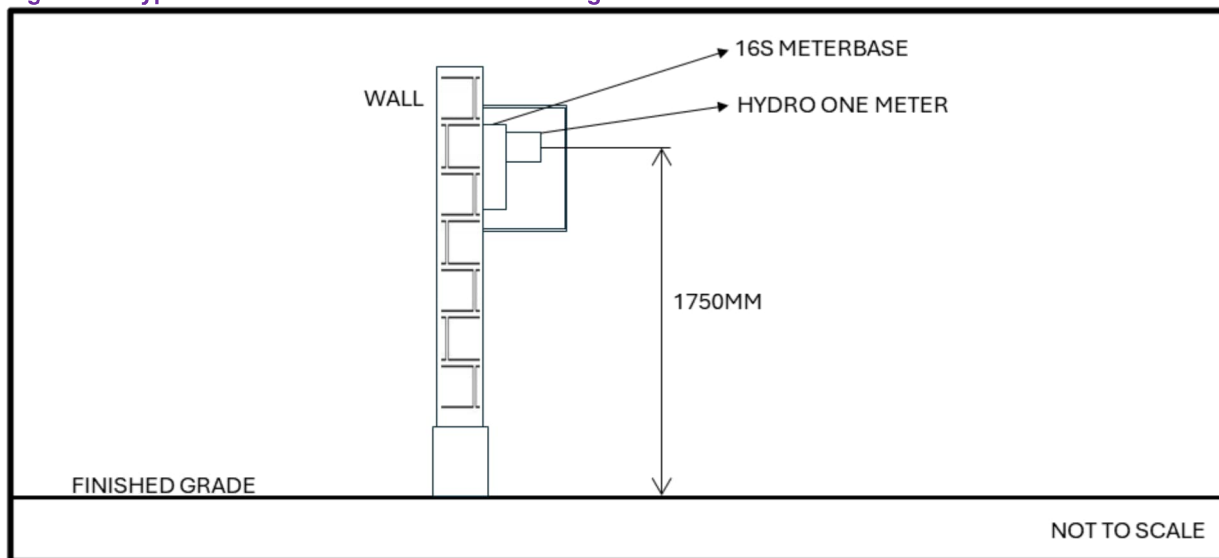
Drawing	Description
<u>DU11-101</u>	TRENCH DETAIL – SEC. SERVICE CABLE FROM U/G DUCTED TRENCH TO METERBASE (SHEETS 1 & 2)
<u>DU11-102</u>	TRENCH DETAIL – SECONDARY SERVICE CABLE FROM DIP POLE TO METERBASE (SHEETS 1, 2 & 3)
<u>DU11-103</u>	TRENCH DETAIL – SEC.SERVICE CABLE FROM U/G ALL-IN-DUCT TRENCH TO METERBASE (SHEETS 1 & 2)
<u>DU11-104</u>	TRENCH DETAIL – SECONDARY SERVICE CABLE FROM UNDER-GROUND TRENCH TO METERBASE UP TO 200A – ALTERNATE ARRANGEMENTS, 1-PH., 120/240v
<u>DU11-111</u>	TYPICAL UNDERGROUND SECONDARY SERVICE CABLE TERMINATIONS AT THE METER BASE UP TO 200A OR UP TO 400A, 1-PH, 120/240V, 3-WIRE
<u>DU11-201</u>	PEDESTAL MOUNTED SELF-CONTAINED METERING UP TO 200A FROM PAD-MOUNTED TRANSFORMER, 1-PH., 120/240V, 3-WIRE

The Single-Position MMD shall:

1. Meet the requirements of the [CSA-Approved Meter-Mounting Devices](#).
2. Have no alterations unless approved by Hydro One or the OEM:
 - Meter jaw arrangements factory installed or modified to meet service requirements using an OEM supplied conversion kit

Three-phase, 347/600V, S/C metering installations, up to 200A are to be located indoors in a dedicated electrical room. Customers that do not have a building facility available, such as electrical charging stations, shall be required to install the MMD within an Enclosure as shown in Figure 5- Typical 347/600V Self-Contained Metering Installation - MMD Inside Enclosure, or in a permanent barriered area, such as with a chain-link fence, or install a [T/R Metering Installation](#).

Figure 5 – Typical 347/600V Self-Contained Metering Installation - MMD Inside Enclosure



A 16S Meter Socket shall be installed within a permanent enclosure outdoors provided:

1. The permanent enclosure shall be outdoor rated and tested to meet the following standard:
 - Minimum NEMA Type 3R
 - If at any time the enclosure does not meet its original rating, the Customer is required to replace the enclosure.
2. The enclosure shall be mounted on a wall, pole, or post.
 - If installed on a wooden post, please refer to [Metering Installation on a Wooden Post](#)
3. There exists a viewing window that permits easy and obvious viewing into the permanent enclosure.
4. There exists a provision for a padlock.
5. When the MMD and meter are installed inside the enclosure:
 - The enclosure and door shall not interfere with the installation or removal of the meter.
 - Meter depth of HONI 3-PH S/C meter
 - 15.24mm (6") from meter ring to optical port
 - The serviceability of the MMD, including, but not limited to installation, reading or removal of the meter, shall not be hindered by any part of the larger enclosure it resides within.
 - 100mm of clearance shall be provided between each side of the Meter and the enclosure walls.

3.1.1.1.1 Responsibilities

The Customer shall:

1. Install the MMD such that it meets the requirements indicated in [Metering Installation Accessibility](#).
2. Install, own, and maintain:
 - MMD, breaker (if installed) and conduits.
 - The pole, if applicable.
3. Install the metering's grounding system.
 - Ownership shall be transferred to Hydro One prior to energization.
4. For pad-mount facilities, install, own, and maintain the vault and the grounding to ESA requirements.
5. For over-head connections, install, own, and maintain up to the top of the service entrance stack.
6. For under-ground connections, install, own, and maintain the load side of the MMD.
7. For installations requiring a MMD installed inside a meter enclosure:
 - Install, own, and maintain the meter enclosure.

Hydro One shall:

1. Terminate the conductors to the MMD on the line side if conductors are owned by Hydro One.
2. Maintain equipment of the secondary service that it owns (e.g., repair and like-for-like replacement of wire or cable that has failed irreparably).
3. Install, own, and maintain the meter.

3.1.1.1.2 Self-Contained Metering Installation Installed on a Wooden Post

For single-phase and three-phase main services up to 200A, it may be preferable to install the metering equipment on a wooden post due to the nature of the service (e.g., parks, temporary installation, utilities, sports facilities, etc.), or due to the location not being suitable to install the metering equipment in a permanent building. After obtaining Hydro One consent, the Customer may choose to install the meter and MMD on a wooden post, ahead of the main service box.

Table 5 - Construction Drawings - Metering on a Wooden Post

Drawing	Description
DU11-201	PEDESTAL MOUNTED SELF-CONTAINED METERING UP TO 200A FROM PAD-MOUNTED TRANSFORMER, 1-PH., 120/240V, 3-WIRE

When metering on a wooden post:

3.1.1.1.2.1 Responsibilities

The Customer shall:

1. Install, own, and maintain the wooden post.
2. Install, own, and maintain the conduits to the MMD on both the line and load side, as well as any other construction materials (e.g., clamps, etc.) to CSA standard in accordance with the OESC.
3. Install, own, and maintain all wiring on the load side of the meter.
4. Install, own, and maintain grounding to OESC.
5. Install, own, and maintain the MMD on the post as defined under [MMD Customer Responsibilities](#).

Hydro One shall:

1. Terminate the conductors to the MMD on the line side if conductors are owned by Hydro One.
2. Maintain equipment of the secondary service that it owns (e.g., repair and like-for-like replacement of wire or cable that has failed irreparably).
3. Install, own, and maintain the meter.

3.1.1.1.3 Multiple-Occupancy Metering

Please see the section on Multi-Occupancy Metering in the [Hydro One Conditions of Service](#).

3.1.1.1.3.1 Multi-Position Meter-Mounting Device – 2 to 6 Position, ≤ 400A Main Service

When metering is required for building structures, where there is a common supply point, such as a condominium or townhouse, a horizontal or vertical trough style Multi-Position MMD shall be permitted. The building structure shall have no more than six units. For services exceeding six units or 400A, a Meter Centre can be used. Refer to [Meter-Centre](#) for more information.

Table 6 - Construction Drawings - Multi-Occupancy Metering

Drawing	Description
DU11-101	TRENCH DETAIL – SEC. SERVICE CABLE FROM U/G DUCTED TRENCH TO METERBASE (SHEETS 1 & 2)
DU11-102	TRENCH DETAIL – SECONDARY SERVICE CABLE FROM DIP POLE TO METERBASE (SHEETS 1, 2 & 3)
DU11-103	TRENCH DETAIL – SEC.SERVICE CABLE FROM U/G ALL-IN-DUCT TRENCH TO METERBASE (SHEETS 1 & 2)
DU11-104	TRENCH DETAIL – SECONDARY SERVICE CABLE FROM UNDER-GROUND TRENCH TO METERBASE UP TO 200A – ALTERNATE ARRANGEMENTS, 1-PH., 120/240V

The Multiple-Position MMD shall:

1. Meet the requirements of [CSA-Approved Meter-Mounting Devices](#).
2. Have no alterations unless approved by Hydro One or the OEM:
 - Meter jaw arrangements factory installed or modified to meet service requirements using an OEM supplied conversion kit
3. Have a separate main service supply compartment, that is pad-lockable.

3.1.1.1.3.1.1 Responsibilities**The Customer shall:**

1. Install the MMD such that it meets the requirements indicated in [Metering Installation Accessibility](#).
2. Install, own, and maintain the MMD and ancillary equipment other than the meter.
3. Provide clear, permanent, and unambiguous nomenclature.
 - Refer to Multi-Occupancy Metering in the [Hydro One Conditions of Service](#).
4. Have unused positions covered with a Customer supplied UV rated cover of Lexan or strong plastic and a stainless-steel sealing ring. Each unused metering position shall not have load side conductors installed.

Hydro One shall:

1. Terminate the conductors to the MMD on the line side if conductors are owned by Hydro One.
2. Maintain equipment of the secondary service that it owns (e.g., repair and like-for-like replacement of wire or cable that has failed irreparably); and
3. Install, own, and maintain the meter.

3.1.1.1.3.2 Multiple-Position Meter-Mounting Devices – More than 6 Position or > 400A Main Service

When metering is required for Multiple-Occupancy services consisting of more than six units or greater than 400A service, the Customer shall supply a Meter Centre installed load side of the main service box for the building. Each meter position shall be installed on the load side of the sub-service disconnect device. These Meter Centres shall be applicable for up to 200A per position, 120/240V, 120/208V and 347/600V services.

The Meter Centre shall:

1. Be certified to CSA C22.2 No. 229 Switching and Metering Centres.

2. Meet the requirements of the [CSA-Approved Meter-Mounting Devices](#)
3. Have no alterations unless approved by Hydro One or the OEM:
 - Meter jaw arrangements factory installed or modified to meet service requirements using an OEM supplied conversion kit

3.1.1.1.3.2.1 Responsibilities

The Customer shall:

1. Install the Meter Centre such that it meets the requirements indicated in [Metering Installation Accessibility](#).
2. Install, own, and maintain the Meter Centre and all ancillary equipment other than the meter.
3. Ensure the Meter Centre is installed on the load side of the main service box.
4. Each Meter within the Meter Centre shall:
 - Be located on the load side of the sub-service disconnecting device.
 - Be protected by a sub-service disconnecting device having an adequate rating to handle the short circuit interruption capacity for the service.
 - Have a provision for locking the sub-service disconnecting device in an open position.
5. Provide clear, permanent, and unambiguous nomenclature.
 - Refer to Multi-Occupancy Metering in the [Hydro One Conditions of Service](#).
6. Have any surplus meter positions that may be used for future additional loads removed/disabled by the contractor with a manufacturer supplied blanking plate to cover the MMD opening and breaker section, and meter positions shall have a blank plastic Meter-Mount Cover and a meter sealing ring installed.
7. Install the Meter Centre in a central service room where it shall be separated from the rest of the building by an approved fire separation.

If the Meter Centre is to be installed outside of the building, **the Customer shall:**

1. Ensure the Meter Centre is installed inside a permanent NEMA Type 3R enclosure of the Customers construction. It shall consist of a permanent roof and walls that meets the requirements of the Ontario Building Code, and shall be covered with brick, siding, or stucco. It shall provide secure access to the metering equipment contained inside and shall be subject to acceptance of Hydro One.
2. When the meters are located inside the enclosure, it must be secure from the public and accessible to Hydro One's employees, agents, and contractors at all hours, to permit meter readings, the changing of meters, and access to metering equipment, and must be locked. The access doors must be able to accommodate a standard Hydro One padlock.

3. Ensure that the enclosure provides adequate mechanical protection for the equipment inside against damage not caused by ordinary wear and tear or acts of god (not including any of insect infestation, animals, or plant/tree growth).

Hydro One shall:

1. Install, own, and maintain the meter.

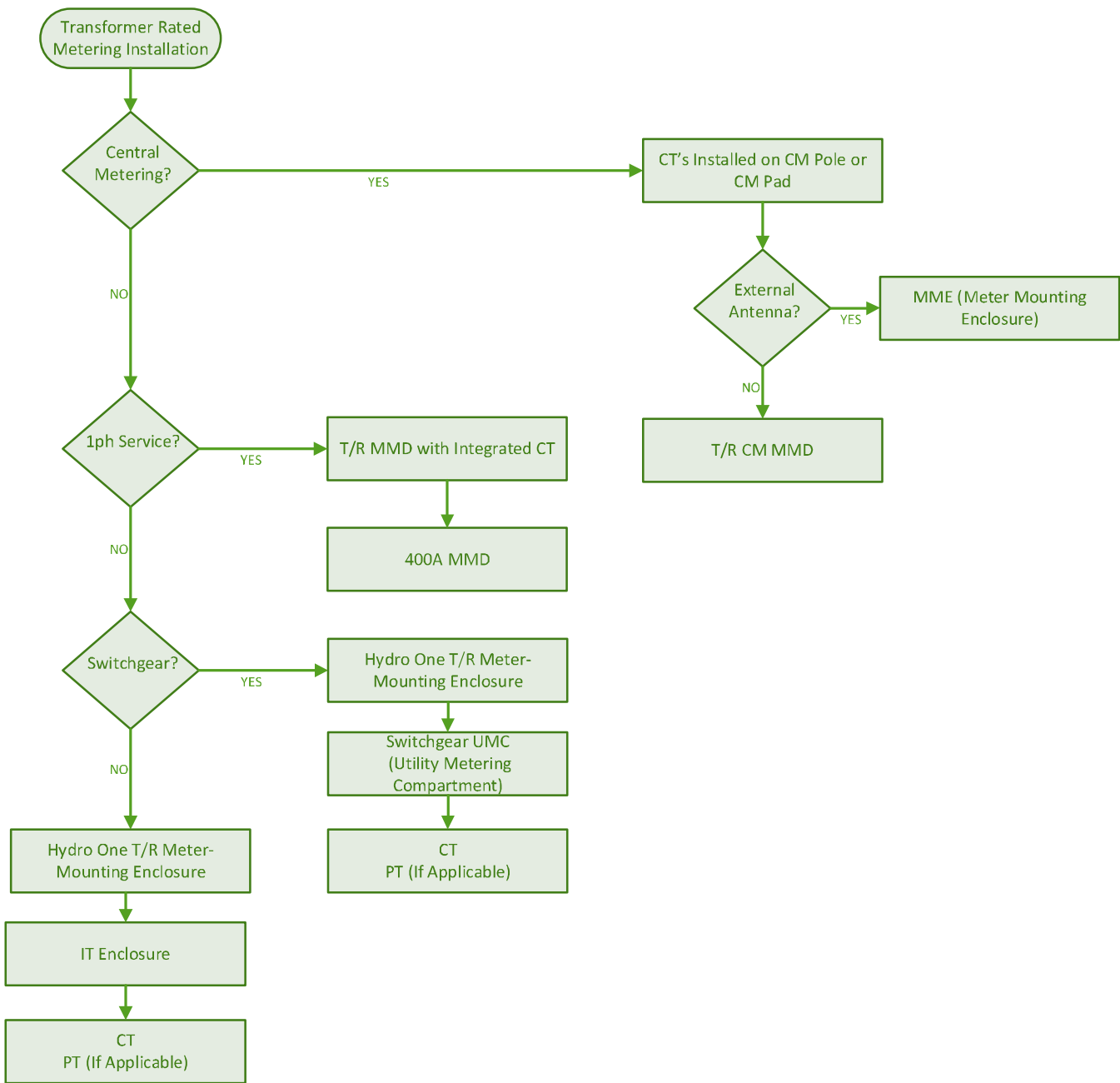
3.1.2 Services Metered Over 200A & Up To 4000A – Transformer-Rated Metering

Single or three-phase services where the metering point is, or is anticipated to be, more than 200A shall use Transformer-Rated (T/R) metering. T/R metering installations unlike S/C, require instrument transformers to step down the current and if necessary, the voltage, to levels that are safe for workers and the equipment that interacts with them. In a T/R installation, current transformers are always required, and they are normally housed in an enclosure. Customers requesting a secondary service shall contact Hydro One prior to commencing work or buying equipment. All secondary installations shall be reviewed and pre-approved by Hydro One prior to construction.

Typically, a T/R metering installation is constructed using the following:

1. T/R Meter & MMD or
2. T/R Meter, Meter-Mounting Enclosure & Instrument Transformer Enclosure
 - a. CM service, CTs mounted on pole or inside pad-mount transformer.

Figure 2 - Typical Transformer Rated Metering Installation Components



For typical installation arrangements, refer to division of Sub-Sections below based on type of service.

Table 7 - Typical T/R Meter Installation Configuration

Service Configuration	Meter Jaws (ANSI Form Factor)	Service Size (A)	T/R Metering Installation Location from Service Box(s)	Metering Configuration	Figures
120/240V (1PH, 3W)	5-Jaw (3S)	>200 - ≤400	Line	T/R MMD with Integrated CT	Figure 7
		>200 - ≤600		Central Metering – CM MMD	Figure 8
		>200 - ≤800	Load	T/R Meter-Mounting Enclosure & IT Enclosure	Figure 9
				T/R Meter-Mounting Enclosure & Switchgear (UMC)	Figure 10
120/208V 277/480V 347/600V (3PH, 4W)	13-Jaw (9S)	>200 - ≤1000	Load	T/R Meter-Mounting Enclosure & IT Enclosure	Figure 9
		>200 – ≤4000		T/R Meter-Mounting Enclosure & Switchgear – UMC	Figure 10
600V (3PH, 3W)	8-Jaw (45S)	>200 – ≤1000	Load	T/R Meter-Mounting Enclosure & IT Enclosure	Figure 9
		>200 – ≤4000		T/R Meter-Mounting Enclosure & Switchgear (UMC)	Figure 10

Figure 7 - T/R MMD with Integrated CT (O/H or U/G)

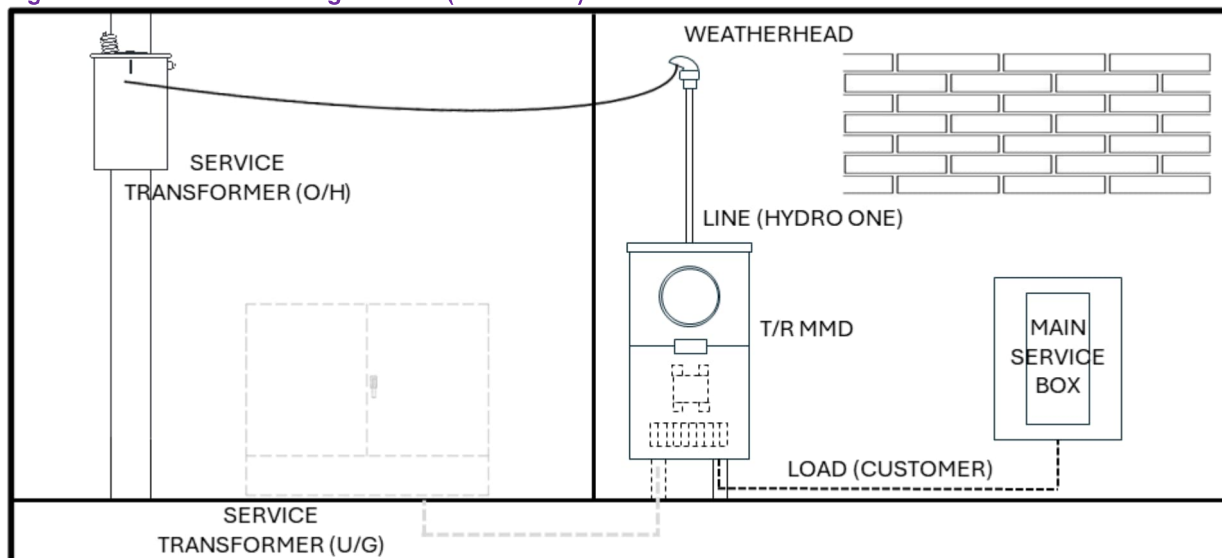


Figure 8 - Central Metering – CM MMD (O/H or U/G)

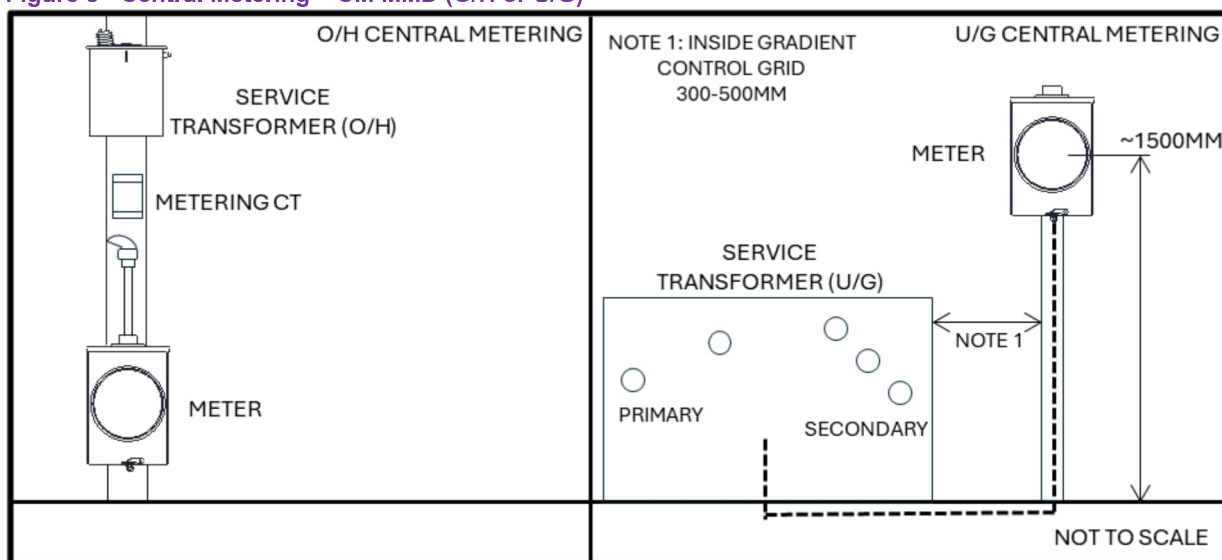


Figure 9 - T/R Meter-Mounting Enclosure & IT Enclosure

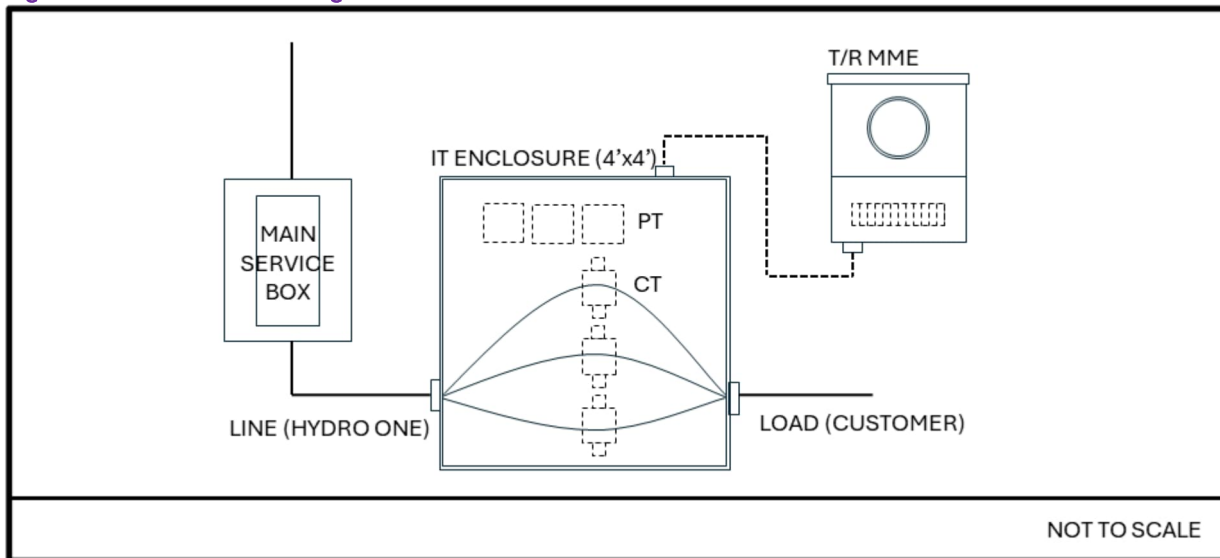
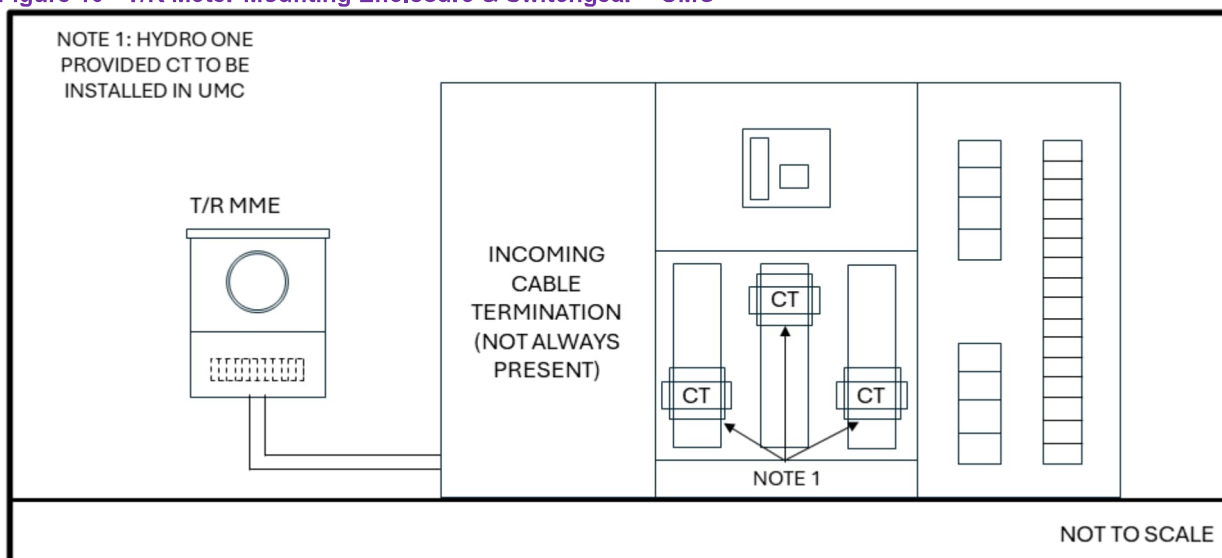


Figure 10 - T/R Meter-Mounting Enclosure & Switchgear – UMC



3.1.2.1 T/R MMD with Integrated CT's

3.1.2.1.1 Construction Guidelines

Single-phase, 120/240V services where the total service box size is between 200A and 400A, a T/R MMD with integrated CT's may be used. The T/R MMD with integrated CT's consists of a 5-Jaw meter mounting device, 4-position test switch and is to be installed on the line-side of the Customer service box.

Table 8 - Construction Drawings - T/R MMD with Integrated CT's

Drawing	Description
DU11-101	TRENCH DETAIL – SEC. SERVICE CABLE FROM U/G DUCTED TRENCH TO METERBASE (SHEETS 1 & 2)
DU11-102	TRENCH DETAIL – SECONDARY SERVICE CABLE FROM DIP POLE TO METERBASE (SHEETS 1, 2 & 3)
DU11-103	TRENCH DETAIL – SEC.SERVICE CABLE FROM U/G ALL-IN-DUCT TRENCH TO METERBASE (SHEETS 1 & 2)
DU11-113/ RM7-303-0500	TYPICAL UNDERGROUND SECONDARY SERVICE CABLE TERMINATIONS AT THE TRANSFORMER RATED METER BASE, 400A, 1-PH, 120/240V, 3-WIRE
RM7-304-0500	O/H INTEGRATED METERBASE, 1 x 3W BAR CT, 1-PH, 3W, 120/240V, CONSTRUCTION CWD UP TO 400A, FULL MULTIPLIER

The T/R MMD with Integrated CT shall:

1. Meet the requirements of the [CSA-Approved Meter-Mounting Devices](#).
2. Have no alterations unless approved by Hydro One or the OEM:
 - o Meter jaw arrangements factory installed or modified to meet service requirements using an OEM supplied conversion kit

3.1.2.1.2 Responsibilities

The Customer shall:

1. Install the T/R MMD such that it meets the requirements indicated in [Metering Installation Accessibility](#).
2. Install, own, and maintain T/R MMD, breaker (if installed) and conduits.

Hydro One shall:

1. Terminate the conductors to the T/R MMD on the line side if conductors are owned by Hydro One.
2. Supply, install, and connect the CT required for the T/R MMD. The CT installation will be completed by Hydro One on or before the date of connection.
3. Install, own, and maintain the meter, CT, and all secondary wiring within the T/R MMD.

3.1.2.2 Central Metering

Hydro One, at its discretion, will consider requests from Customers to provide Central Metering (CM) for single-phase, 120/240V or three-phase 120/208V, over-head and underground service. CM may be used to meter two or more buildings, up to a maximum of four, belonging to one Customer. Customers requiring Central Metering are limited to 600A of total calculated or anticipated load current. Any additional services shall be connected downstream of the CM point at a remote location or pony pole. All Customer work and equipment must be certified by

ESA. For more details on CM services, please refer to Central Metering in the [Hydro One Conditions of Service](#). Typically, CM services will require the installation of a T/R CM MMD.

3.1.2.2.1 Construction Guidelines - Central Metering – Pole-Mounted

Pole-mounted CM will be permitted for single-phase 120/240V or three-phase 120/208V services up to 600 amperes of anticipated or calculated load, where all CM equipment will typically be located on a Customer owned pole ahead of the Customer services box(s). Three-phase services will require a T/R Meter-Mounting Enclosure. See section on [T/R Meter-Mounting Enclosure](#).

Note: Hydro One shall install a #10AWG green conductor, bonded to the down ground at the stack near the CT at the time of connection. Electrical Contractors shall not use copper ground wire to bond the Meter-Mounting Device on a pole.

Table 9 - Construction Drawings - CM Pole-Mounted

Drawing	Description
DL11-305-0500/0501	CENTRAL METERING FOR SECONDARY DROP LEADS (1-CT ARRANGEMENT) 1-PH., 3-WIRE, 120/240V (SHEETS 1 & 2)
RM7-309-0500	SOCKET METER-BASE ENCLOSURE, 1PH, 3W, 120/240V, CONSTRUCTION CWD (for CM System)

The T/R CM MMD shall:

1. Meet the requirements of the [CSA-Approved Meter-Mounting Devices](#).
2. Have no alterations unless approved by Hydro One or the OEM:
 - o Meter jaw arrangements factory installed or modified to meet service requirements using an OEM supplied conversion kit

3.1.2.2.2 Construction Guidelines - Central Metering – Pad-Mounted

At Hydro One's discretion, a Customer may be metered using a pad-mounted CM service as an alternative to pole-mounted CM. Please note that the preferred CM option is pole-mounted metering and Customers may be required to pay for additional labour and material costs of a pad-mounted CM service.

Note: A commercial Meter Pedestal may be allowed upon Hydro One's discretion. It is the Customer's responsibility to obtain Hydro One's approval prior to procurement and installation.

Table 10 - Construction Drawings - CM Pad-Mounted

Drawing	Description
DU11-202-0500	CENTRAL METERING NEAR PAD-MOUNTED TRANSFORMER, 1-PH. 120/240V, 3-WIRE
RM7-309-0500	SOCKET METER-BASE ENCLOSURE, 1PH, 3W, 120/240V, CONSTRUCTION CWD (for CM System)

3.1.2.2.3 Responsibilities

The Customer shall:

1. Install, own, and maintain:
 - T/R CM MMD with 4 or 10 position test switch.
 - All service conductors, equipment, and facilities on the load side of the meter.
2. For pole-mounted CM, supply, install, own, and maintain:
 - Masts, entrance conduits and CM pole
3. For pad-mounted CM, supply, install, own, and maintain:
 - Wooden post
 - Install wooden post connection to the ground gradient control grid.
Refer to [DU11-202-0500](#)
 - Conduits to the T/R CM MMD

Hydro One shall:

1. For pad-mounted CM:
 - Supply and install the pad-mount transformer including terminations on primary and secondary connections.
2. Supply secondary wire harness and CTs and install CM as per Hydro One Distribution Standards, including #10AWG green conductor to ground the T/R CM MMD.
3. Install, own, and maintain the meter.

3.1.2.3 T/R Meter-Mounting Enclosure & Instrument Transformer Enclosure

This section shall focus on metering requirements when the instrument transformers (IT) are housed in a NEMA-rated IT Enclosure in conjunction with a separate, [T/R Meter-Mounting Enclosure](#).

3.1.2.3.1 Construction Guidelines

Table 11 - Construction Drawings - T/R Meter-Mounting Enclosure & Instrument Transformer Enclosure

Drawing	Description
RM8-300-0500	T/R METER ENCLOSURE LAYOUT 3PH, 3W OR 4W, UP TO 600V, CONSTRUCTION DWG
RM8-301-0500	IT ENCLOSURE - 3 X 2W BAR CT, 3PH, 4W, 120/208V, CONSTRUCTION CWD
RM8-302-0500	IT ENCLOSURE - 3 X 2W DONUT CT, 3PH, 4W, 120/208V, CONSTRUCTION CWD
RM8-303-0500	IT ENCLOSURE - 2 X 2W BAR CT, 3PH, 3W, 600V, CONSTRUCTION CWD
RM8-304-0500	IT ENCLOSURE - 2 X 2W DONUT CT, 3PH, 3W, 600V, CONSTRUCTION CWD
RM8-305-0500	IT ENCLOSURE - 3X 2W BAR CT, 3PH, 4W, VOLTAGES OTHER THAN 120/208V, CONSTRUCTION CWD
RM8-306-0500	IT ENCLOSURE -3X 2W DONUT CT, 3PH, 4W, VOLTAGES OTHER THAN 120/208V, CONSTRUCTION CWD
RM7-308-0500	IT ENCLOSURE, 2 X 2W DONUT or BAR CT 1PH,3W, 120/240V, CONSTRUCTION CWD, ½ mult

The IT Enclosure shall:

- Be applicable for the following service configurations with over 200A service size and one metering point per service entrance:
 - 1-PH, 3W 120/240V
 - 3-PH, 4W 120/208V, 277/480V, 347/600V
 - 3-PH, 3W 600V
 - Refer to metering requirements for [Neutral Grounding Resistor \(NGR\)](#) if NGR is installed.
- Be minimum NEMA type 3R
- Be secured with a padlock, and have a backplate to mount IT's, fuses, and bonding equipment to Hydro One specifications. Have a maximum of 3 runs of 500MCM or 2 runs of 750MCM cables per phase
 - [Metering inside Switchgear](#) is required for anything beyond this threshold.
- Be a minimum of 48" x 48" x 12" for all 3-PH services.
- Be a minimum of 36" x 36" x 12" for 1-PH service up to 400A
- Have the neutral enter the IT Enclosure. If the neutral is to be terminated in the IT Enclosure, an insulated neutral block in the IT Enclosure is required. Connection to the neutral with an Insulation Piercing Connector (IPC) shall be supplied and installed by Hydro One .
- Connectors which pass through the side panel of the IT enclosure shall be self-sealing or must be sealed to prevent water ingress.
- Only Hydro One approved material is to be housed within the IT enclosure.

3.1.2.3.2 Responsibilities

The Customer shall:

1. Install and maintain an IT Enclosure:
 - That meets the requirements in the [Construction Guidelines](#) mentioned above.
 - Where located indoors, shall be in the same room as the main service box.
 - Located on the load side of the main service box of the Customer facility.
 - Customer loads shall be connected on the load side of the instrument transformers
 - Surface mounted, visible, and accessible from all sides along with conduits.
 - Elbows with covers or pull boxes for conduits between the IT Enclosure and the Meter Enclosure are not permitted.
 - If using multiple conductors per phase through donut CTs, all conductors require phase tape to clearly mark them for traceability.
 - That does not house any Customer owned equipment and power factor correction monitoring equipment.
 - IT enclosure shall not be used as a pull-box
 - Conductors must maintain minimum bending radius at all times
 - If NGR is installed, ensure the installation meets the requirements for services with NGR.
 - For more details refer to section on [NGR](#)
2. Install the supplied T/R Meter-Mounting Enclosure:
 - Refer to [T/R Meter-Mounting Enclosure](#) for installation requirements.
3. Supply and install conduit between the IT Enclosure and the Meter Enclosure.
4. Install the IT Enclosure and Metering Enclosure such that it meets the requirements indicated in [Metering Installation Accessibility](#).
5. If there is generation connected after the Service Box, refer to section on [Distributed Generation](#) for additional requirements.

Hydro One shall:

1. Supply Measurement Canada approved IT's for revenue metering.
2. Supply, own and maintain the T/R Meter-Mounting Enclosure.
3. Make all connections to the VT including primary connections.
4. Install VT secondary fusing in IT Enclosure.
5. Install, own, and maintain the test switch, meter, and all meter wiring and terminations.

3.1.2.4 T/R Meter-Mounting Enclosure & Low-Voltage Switchgear with Utility Metering Compartment (UMC)

This section includes construction guidelines and responsibilities for metering using Switchgear assemblies. Switchgear assemblies shall be manufactured with a Utility Metering Compartment (UMC) that houses the Hydro One IT.

Manufactured enclosed switchgear assemblies under 750V shall be certified to CSA 22.2 No. 31 Switchgear Assemblies or C22.2 No. 244 for Switchboards. Certification shall be completed by a recognized certification body and shall be indicated on the drawings and the equipment nameplates. The switchgear shall be installed as per the Original Equipment Manufacturer (OEM). Customers metered within Switchgear require a Utility Metering Compartment (UMC) embedded within the Switchgear to house metering IT's and shall meet the construction guidelines defined in this guide. The UMC shall be used exclusively by Hydro One and shall not house any Customer owned equipment. Hydro One can support metering three-phase loads within the UMC up to 4000A. Loads above 4000A may require [Primary Metering](#).

3.1.2.4.1 Construction Guidelines

Table 12 - Construction Drawings - T/R Meter-Mounting Enclosure & Utility Metering Compartment (UMC)

Drawing	Description
RM8-300-0500	T/R METER ENCLOSURE LAYOUT 3PH, 3W OR 4W, UP TO 600V, CONSTRUCTION DWG
RM8-307-0500	TYPICAL LV SWITCHGEAR ARRANGEMENT UTILITY METERING COMPARTMENT 3 PHASE UNDER 750V (NEW)

Switchgear UMC shall:

1. Meet the requirements specified in Drawing RM8-307-0500.

3.1.2.4.2 Responsibilities

The Customer shall:

1. Supply and install a Switchgear with a UMC:
 - That meets the requirements in the [Construction Guidelines](#) mentioned above.
 - Where located indoors, shall be in the same room as the main service box
 - Located on the load side of the main service box.
 - Where conduit between UMC and T/R Meter-Mounting Enclosure shall be 1-1/4" and have no elbows with covers or pull boxes
 - If metering wire must go through another section of the SG, it must be in conduit.
 - If an NGR is installed, ensure the installation meets the requirements for services with an NGR
2. Securely mount ITs in the UMC

3. Install the supplied T/R Meter-Mounting Enclosure:
 - Refer to [T/R Meter-Mounting Enclosure](#) for installation requirements.
4. Supply and install conduit between the LV Switchgear UMC and the Meter Enclosure.
5. Install the LV Switchgear with UMC and Metering Enclosure such that it meets the requirements indicated in [Metering Installation Accessibility](#).
6. If there is generation connected after the Service Box, refer to section on [Distributed Generation](#) for additional requirements.

Hydro One shall:

1. Supply Measurement Canada approved IT's for revenue metering.
2. Supply, own and maintain the T/R Meter-Mounting Enclosure.
3. Make the IT connections within the UMC.
4. Install VT secondary fusing within the UMC.
5. Install, own, and maintain the test switch, meter, and all meter wiring and terminations.

3.2 Services Metered Over 750V – Primary Metering

3.2.1 General Requirements

Services exceeding 750V or 4000A may require the service to be metered by a Hydro One supplied and installed Primary Metering Unit (PMU). A primary metered Customer is eligible to be metered at the Hydro One supplied primary voltage present in the vicinity of the connection. Customers requesting primary metering shall contact Hydro One prior to commencing work for site eligibility confirmation and review.

PMU installations are subject to Hydro One approval and include the following considerations:

- The PMU is installed on the Customer property in a location approved by Hydro One.
- Hydro One has a line side disconnecting device at or near the Customer property line (demarcation point).
 - Ensure a minimum of 30m is maintained between the line side service disconnecting device and the PMU.
- Customer owned disconnecting device load side of PMU.
- For Large Distribution Accounts (equal to or greater than 2MVA of transformation capacity), with the exception of Wholesale Market Participants, Hydro One will supply and install a power quality meter (e.g. ION meter).
- The Customer should co-ordinate in-service dates with Hydro One well in advance to ensure long lead-time equipment can be delivered on time.
- Where minimal Customer loading makes Primary Metering impractical, Hydro One will only meter at a standard Secondary voltage. See [Services Metered Under 750V – Secondary Metering](#).

3.2.1.1 Primary Metering Requirements

A typical primary metering service will be required in the following situations:

1. The Customer's main service box exceeds 4000A.
2. Secondary metering is considered impractical due to:
 - o Economic evaluation
 - o Site conditions that prohibit a secondary metering installation
 - o Site location that poses safety hazards, environmental concerns, or lack of ease of access
 - o Other factors and considerations requiring further assessment such as presence of neutral ground resistors, two or more stages of transformation and/or others
3. The Customer requests a primary metering service:
 - o A Customer will be invoiced for the incremental cost of a PMU over secondary metering.
 - o A Customer will be invoiced for the incremental cost of a pad-mount PMU over a pole-mount PMU if the Customer has requested the upgrade.

3.2.2 Primary Metering – Pole-Mounted

3.2.2.1 Construction Guidelines

The location of the PMU and its ancillary equipment shall be determined in consultation with, and subject to approval by, Hydro One. Typically, the PMU is to be located on the first pole on the Customer property. The location shall be accessible by Hydro One to install and maintain this PMU.

Table 13 – Construction Drawings – Typical Primary Metering Pole-Mounted

Drawing	Description
DL-11-301-0500/0501	RETAIL METERING, O/H PRIMARY 1-PH., GROUNDED PRIMARY, (1-EL.) 2.4 kV - 16kV (SHEETS 1 & 2)
DL-11-302-0500/0501	RETAIL METERING, O/H PRIMARY 3-PH., 4W, GROUNDED WYE (3-EL.) 2.4/4.16kV-16/27.6Kv (SHEETS 1 & 2)
DL-11-302.1-0500/0501	RETAIL METERING, SUBTRANSMISSION, 3PH, 3W, (2-EL.), 27.6kV & 44kV (SHEETS 1 & 2)
DL-12-301-0500	GROUNDING FOR OVER-HEAD INSTALLATIONS ON WOOD POLES, GROUND PLATE OR ROD UNDER-GROUND

3.2.2.2 Responsibilities

The Customer shall:

1. Be responsible for the purchase and installation of any poles, platforms, or other supporting structures required for Hydro One equipment.

2. Ensure that the distance between the PMU pole and any adjacent poles on the line/load side are at least 7m in order to allow direct vehicle access to the overhead metering point and the Customer's load break disconnect switch.
3. Install the PMU in a location that is 30m from the HONI disconnect switch.
4. Ensure the metering installation meets the requirements indicated in [Metering Installation Accessibility](#).

Hydro One shall:

1. Supply and install an approved pole-mount PMU.
2. Be responsible for making the connection from the supply
3. Install the service line disconnect and line and load side arresters.
4. Supply and install the [T/R Meter-Mounting Enclosure](#) on the PMU pole.

3.2.3 Primary Metering – Pad-Mounted

3.2.3.1 Construction Guidelines

A pad-mount PMU is intended for use where the service is fed from underground, and the metering is measured at the primary voltage supplied by Hydro One. The pad-mount PMU shall be installed as per Hydro One Distribution Standards on Customer owned property.

Table 14 – Construction Drawings – Typical Primary Metering Pad-Mounted

Drawing	Description
DU-12-101-0500	GROUNDING FOR PAD-MOUNTED EQUIPMENT – TYPICAL CONCRETE FOUNDATION INSTALLATIONS WITH GROUND ROD OR GROUND PLATE
DU-12-102-0500	GROUNDING FOR PAD-MOUNTED EQUIPMENT – TYPICAL ALUMINUM BASE INSTALLATION WITH GROUND ROD OR GROUND PLATE
DU15-121-0500	EQUIPMENT FOUNDATION INSTALLATION CONCRETE FOUNDATION FOR DIRECT BURIED INSTALLATIONS

3.2.3.2 Responsibilities

The Customer shall:

1. Be responsible for the purchase and installation of any poles, foundations, platforms, or other supporting structures required for Hydro One equipment.
2. Supply primary cables with concentric neutral subject **to Hydro One approval**.
Note: The Customer to ensure primary cables are of sufficient length to allow operation of the elbows with live line tools. Primary cables are to be coiled at the bottom of the Pad-mount vault as per Hydro One standard.
3. Supply and install the load break switch on the load side of the pad-mount PMU.

4. Supply and install a concrete foundation (vault) for the metering pad-mount in a location that is minimum 30m from the HONI disconnect switch and subject to Hydro One standards.
5. Ensure the metering installation meets the requirements indicated in [Metering Installation Accessibility](#).
6. Customer to ensure that the metering pad-mount shall meet the following minimum clearances:
 - 3m for the operating side
 - 3m for the live front
 - 1m for all other sides
7. If installed in a location with moving vehicles or machinery, mechanical protection is required. Refer to [Protective Bollards for Metering Equipment](#) for additional information.

Hydro One shall:

1. Supply an approved pad-mount metering unit designed for medium voltage with a dead front design, outdoor rated and tamper proof, for above grade installation on a concrete vault.
2. Supply and terminate the elbow connections on the primary cables.
3. Supply and install bushing inserts, and caps to match the system voltage, cable size and load.
4. Supply a [T/R Meter-Mounting Enclosure](#) installed on the side of the pad-mounted metering unit.

4. Embedded Generation

Embedded Generators are solely responsible for all commercial arrangements entered into with the IESO concerning their Embedded Generation Facility. This includes the IESO contract application process and contract administration.

Embedded Generators shall ensure that their Embedded Generation Facility meets the technical requirements specified in Appendix F.2 of the Distribution System Code, the Ontario Electrical Safety Code, and the Technical Interconnection Requirements (TIR) (including any Hydro One (TIR) update in the form of bulletins and/or amendments).

If there is a conflict between the Technical Interconnection Requirements and the technical requirements in Appendix F.2 of the Distribution Code, Appendix F.2 will take precedence.

Embedded Generation Facilities also include Net Metered Generation Facilities.

The net metering arrangement option (see Ontario Regulation 541/05 for additional details) is available to Customers wanting to install Embedded Generation provided that the Hydro One Distribution System can support the maximum cumulative output capacity of the Embedded Generation Facility equipment to be connected.

The location of revenue meters and the location of Instrument Transformer(s), if applicable, are subject to Hydro One's discretion and approval.

Please refer to Embedded Generation in the [Hydro One Conditions of Service](#).

4.1 Governing Principles

Hydro One Networks Inc. shall comply with the conditions outlined in its Ontario Energy Board (OEB) Distribution License, and all regulatory and legal obligations.

The following are Governing Principles for Hydro One:

- Minimize the risk of injury to the public and Hydro One employees.
- Conform to applicable Market Rules and Distribution System Code requirements.
- Comply with Measurement Canada, Hydro One's Technical Interconnection Requirements and Electrical Safety Authority requirements.

4.2 General Requirements

In addition to the metering requirements listed in [Service Connection Types](#), the following applies to Distributed Generation:

1. Generators shall provide Hydro One with a copy of the “as built” Single Line Diagram (SLD) showing revenue metering connection in the format specified by Hydro One.
 - The final “as built” Single Line Diagram shall be signed and stamped by a Professional Engineer registered in the Province of Ontario.
 - Main service box shall have a permanent, legible sticker/sign/label displaying the “as built” SLD on the front panel of the service main box.
 - Distribution/Interface Transformer Size, ownership and configuration
 - Type of DG contract (Net, Storage or Load Displacement)
 - Type and Size of Generator
 - Include size of each generating unit or inverter
 - Switchgear (if applicable)
 - Capacity Rating (A)
 - Main Service Box
 - Size (A)
 - Meter & IT Information
 - Illustration of UMC & T/R Meter-Mounting Enclosure
 - Back-Feed Disconnect for Metering Work Protection
 - Location (Indoor/Outdoor)
 - Isolation point
 - Label/Name
 - Back-Feed Disconnect for Lines (HONI Owned Service TX)
 - Location (Outdoor) accessible, visible isolating point
 - Label/Name
 - Any other relevant information such as presence of existing stand-by generator and Automatic Transfer Switch
2. Hydro One requires:
 - A means of disconnection and proof of isolation for metering work. If multiple generators are connected at the generator facility, one disconnect switch shall be capable of isolating all the generators simultaneously.
 - A lockable disconnect shall be provided on the load side of the Instrument Transformer compartment.
 - The disconnect shall have a permanent, legible sticker/ sign/ label displaying its nomenclature on the front panel
3. Customers with a Generation Facility that sells energy and settles through Hydro One’s retail settlement system will be responsible for all costs for Hydro One to enable the generation. This included the costs to enable communication with the Head End billing system.

4.3 Embedded Generation Classes

Below, are the different classes of Distributed Generation:

1. Net Metering
2. Load Displacement Generators
3. Energy Storage Facilities
4. Emergency Back-Up Generation

4.3.1 Net Metering

Subject to the requirements outlined in the latest revision of the Distribution System Code, Ontario Regulation 541/05, and the latest revision of Hydro One's Conditions of Service, Hydro One offers Net Metering to eligible Customers on a first come, first served basis.

Hydro One shall apply the [General Requirements](#) in conjunction with one of the following types of metering installations for Net Metering eligible load Customers installing Embedded Generation stand alone or in parallel with MicroFIT:

1. [Services Metered Over 750V - Primary Metering](#)
2. [Services Metered Under 200A - Self-Contained Metering \(Generation Up to 50kW\)](#)
3. [Services Metered Over 200A & Up to 4000A \(Generation Above 50kW up to 500kW\)](#)

Hydro One will determine what type of meter to install based on the size of the generation.

The generation facility shall follow the applicable technical requirements document "Technical Interconnection Requirements for Distributed Generation, Micro Generation & Small Generation, 3-phase, less than 30 kW DT-10-20" or "the Distributed Generation Technical Interconnection Requirements, Interconnection at Voltages 50 kV and Below DT-10-015".

4.3.2 Load Displacement Generators

Please refer to Load Displacement DER Facilities in the [Hydro One Conditions of Service](#).

A meter replacement shall not be required for any existing load meter for all Load Displacement less than 500kW. However, all Load Displacement Embedded Generators, greater than 500kW, shall require a bi-directional 4-Quad PQ meter at PCC.

4.3.3 Energy Storage Facilities

Customers with an Energy Storage Facility, whether it is portable or permanently affixed, shall comply with the requirements of the Technical Interconnection Requirements and all the applicable criteria of the Ontario Electrical Safety Code. Furthermore, the Customer is responsible for complying with all applicable laws in respect of the Energy Storage Facility, including, all applicable environmental requirements. Customers with permanently affixed

Energy Storage Facilities shall notify Hydro One regarding the presence of such equipment and shall enter a DCA with Hydro One.

4.3.4 Emergency Back-Up Generation

Please refer to Emergency Back-Up Generation in the [Hydro One Conditions of Service](#).

CSA approved Meter-Mounting Device models with manual or Automatic Transfer Switches can be found in [CSA Approved Meter-Mounting Devices](#).

Customers intending to use a back-up generator and Transfer Switch attached to a MMD shall contact Hydro One for more information.

Hydro One is not responsible for any damage to such equipment during the installation, inspection, reading, maintenance, repair, alteration, removal, or replacement of all or any part of a Meter Installation. If the Transfer Switch is obstructing the metering installation during servicing, Hydro One will not be able to service the equipment.

5. Appendix

5.1 Units of Measurements

Recognized symbols for SI units have been used in the Canadian Electrical Code, Part I. For the convenience of the user, these symbols, and the units they represent have been listed below:

Unit Abbreviation	Unit Detail
A	ampere(s)
dBm	decibel
Hz	hertz
kcmil	1000 of Circular Mills
kW	kilowatt
kWh	kilowatt-hour
m	metre
mm	millimetre
V	Volt

5.2 Definitions & Abbreviations

Capitalized terms used in this Guide that are not defined below will have the meanings set out in Section 2 of the Ontario Electrical Safety Code or the Conditions of Service. Otherwise, capitalized terms used in this Guide will have the corresponding meanings as defined below in this Section 3.

400A T/R Meter-Mounting Device

A 400A rated, single-phase, transformer type, 5-Jaw Meter Mounting Device assembly with integrated CTs and 4 pole test-switch.

Acceptable

A product or service that meets Hydro One requirements.

AMI

Advanced Metering Infrastructure.

American National Standards Institute or ANSI

Is the primary organization for fostering the development of technology standards in the United States.

American Wire Gauge or AWG

The American (or Brown and Sharpe) Wire Gauge as applied to non-ferrous conductors and non-ferrous sheet metal.

Bonding Point

A junction point in a Meter Socket, which connects the non-current-carrying metal parts of electrical equipment.

Burden

A load, usually expressed in volt-amperes, which is placed on instrument transformer secondary terminals by the associated meter coils, leads and other connected devices.

Typical burdens for current transformers (CT): BO.1 (2.5 VA), BO.2 (5 VA), BO.5 (12.5 VA), BO.9 (22.5 VA), B1.8 (45 VA).

Typical burdens for potential transformers (VT): W (12.5 VA), X (25 VA), Y (75 VA), Z (200 VA) and ZZ (400 VA).

Central Metering

Two or more services, up to a maximum of four, belonging to one Customer with one transformer-type Meter Installation. Additional services shall be connected downstream of the Central Metering point on a Pony Pole.

Conditions of Service or COS

Describes Hydro One's operating practices and connection policies and sets out the terms and conditions upon which Hydro One offers, and the Customer accepts Distribution Services.

Connection Wiring Diagram or CWD

An electrical diagram, which shows the terminal-to-terminal physical wiring connections from one device to another.

Current Transformer or CT

An instrument transformer designed for the measurement of current. The CT primary terminals are connected in series with the conductor carrying the current to be measured. There are three different types of Current Transformers – Bar Type, Donut Type and Window Type.

Current Transformer – Bar Type

An instrument current transformer that has a fixed, insulated straight conductor in the form of a bar, rod or tube connected in series with the load.

Current Transformer – Donut Type

A specific type of instrument current transformer, which has an opening in the centre, which is normally circular in shape, through which the primary conductor passes.

Current Transformer – Window Type

A specific type of instrument current transformer that has an opening in the centre, which is rectangular or circular in shape, through which the primary (bus bar) conductor passes.

Canadian Standards Association or CSA

Canadian Standards Association is a provider of product testing and certification services for electrical, mechanical, plumbing, gas, and a variety of other products. It is recognized in the U.S. and Canada. A product with a CSA registered mark shows that it has been independently tested and certified to meet recognized standards for safety and performance. In addition, it authors the Electrical Safety Code.

T/R Central Metering (CM) Meter-Mounting Device (MMD)

20A rated, single-phase, transformer type, 5-Jaw Meter Mounting Device assembly with 4 or 10 pole test-switch. Normally used for Central Metering.

CT Ratio

A number that is derived by dividing the primary rating of the CT by the secondary current of the CT (e.g. for a CT rated 400:5 A, the ratio would be 80).

Customer

A person that has contracted for or intends to contract for connection of a building or an embedded generation facility. This includes developers of residential or commercial subdivisions.

Demand Meter

A metering device, which indicates or records the peak value of power consumed over specified time duration as approved by Measurement Canada, usually expressed in kW, kVA, or kVAr.

Disconnect switch (Isolation Device)

An isolating device that conforms to OESC Section 84 and additional Hydro One requirements to ensure a safe and reliable means of electrically isolating the generation or load facility from Hydro One's Distribution System.

Distribution Generator Interface Transformer or DGIT

Interconnection of Distribution Generators with the utility distribution feeders

Distribution Standards

Hydro One standards for design and construction of Retail Revenue Metering, Over-head and Under-ground installations for all Hydro One-owned Distribution System assets less than 44kV.

Distribution System Code or DSC

Distribution System Code sets the minimum conditions that a distributor shall meet in carrying out its obligations to distribute electricity under its license and the Energy Competition Act, 1998. It applies to all retailers, generators, distributors, transmitters, and Customers of electricity who use the distributor's distribution system.

Embedded Generator or Embedded Generation Facility

A generator whose generation facility is not directly connected to the IESO-controlled grid but instead is connected to a distribution system.

Emergency Backup Generation Facilities

Generation facilities that are designed to supply power to a load if supply from the distribution system is lost, but not to feed power back into the grid or use for load displacement purposes.

Energy Meter

A meter which measures the total energy consumed over a period. This consumption is normally expressed in kilowatt-hours (kWh).

Energy Storage Facilities

Facilities designed to draw power from the grid during times of low demand and store it for eventual export back to the grid typically during times of high demand.

Electrical Safety Authority or ESA

ESA is a delegated administrative authority; an independent, not-for-profit corporation acting on behalf of the Government of Ontario with specific responsibilities for electrical safety. As part of its mandate, the ESA administers regulation in four areas: the OESC; licensing of Electrical Contractors and Master Electricians, electricity distribution system safety, and electrical product safety. The ESA also administers the Appeals Regulation.

Hydro One or HONI

Hydro One Networks Inc.

Independent Electricity System Operator or IESO

A not-for-profit corporate entity established by the Electricity Act, which operates the electricity grid in real time and oversees Ontario's Electricity Market.

Interval Meter

An electronic meter that measures and records electricity parameters and/or consumption on an hourly or sub-hourly basis.

Instrument Transformer

Voltage or Current Transformer that transforms the circuit voltage and current to lower levels for connection to a transformer type meter.

Instrument Transformer Enclosure

NEMA rated enclosures to house current and voltage transformers. Typically, these enclosures are 4' x 4' x 1' for three-phase metering and 3' x 3' x 1' for single-phase metering. For enclosure or compartment used in Switchgear/Switchboard, refer to Utility Metering Compartment.

Load Displacement Generation Facilities

Generation that is used to supply part or all a Customer's electricity needs. The generator is located behind the meter that measures the Customer's electricity supplied by the distributor.

Load Side

The part of the line or electrical installation located between a given point and the load.

Location

- **Outdoor Location:** Any location outside of a building or enclosed structure, exposed to the weather or in other words, if the location is sheltered from the weather, it shall not be considered outdoors.
- **Indoor Location:** Any location that is not an Outdoor Location is considered an Indoor Location.

Local Distribution Company

A distribution company that is responsible for distributing power from transmission lines to residential, industrial, and commercial Customers.

Main Service Box

An assembly consisting of an enclosure that can be locked or sealed, containing either fuses and a switch, or a circuit breaker, and designed so that it is possible to operate either the switch or circuit breaker to the open position by manual means when the box is closed.

Maximum Demand

The highest demand measured over a selected period, such as one month, and referred to as peak demand.

MCM

Is an abbreviation for thousands for circular mills, an old measurement for wire gauge.

Measurement Canada or MC

The Federal Government authority responsible for revenue metering regulations in Canada, formerly known as Industry Canada and Customer and Corporate Affairs Canada (CCAC) - more information can be found at <http://www.ic.gc.ca/eic/site/mc-mc.nsf/eng/Home> or 1-877-325-3996

Meter Centre

A modular metering solution accommodating compact, group metering applications, typically used in commercial or high density residential areas.

T/R Meter-Mounting Enclosure

Outdoor rated metal enclosure to house a transformer type meter, test switch, fusing, wiring and associated equipment.

Meter Installation

The meter and, if so equipped, the instrument transformer(s), enclosure or compartment housing the instrument transformers (IT), wiring, test links, fuses, lamps, loss of potential alarms, meters, data recorders, telecommunication equipment and spin-off data facilities installed to measure power, provide remote access to the metered data and monitor the condition of the installed equipment, whether or not such equipment is located in the immediate vicinity of the meter and includes, where applicable, AMI Network Equipment, and including all other equipment required for the Meter Installation.

Meter Multiplier

The actual amount of energy consumed is too large to be registered and the meter shows a fraction of the actual use. A multiplier is then applied to the difference between your present and previous readings to determine your actual energy use. The meter multiplier is determined by the meter manufacturer and is indicated on the meter nameplate. If the meter multiplier is X1, it may or may not appear on the meter nameplate. All meter multipliers other than X1 will appear on the meter nameplate.

Meter Socket

Device for mounting a self-contained S-Base meter. In addition, there are transformer type meter sockets that come with test switch compartments in various jaw configurations required to install Hydro One supplied test switches and meters for Transformer Type Metering. Both types of Meter Sockets are referred to as a meter mounting device **MMD** in the OESC.

Multiplier

A term used in metering circuits to express the ratio of instrument transformers or the rating on meters.

Meter-Mounting Device, MMD

A Meter-Mounting Device is a device for mounting a meter. A S/C MMD does not need a current transformer or voltage transformer. A T/R MMD works in conjunction with a current transformer and/or a voltage transformer. The load side is energized whether the meter is in place or not.

Multiple-Meter-Mounting Device.

A Meter-Mounting Device with a more than one meter position.

Multi-position Meter Sockets or Ganged Meter base Socket

A Multi-position, self-contained meter socket that houses Hydro One's meters. A Multi-Position Meter-Mounting Device may be either Horizontally or Vertically arranged.

National Electrical Manufacturers Association or NEMA

The National Electrical Manufacturer Association (NEMA) uses a standard rating system that defines the types of environments in which an electrical enclosure can be used, and frequently signifies a fixed enclosure's ability to withstand certain environmental conditions.

Net Metering

A special service or program where eligible Customers with specific generation facilities can reduce their energy consumption costs by exporting generated energy back into the distribution grid for a credit towards their energy use.

Network Meter Installation

A network service is a three-wire service supplied from a three-phase, four wire, wye distribution system, with one of the conductors being the neutral conductor, and the other two being phase conductors.

Neutral Ground Resistor or NGR

A resistor that has been installed between the transformer neutral and ground.

Ontario Energy Board or OEB

Regulates the province's electricity and natural gas sectors in the public interest.

Ontario Electrical Safety Code or OESC

The Ontario Electrical Safety Code is primarily a technical document that describes the standards for electrical installations in detail.

Point of Common Coupling or PCC

Point of supply or demarcation point where the primary live clamp or line switch that is installed on or at the Hydro One distribution line where the Generator's facilities are to connect to Hydro One's distribution system.

Point of Supply

The point of interconnection to Hydro One Networks Inc.'s Wholesale System for the purpose of metering. For example, "Point of Supply to Toronto Hydro" refers to a wholesale metering point for Toronto Hydro, the Municipal Utility. This may be located at Hydro One Networks Inc. owned stations or Customer owned stations.

Pony Pole

A pole used for Central Metering installation, when greater than 4 services are required.

Potential Transformer

See Voltage Transformer.

Primary Metering Unit or PMU

A specific type of equipment, either single or three-phase, consisting of instrument transformers connected to the primary distribution system. It consists of an assembly of individual VTs, CTs, and a bracket. May also be referred to as modular metering unit.

Pulse

An electrical signal which departs from an initial level for a limited duration of time and returns to the original level. For example, a sudden change in either the voltage or current in a digital circuit produced by the opening or closing of a contact and used to activate a counting device. In an electronic meter, each pulse represents a specific amount of energy that varies by meter model/type.

Retail System

Hydro One Networks Inc.'s electrical distribution system (less than 44kV) used to supply retail Customers.

Retail Customer

An end-use Customer served directly by Hydro One Networks Inc. and not a wholesale market participant (i.e., registered with the Independent Electricity System Operator).

'S'-Base

A type of meter with a standard arrangement of blades at the back of the meter, which fit into an ANSI standard socket base.

Self-Contained Meter, S/C

A meter designed to be connected directly in the Customers supply circuit, typically 100A or 200A. No instrument transformers are required. Also referred to as S/C within this document.

Service Type

The number of phases and wires and the interconnection between them. The three main Hydro One metering service types are defined below:

Single-phase:

- **Two-wire (2W) service:** typically has one conductor grounded (neutral) and a phase conductor, with a nominal voltage of 120V between them.
- **Three-wire (3W) service:** typically has one conductor (neutral) which is grounded and two-phase conductors with a voltage of 240V between them and 120V between each phase conductor and neutral.

Network: A network service is a three-wire service supplied from a three-phase, four-wire, wye distribution system, with one of the conductors being the neutral conductor, and the other two being phase conductors.

Polyphase:

- **Three-phase, three-wire (3W) service:** has no neutral conductor and may be supplied by either an open delta or closed delta transformer bank.

- **Three-phase, four-wire (4W) service:** has three-phase conductors and a neutral conductor where the phase-to-phase voltage is equal to the square root of 3 times the phase to neutral voltage.

Three-phase, four-wire, delta service: has one transformer winding which is centre tapped and grounded. The voltage between the two adjacent phases and the centre tap is 120V, and the voltage of the third phase to the two adjacent phases is 240V. The voltage between the third phase and the centre tap is 208V.

Service Upgrade

Changing an existing Meter Installation to comply with the latest metering standard.

Single Stage of Transformation

Voltage supplied to the Customer following a single step down after an initial step down at a Distribution Station.

Single Line Diagram or SLD

A simplified notation for representing a three-phase power system.

SMMD

Single-Meter-Mounting Device. A Meter-Mounting Device with a single meter position.

Single-phase

Refer to Service Type.

Smart Meter

A smart meter records how much electricity used based on when it was used (typically hourly) and communicates this information automatically via wireless and other technologies. In contrast, conventional electricity meters are read manually and measure only how much electricity is used between readings.

Surge Suppressor/ Arrestor

A device that is used to protect metering and telecommunications circuits from excessive or damaging voltage surges.

Test Switch

A device containing current and/or voltage isolating mechanisms, which are used to isolate meters from their current and voltage input sources.

Transformer (XFMR) Type Meter

A meter designed to be used with instrument transformers such as current and voltage transformers.

T/R

See Transformer-Rated Meter Installation.

Transformer-Rated Meter-Mounting Enclosure

A device for mounting a meter that works in conjunction with a current transformer and/or potential transformer. The load side is energized whether the meter is in place or not.

Transformer-Rated Meter Installation

Comprised of the meter, meter enclosure, the instrument transformers, instrument transformer enclosure, wiring, test switch, fusing and all associated equipment required for the Meter Installation. Also referred to as “T/R”.

Underwriters Laboratories of Canada or ULC

Underwriters Laboratories of Canada (ULC) is an independent product safety testing, certification, and inspection organization.

Utility Metering Compartment (UMC)

Enclosure or compartment that is used to house instrument transformers within a Customer owned switchgear or switchboard.

Voltage

- **Low Voltage** – Any voltage exceeding 30V but not exceeding 750V.
- **Medium Voltage** – Any voltage exceeding 750V but not exceeding 44kV.

Volt-amperes or VA

The mathematical product of voltage and ampere carried thereby.

Voltage Transformer or VT

An instrument transformer designed to reduce the measured voltage to a lower secondary value suitable for application of metering.

VT Ratio

The VT ratio is the primary voltage of the VT divided by the secondary voltage of the VT (e.g., For a VT rated at 4800V primary and 120V secondary, the ratio would be 40).

Wooden Post

A 6x6 wood post used mainly to mount a Meter Mounting Device for pad-mount central metering installation.